HighNyammer Social Scanner: Continuous Visual Feedback of Collaborative Community to Improve Collective Cognitive Responsibilities

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Abstract

Collective Cognitive Responsibility (CCR) of individual members is important in knowledge-creation communities. There are some possibilities to improve CCR through feedback functions that implement learning-support systems; however, it is unclear whether such a function is effective in extracurricular activities. Our research target is "HighNyammer," a bulletin board system (BBS) for student-staff members who are working in "Classroom-M" as extracurricular activities. We developed "HighNyammer Social Scanner," a tool comprising three types of feedback functions based on social network analysis to improve community members' CCR. To examine the functions' effect, we conducted two types of analysis: trends analysis based on HighNyammer logs and a questionnaire survey with student-staff members. A comparison between nine-members in 2020 (with HighNyammer Social Scanner) and nine-members in 2019 (without it) showed that HighNyammer Social Scanner helped the student-staff members perform as the members with high-CCR, especially novice members. The results suggested that each member was helped to recognize their activities more concretely by comparing one's activities with those of other members using HighNyammer Social Scanner. Furthermore, the comparison encouraged the student-staff members to improve their activities.

Keywords: feedback, BBS, collective cognitive responsibility, social network analysis.

1 Introduction

It is well-known that individual members' Collective Cognitive Responsibility (CCR) is important in knowledge-creation communities, including companies and collaborative knowledge-building communities in schools [1]. Previous research suggested relationships be-

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tween CCR and the value of Betweenness Centrality (BC), calculated using the social network analysis (SNA) method. The BC value is a relative indicator that reflects the relationship between a member and other members. Therefore, the relationship between a member's CCR and BC value is also relative. It is not a simple correlation. For example, if the CCR of a few members is high and the CCR of others is low, the BC value of members with high CCR tends to be relatively high. This is because members with high CCR are more likely to actively communicate with other members and, as a result, to mediate connections among many members. Even newcomers to a community can achieve high BC values if they are able to successfully engage in activities that are considered high CCR. However, if all members of a community engage in activities with high CCR, the BC of individual members will be low. This is because everyone mediates interactions among members equally, and everyone becomes the center of the network to the same degree. For example, lower values of BC appeared in the high-CCR community [2]. Our previous research, related to the previous works mentioned above, also supported the importance of CCR from an outside school viewpoint. In our study, CCR was an important concept to be learned by students who voluntarily participated in activities outside school [3]. In our previous research, we hypothesized that values of BC reflect one of the characteristics of CCR in a community and that the real-time feedback on these values to each community member contributes to the improvement of CCR. The results suggested that members, especially novices, improved their activities. Novice members attained higher values of BC than experts, which encouraged them to perform as members with higher CCR [3].

Conversely, our previous research also suggested that it was difficult for student-staff members to consider what actions were appropriate to attain higher values of BC only with feedback on the values previously attained [3]. The appropriate action for members is to contribute to the advancement of the knowledge of the community as a whole. In many cases online, members will respond to each other's articles and replies, adding what they know, ideas they have, and comments on those ideas. If a member's BC value has changed as a result of some action, they are aware that their activity has had some impact on the community. However, it is not significantly clear how to reflect this in the CCR. In particular, it was extremely vague for novices to discover appropriate ways of completing activities as higher CCR members because the value of BC did not suggest to members what relationships were missing (for example, who is the most appropriate member to communicate with to attain a higher value of BC). This example implies that improving CCR requires members to know one's value of BC and understand all relationships between the community members. In this study, we examined the effect of visualizing the relationship between each community member in real-time to improve one's CCR using "HighNyammer Social Scanner."

2   Purpose

This research aims to examine the advantages of providing feedback on individual values of BC for all members of a community. Comparing the feedback function to a function that only feeds one's value to oneself, each member can easily determine whether their communication is more active than the others. Furthermore, each member may identify a lack of communication between members.

3   Research Background

Previous research has attempted to provide feedback to students individually using Learning Analytics technology. In general situations in Learning Analytics, access logs, post-article logs, and each student's academic achievements in learning management systems or Computer-Supported Collaborative Learning (CSCL) systems were recorded. Teachers generally use these logs for course management, enabling them to check students' activeness and achievements in the system. Interestingly, these data can also be used for student feedback to improve students' self-regulated learning skills [4]. Improving self-regulated learning is possible but difficult because of the complex relationships between students, teachers, and content [5]. Some studies have attempted to overcome the difficulty of Learning Analytics. Corrin and Barba's [6] preliminary study provided feedback to students through the "learning analytics dashboards" using cumulative data in a learning management system and examined the effect of such feedback. The results suggested that most students reflected on their activities using learning analytics dashboards. Konomi et al. introduced the function of feedback to each student in a university-level Learning Analytics system [7].

