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The effect of discourse analysis activity with KBDeX on students' understanding about collaborative learning

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Abstract: (350 words) It is known that collaborative learning enhances deepening participants' understanding because there are iterative processes of questioning and answering about subjects. One person finds incomplete points and asks questions about his/her partner's explanation, and the asked person answers the questions. Although such iterative processes improve deepening understanding, Japanese first-year undergraduates typically divide tasks among group members and have little discussion. It suggests that students have difficulty to recognize the effect of collaboration because its processes are complicated. We provided following ones to the students to help analysis of constructive interaction: a simple discourse data of constructive interaction, discourse analysis support tool called KBDeX, and DASK which suggests the important points when analyzing constructive interaction. Students in 2013 "Learning Management" class studied the effect of collaborative learning through discourse analysis activity of constructive interaction. On the other hand, students in 2012 class only learn theories about the effect of constructive interaction from texts. The students in the 2013 class compared with the 2012 class using design research. We analyzed the students' beliefs about collaborative learning using their reports. 38 reports in the 2013 and 41 reports in the 2012 were analyzed. The result is that the students of 2013 changed their beliefs from "dividing tasks" to "exchange one's own thinking" than the students in the 2012 class. KBDeX and DASK supported finding characteristics of constructive interaction.

Keywords: KBDeX, Discourse Analysis, Constructive Interaction, Deep understanding.

1. Introduction

Students have been expected to have the skill of deepening their understanding in recent years, and the skill is claimed to be one of the important "21st-century skills" (Griffin, McGaw and Care, 2012) for creating an innovative future society, but it is not easy. We focused on the mechanism of "constructive interaction" (Miyake, 1986) as a way of deepening one's understanding in collaborative learning. When a student gives his/her opinion to his/her collaborator, the collaborator may ask questions about the student's incomplete opinion. The student rethinks his/her opinion and answer the collaborator. The processes of questioning and answering will continue iteratively through exchanging questioner and answerer. Such interactions enhance each participant's deepening understanding of the subject, not lead convergence of understanding (Miyake & Miyake, 2014). This effect of constructive interaction is shown in many learning situations (CoREF, 2013), but first-year undergraduates think that a group activity consists of dividing tasks among group members with little discussion, even when they had experienced group activities before entering the university (Matsuzawa, Tohyama and Sakai, 2013). We think that students miss numerous opportunities for deepening understanding because they do not know the relationship between collaborative learning and deepening understanding. However, if we lecture the students on the relationship between collaborative learning and deepening understanding, the students tend to forget it in the future because this type of knowledge is easy to disappear (Clement, 1987). We can observe the mechanism of constructive interaction when we analyze discourses from meta point of view (Tohyama, 2013). Thus, we provided KBDeX (Knowledge Building Discourse

eXplorer) and DASK (Discourse Analysis Sheets for KBDeX) to help students' own discourse analysis activity for understanding the characteristics of constructive interaction. We analyzed the students' beliefs about collaborative learning in the 2012 class and the 2013 class, focusing on changes in the Learning Management class curricula using design research (Brown, 1992).

2. Experiment Design

Our target was first-year undergraduates who studied "Learning Management" which held in 2013 at Japanese University during the autumn term as required classes. The students were expected to learn how to reflect their own study processes from meta points of view. In this study, we targeted the initial phase of the Learning Management because the students learn about merits of group work. The classes were also held in 2012 