However, the previous works mentioned below suggested the effect of student feedback to scaffold whole-community activities in computer-supported collaborative learning—scaffolded collaborative activities of learners in each community in in-school learning activities. The tool "i-Bee" [8] is an almost-real-time visualization function of keywords and relationships between keywords and participants in BBS. The BBS supported discussions between students in teacher training courses at Japanese universities using students' teaching portfolios and motivated them to reflect on teaching practices in Japanese elementary and junior high schools as pre-service teachers. The results suggested that i-Bee encouraged students to notice changes in communication between peers and reflect on their teaching practices with peers. "SNAFA" [9] illustrated the relationships between students in a specific course at a university, and the illustration was feedbacked to students to select appropriate helpers to seek help. The analysis was conducted to reveal the effect of social context awareness on learning and social activities. High students' learning achievements were shown in the results: students were encouraged to find appropriate peers and collaborate with them. "Knowledge Forum" is a well-known CSCL system that supports students' collaborative knowledge-building, a provided posting-articles function, relation-making between the articles function, and a multi-layered view function [10]. In the Knowledge Forum, there were some lead statements called "theory-building scaffolds" for supporting externalization of students' ideas, such as "My theory is…" and "New information…" The recent Knowledge Forum provides feedback on the number of articles in each category of theory-building scaffolds called "Scaffold Meter." The scaffold meter encouraged students to see their activities from a bird's-eye view in their knowledge-building community.

As mentioned above, there are solo and social types of automated feedback systems in in-school activities. However, it is unclear whether the feedback function for scaffolding reflection in social activities introduced above is effective in extracurricular activities. It is believed that learning outside the regular curriculum is adjusted based on work experience rather than on a given curriculum. As learning outside the regular curriculum is not guided by curricula, feedback may be extremely vague if community members do not have a direction of the appropriate action to be taken. In particular, as we present below, the work of Classroom-M expects student-staff members themselves to improve their CCRs. It is meaningful to consider the CSCL system outside the regular classes.

4   Research Target

Our research target was "HighNyammer," a BBS system developed for student-staff members [3] who work for the active-learning university classroom called "Classroom-M" [11]. High-Nyammer was developed to help the student-staff members perform their tasks along with their peers by sharing events in Classroom-M and technological information to maintain servers and laptops in Classroom-M. HighNyammer has been used since 2018 and has implemented some new functions to improve student-staff members' activities. For example, feedback on the value of BC for members was implemented in 2019. In 2020, three types of new feedback functions were developed.

All student-staff members are expected to contribute to improving the community's knowledge. In this context, the student-staff members' CCR is necessary for the continuous improvement of community achievements. HighNyammer performed as a technological device for knowledge sharing and co-creation by student-staff members. Access logs, such as page viewing, number of posted articles, and replies to articles posted by others on HighNyammer, reflect student-staff members' activities related to knowledge improvement. According to previous studies [2, 12], the logs of posted articles revealed key persons who connect many community members by referring to their articles. From the perspective of CCR, all members are expected to perform as key persons. This means that the responsibility for improving community knowledge was equally attributed to the members, without a dominant person. HighNyammer logs provide information about the status of CCR of student-staff members.

5   HighNyammer Social Scanner

We developed three types of feedback functions of BC of all community members to each member on HighNyammer called "HighNyammer Social Scanner." These three functions are shown by clicking on each of HighNyammer buttons (Figure 1) and are focused on three levels of feedback: (1) yearly changes in the BC of the entire community, (2) the weekly values of BC of each member, and (3) what links exist and how dense each link is with the value of BC, using
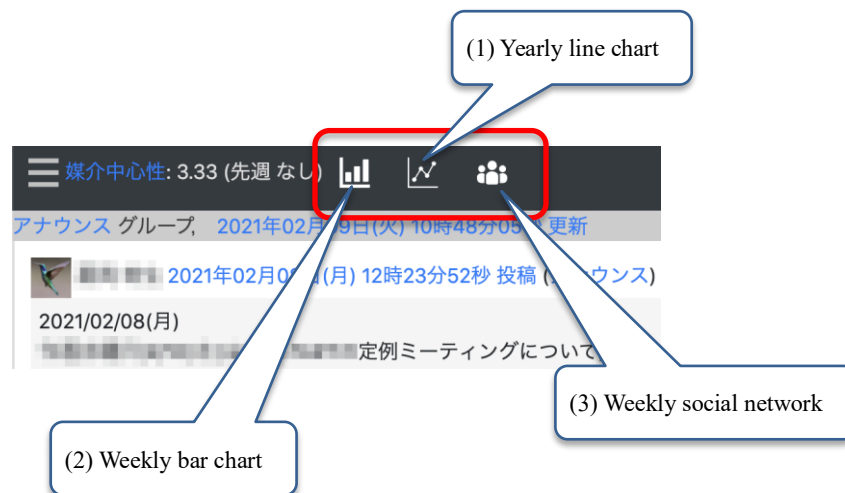

Figure 1: Toolbar for Social Scanner in an article view on HighNyammer.

social network graph. As users, student-staff members can activate these functions at any time using the toolbar at the top of the screen. Figure 2 shows the three functions of HighNyammer Social Scanner.

The value in Function (1) is obtained by calculating the value of the BC of each user in the community for each week of the year. The year begins on Monday of the week, which includes January 1st. Subsequently, the maximum and minimum values in the whole community and each user's value for each week are plotted. The community's highest BC values are plotted in red, and the lowest BC values are plotted in blue for each week. The values of the user who invoked this function are shown in green. The ratio of one's own values to the community's maximum and minimum values can be seen as a rough characterization of your activities during the week. It is not the change in each value but that in the ratio that allows you to reflect on how you work. This feedback allows members to compare the ratio of their BC to the maximum BC of the community. As a result, it provides an opportunity to reflect on one's own activity trends, such as whether to continue with the current behavior or to write more often and with more replies.

To calculate the value in Function (2), a social network is constructed from replies to articles on HighNyammer for a week, and the values of the BC of each user are calculated. The week begins on Monday. The results are displayed in descending order from the left. The user's value is highlighted in red. The user can clearly see how they rank against each of the other members of the community. It is expected that this function will be used to improve BC values in the following ways. The user can pay attention to the behavior of other staff members who are to the left of their value, interpret and mimic their work style, or ask questions directly about the work style to the members who have a higher value. Thus, users can compare their rankings with those of other members in the community and use this information to improve their own BC values. This feedback indicates to members which members are close to them in terms of their BC values. As a result, it provides an opportunity to compare their behavior with their own and to reflect specifically on how to behave. Identifying close members also allows members to contact them directly and discuss how they are working.

The directed graph in (3) represents the reply relationships between users in the community during a week. The calculation method is the same as used in (2). The nodes in this graph mean users, while the edges between them show the reply relationships of articles between users. The directions of the edges indicate the parent-child relationships of the articles. Nodes are labeled with the user name and their BC value. The number of replies is displayed as the edge's label, and the thickness of the edge is expressed based on the number of replies. This visualization feature allows the user to understand concretely whether there is a reply relationship. A state of high CCR is a state in which members are responsible for advancing the knowledge of the community. One of the ways to improve the knowledge of the community as a whole is to actively add information to messages written by other members or significantly clarify the content of messages through questions. Therefore, the number of articles replied to may be an indicator of expected communication. For example, if there is a thick edge between Staff A and Staff B, we can assume that expected communication has been established. However, if the edge between Staff B and Staff C is thin or non-existent, the communication may not be sufficient. We expect staff members to understand the whole condition of the network and be aware of the improvement of CCR. In the calculation mentioned above, we excluded logs from non-student staff and faculty members on HighNyammer because our purpose was to examine the improvement of student-staff members' CCR. However, it is possible to include faculty and non-student staff for

the calculations and get the corresponding results easily if necessary. This feedback provides a holistic view of the contributing relationships (i.e., reply relationships) within the community. As a result, it supports decisions about who to reply to in order to contribute more. The visualized network suggests finding members who are not connected to the user and encouraging them to reply, as well as reaching out to members who are not shown.

6   Evaluation Method

We conducted two types of analysis: trends analysis based on HighNyammer logs and a questionnaire survey with the student-staff members. The purpose of the trends analysis was to reveal HighNyammer Social Scanner's influence on the frequency of visitation and posting on High-Nyammer for each student-staff member. In turn, the questionnaire survey aimed to verify the student-staff members' use and impression of the three types of feedback function.

For the trends analysis, we analyzed HighNyammer logs from December 30, 2018, to December 28, 2019, for 2019 data and December 29, 2019, to December 26, 2020, for 2020 data (with Sunday as the first day and weeks of the calendar year as units). While 2019 consisted of 53 weeks, 2020 had 52 weeks. These time periods were chosen to compare the BC-only feedback feature with HighNyammer Social Scanner features in a one-year cycle. Notably, the first week of 2020 includes HighNyammer Social Scanner's release date (January 1, 2020). The number of student-staff members for both 2019 and 2020 was 9. Some members have been replaced in 2020. Only student-staff members who were active for at least three weeks in each period were included in the survey to exclude inactive student-staff members. The mean number of years of experience of the student-staff members was 2.26 (SD=1.50) in 2019 and 3.26 (SD=1.17) in 2020. Some of the members belonged like Classroom-M community joined in 2020. For those members, the number of years they worked before joining Classroom-M was added to the total number of years they worked at Classroom-M.

The questionnaire survey asked students and staff about the HighNyammer Social Scanner using a Google Form. The current study attempted to determine the impact of the BC feedback. Thus, items from the study regarding their understanding of BC's visualization features and items regarding how they utilize those features were excerpted and evaluated. The selected questions are shown in Table 1.

We conducted two surveys, one in March 2020 and the other in February 2021. The first survey examined short-term usage and user impressions of HighNyammer Social Scanner during the first three months of its release, and the second survey examined usage eleven months after the first survey. The two surveys were compared to determine not only the acceptance of High-Nyammer Social Scanner as a new feature but also the long-term impact of feedback from HighNyammer Social Scanner.

Eight students each responded to the first and second surveys. As some members changed between the two surveys, and some members did not respond, the five student-staff members who responded to both surveys were included in the analysis.
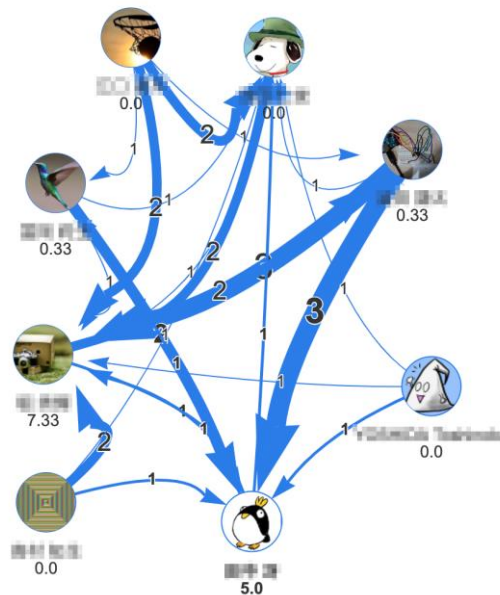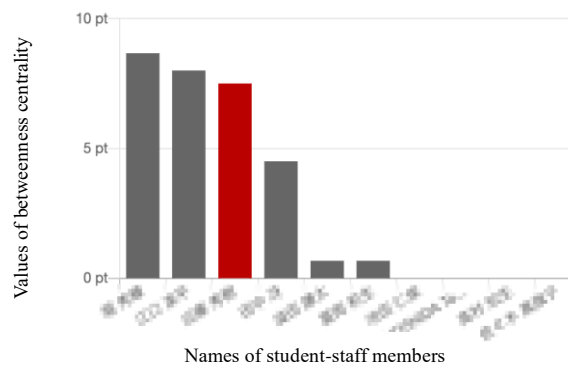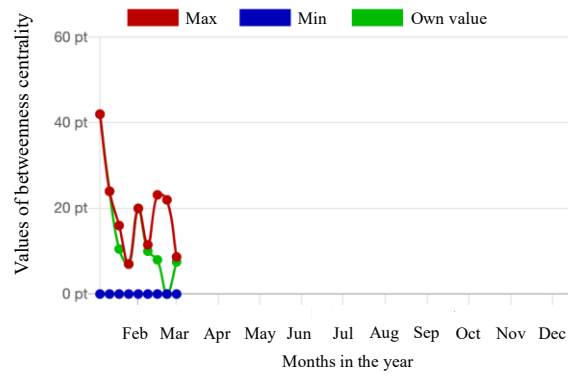
Figure 2: Screenshots of Social Scanner of (1) yearly changes of values (top), (2) each member's weekly values (center), and (3) social network view with values of betweenness centrality (bottom).

Table 1:   Questionnaire Survey Items

	Questions and Answering options

Q5	Have you ever tried to change your value of betweenness centrality?
	Answering options:
	    1. I try to attain a higher value.
	    2. I try to attain a lower value.
	    3. I do not try to change the value.
	    4. Other (please explain).

Q6	This question is only for those who have tried to change their value of betweenness centrality. Which functions among (1), (2), and (3) most influenced your activity? Please select the one that has been most influenced among the three. If you did not use any of the functions, please indicate. *Answering options:* 1. (1) yearly changes of betweenness centrality 2. (2) each member's weekly values of betweenness centrality 3. (3) social network 4. no differences between (1), (2), and (3) 5. nothing
Q9	This question is only for those who have tried to change their value. Are you able to continue your activities to change your value of betweenness centrality? *Answering options:* 1. Yes, I did these activities before HighNyammer Social Scanner was installed, and I continue to do these activities now. 2. Yes, I will probably continue because I have become accustomed to doing such activities. 3. Yes, I may continue doing such activities while paying attention to the value of betweenness centrality. 4. No, it may be difficult to continue without paying attention to the value of betweenness centrality. 5. Other (please explain)
Q13	Have you reflected on your own activities using HighNyammer Social Scanner? Please choose three options that fit your situation. If there are no options that fit your situation, please check "other" and explain your thinking. *Answering options:* 1. Whose articles I should read. 2. Whose articles I should reply to. 3. Whom should I mention in my articles. 4. Whether I should change my frequency of posting articles 5. Whether I should change my frequency of visits to HighNyammer 6. Whom should I talk to outside of HighNyammer 7. Whether I should change my way of working 8. Whether I should give my colleague advice about their way of working 9. Other (please explain)
Q14	Please explain how you change your thinking about your activities using HighNyammer Social Scanner. If you have not changed your thinking, please describe what you think about HighNyammer Social Scanner. *Answers in free format*

7   Expected Results

HighNyammer Social Scanner is expected to be used with some frequency to help users examine their own behavior in more detail and verify whether they are behaving properly in the community. Using the "yearly" or "weekly" function, one can ascertain the relative position of their

previous activities in the community. Moreover, users can choose whether to spend more time on the board. Using the "social network" function, users are expected to check how they are connected to other members. After the student-staff members know how they are connected, they may actively engage with non-connected members.

8   Results and Discussion

A. Effect of HighNyammer Social Scanner

First, we calculated the frequency with which the student-staff used HighNyammer. Figure 3 shows the results for 2019 (one year before the introduction of HighNyammer Social Scanner), and Figure 4 shows the results for 2020 (one year after the introduction of HighNyammer Social Scanner). For 2020, we also counted the number of HighNyammer Social Scanner users.

Regarding the number of views and posts in 2019, the first week was during the New Year's vacation. The university reopened in the second week, but it was a period of exams and other activities that were different from the normal operation of the facility. It is not always the case that paper exams are administered in active learning facilities, and it was assumed that the students are staff students and busy taking exams. Therefore, until the eighth week, there was a period of low activity, different from the rest of the semester, which was comparable to the first week. Thereafter, there were peaks in weeks 23 and 29, followed by a drop in activity from week 32 to 38 to the same level as at the beginning of the year. This period was the summer vacation period when there were almost no classes. Thereafter, there were peaks in weeks 43 and 48, and activity declined toward the end of the year vacation period. These results can be interpreted as being linked to the teaching period.

The number of views and posts in 2020 appeared to have a considerably different trend from 2019. In the first week, the number of accesses was about twice that of 2019, although it was a New Year vacation. After the second week, the number of accesses was also higher than that in 2019. The trends in increases or decreases in the number of accesses and submissions in 2020 are similar to those of 2019 during the same period, suggesting that the activity has not been transformed.

The reason could be the COVID-19 pandemic in 2020, which significantly changed the university's cycle throughout the year. Many classes conducted in Classroom-M were designed for close face-to-face interactions. However, due to the pandemic, the university was closed to the public for about a month, during which time faculties were required to switch to online classes. Student-staff helped with this switch and planned and conducted online workshops in lieu of their regular work support. Such work has not been conducted before 2019. It is possible that HighNyammer Social Scanner supported this activity, which led to an increase in the number of views and posts.

To compare and confirm the number of visits to HighNyammer and the number of articles posted in 2019 and 2020, we conducted the Mann-Whitney U-test. The U-test results for the number of visits showed that the number of visits to HighNyammer was significantly higher in 2020 ($U=784.5$, $p<.01$). The U-test results showed no significant difference in the number of articles posted ($U=1175$, *n.s.*).
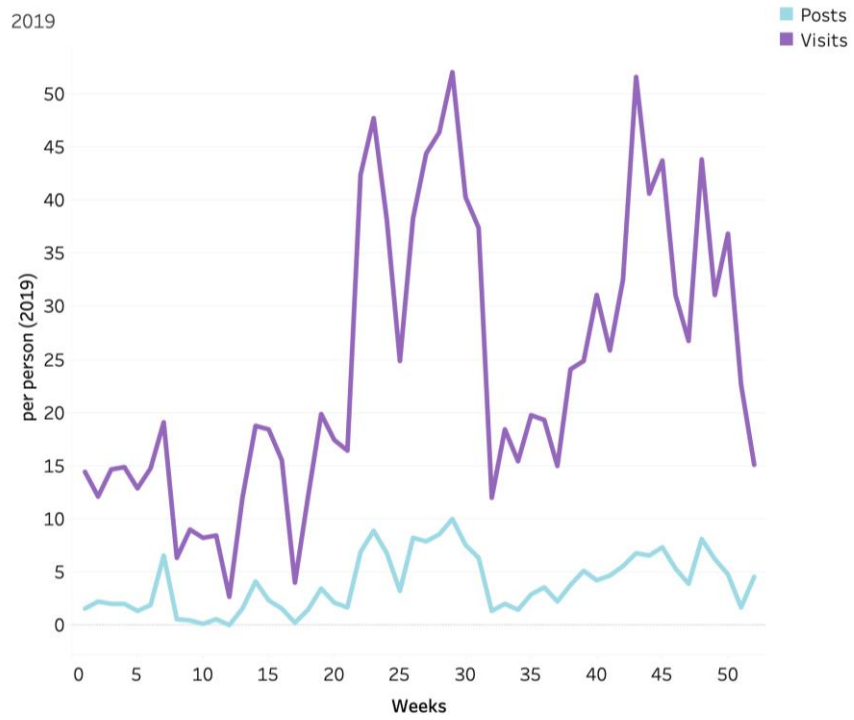
Figure 3: Numbers of visits and posted articles on HighNyammer in 2019, week 1 to week 53
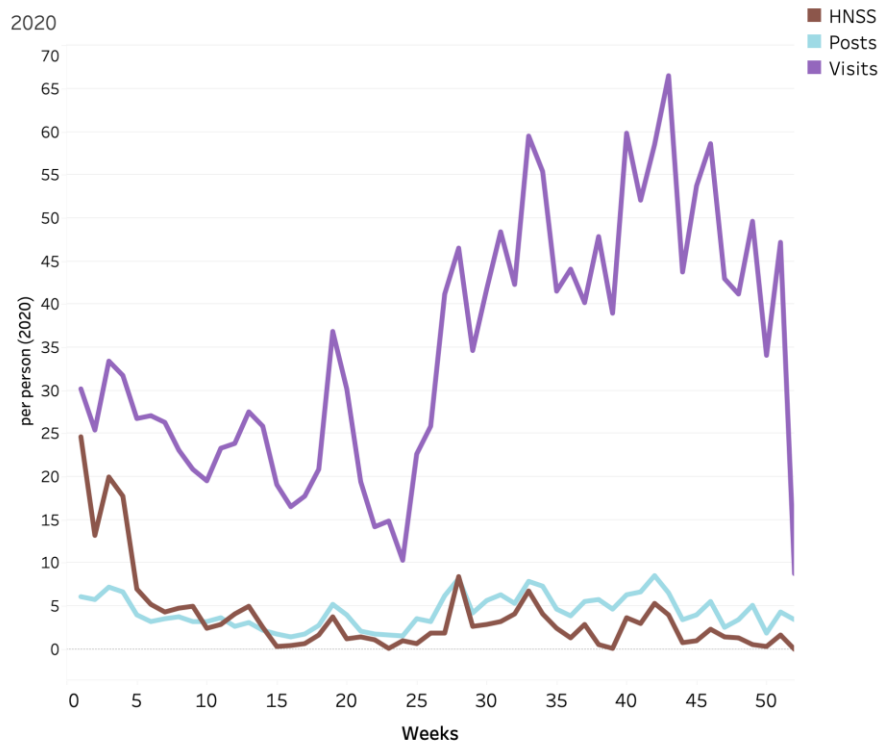

Figure 4: Numbers of visits, posted articles, and use of HighNyammer Social Scanner in 2020, week 1 to week 52
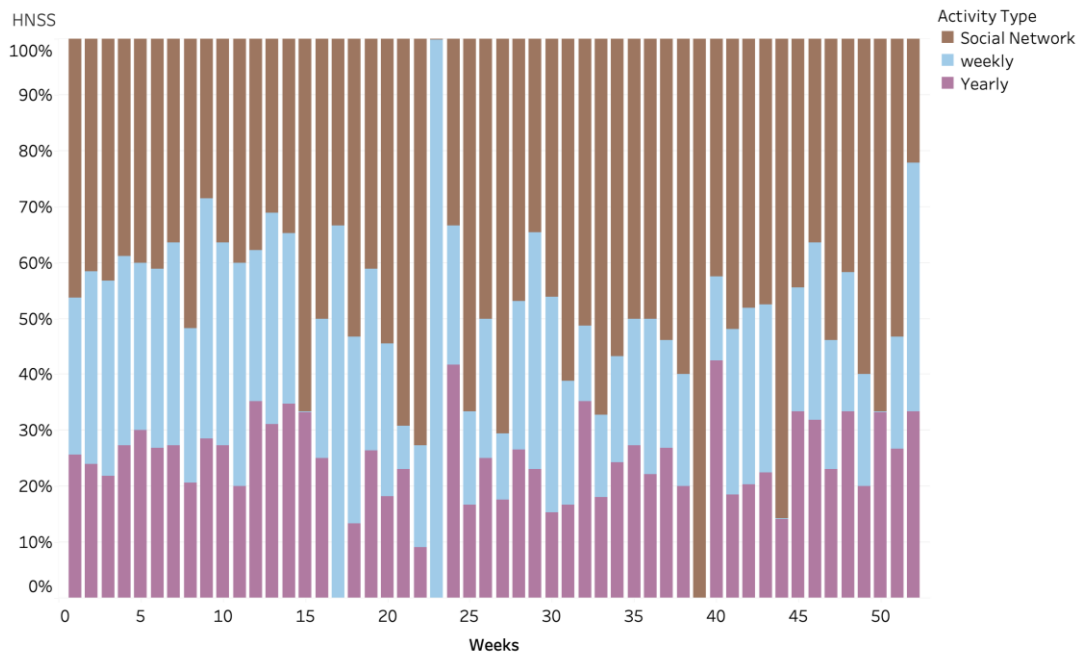
Figure 5: Ratio of use of HighNyammer Social Scanner in 2020

HighNyammer Social Scanner browsing log in 2020 showed that the student-staff began using the three functions of HighNyammer Social Scanner in the first week of its introduction. However, after the fifth week, the number of views gradually decreased; from the sixth to the ninth week, the number of views leveled off at around five times per week. This suggests that the student-staff members were interested in the new feature for the first time and gradually broke away from curiosity and trial. Thereafter, the number of times visited for HighNyammer increased somewhat in conjunction with the number of times invoked, but not to the same extent as during the first five weeks of use. However, the use of HNSS itself did not disappeared, and the tendency to utilize HNSS in conjunction with the number of times invoked suggests that it was utilized on a sustained basis.

To determine which of the three HighNyammer functions was preferred, an analysis of variance was conducted on the ratio of views observed for each function (1, 2, and 3) of the High-Nyammer Social Scanner. Figure 5 shows the ratio of the number of views of each function per week. The results show no significant difference in the number of times invoked for the three functions ($F(2,153)=2.14$, n.s.). This result suggests that student staff utilize each of the three functions.

B.   Questionnaire Survey for HighNyammer Social Scanner

As a survey, we asked the student-staff who used HighNyammer daily to answer questions about HighNyammer Social Scanner feature. We conducted the same survey less than three months after the introduction (2020) and about 12 months after the introduction (2021). We analyzed and compared the results of the five members who responded to both surveys (Staff A, B, C, D, and E). Table 2 shows an excerpt of the responses to the two surveys.

Table 2:   Answers to questionnaire Survey Questions Q5 to Q13

		Staff A	Staff B	Staff C	Staff D	Staff E
Years of Experience (Mar 2021)		4 years	5 years	4 years	2 years	3 years
Q5	2020	(1) higher	(1) higher	(1) higher	(1) higher	(1) higher
	2021	↑	↑	↑	↑	↑
Q6	2020	(3) Network	(3) Network	(2) Bar chart	(3) Network	(3) Network
	2021	↑	↑	(1) Line chart	(2) Bar chart	(1) Line chart
Q9	2020	(2) maybe Yes	(3) weak Yes	(4) No	(2) maybe Yes	(2) maybe Yes
	2021	↑	↑	(3) weak Yes	↑	↑
Q13	2020	1, 7, 8	2, 4, 8	2, 7, 8	1, 2, 8	2, 3, 4
	2021	1, 6, 7	2, 3, 4	1, 2, 7	2, 4, 7, 8	1, 2, 3, 8

Table 3:   Answers to Q14 of the questionnaire Survey

	Year	Answers to Q14
Staff A	2020	I became more careful to pay attention to tasks in which I was not directly involved.
	2021	I became more aware of whom I was working with in terms of not only my work's content but also how I proceeded.
Staff B	2020	I found it easier to compare my betweenness centrality score with others' when I compared my betweenness centrality score from one month to another, which made me more aware of improving my score than before.
	2021	Among the three visualization functions, the reply relationship diagram, in particular, made me aware of the fact that replies are biased toward certain staff members. The betweenness centrality score does not increase even if I am only involved with one staff member, so I think the visualization function has changed how I consciously try to be involved with other staff members.
Staff C	2020	Although I have not utilized all three visualization functions, I often try to use the networking function within the community to look for comments from staff members who have more betweenness centrality.
	2021	In particular, by using the network function within the community, I could see which people were interacting on HighNyammer and pay attention to their posts.
Staff D	2020	In the past, I often merely posted my own text or browsed other people's posts. When the visualization feature was first implemented, I started to reply more because everyone could see whom I replied to and how many times I replied to them this week. Now, I have developed the habit of replying to people without being conscious that they can see me.
	2021	I changed my mindset to give more opinions to other members.
Staff E	2020	To increase the betweenness centrality, I started to refer to the community's network function, leave comments and additions to the posts of people I did not interact with, and consciously make posts that mention members I did not interact with. As there are many opportunities to share opinions on topics discussed on HighNyammer in person, it seems that I can work well with other staff members outside of HighNyammer as a result.
	2021	I look at the visualization of everyone's betweenness centrality (bar graph), and when I am low in betweenness centrality, I look at the network functions within the community and actively comment back on the posts of those with whom I am not communicating.

In response to Q5, we found that all five sought to improve their BC values in 2019. This trend will continue in the 2020 survey.

In Q6, four out of five respondents said that social network function (3) was more affected than functions (1) and (2) in 2019. However, in 2020, three out of five respondents indicated that (1) and (2) had a greater impact than (3). Of the four respondents who indicated that (3) had a greater impact in 2020, two did not change their opinion, while the other two changed their opinion and indicated that (1) and (2) had a greater impact. These trends are supported by responses to Q13 and Q14.

Q13 asked how members perceive the HNSS to be utilized of the facility. Options 1, 2, 3, 6, and 8 imply a focus on one's activities and relationships with others; options 4 and 5 imply frequency of activities; and option 7 implies an abstract view of activities. According to Q13 in Table 2, every staff member's response indicated that two or more of the three options focused on their relationships with others in both FY2020 and FY2021. This suggests that when student staff members reflect on their activities, they tend to focus on their relationships with others using the HNSS.

In Q14, Staff A and B were asked to indicate how their understanding of the activity had changed as a result of using the HNSS. The results are shown in Table 3. Staff A and B were not aware of their involvement with other members as of 2020, but they started to mention their involvement with other staff members in 2021. Staff C, D, and E started to use the HNSS early on to improve and consider their involvement with other staff members, and this idea was maintained in 2021. Staff C, D, and E also changed their minds about using the HNSS early on in their use of the system to improve and examine their interactions with other staff members, and they maintained this change in 2021. These findings suggest that use of the HNSS makes members more aware of the lack of communication with other members in their activities and shifts their mindset to try to be more involved with other members.

Q9 examined whether it is realistic to work while being aware of feedback from the system. Table 2 shows that except for Staff C, the answers were either "weak Yes" or "maybe Yes" in both 2020 and 2021, indicating that there was no change. Staff C felt stressed by the sustained awareness of the value of BC in 2020, but improved to "weak Yes" in 2021. This suggests that it is practically possible to be aware of the feedback of the BC value while working.

9   Conclusion and Future Work

We implemented HighNyammer Social Scanner, a new externalizing feedback function of the values of BC for each staff member, and visualizing relationships between the student-staff members to improve the members' CCR. HighNyammer Social Scanner was already used by the student-staff members who were expected to improve their CCR through working in Classroom-M since 2018. The quantitative and qualitative analyses suggested that HighNyammer Social Scanner helped the student-staff members perform as high-CCR members, especially novice members. The results of the quantitative analysis showed that the student-staff members continued to access HighNyammer during vacation. Furthermore, the number of their posted articles on HighNyammer was increased few weeks later from HighNyammer Social Scanner's launch. This suggests that the student-staff members gradually applied what they learned by

using HighNyammer Social Scanner to their posting activities. Further, the student-staff members used the social network function (3), which shows the detailed relationships between the student-staff members, more than function (1), which shows the numerical change during a year in the whole community. The qualitative analysis suggested that the student-staff members received concrete information to improve their activity from function (3) on HighNyammer Social Scanner. It implies that they changed their activities from only focusing on their activities to collaborative reflecting with their peers.

As a restriction, this research comprised limited participants and periods to examine High-Nyammer Social Scanner's effect. We will increase the number of participants, continue this practical experiment, and reexamine the effect of feedback to improve community members' CCR using HighNyammer Social Scanner. Furthermore, we would like to export HighNyammer Social Scanner function to other communities that try to improve the CCR of community members.

Acknowledgments

References

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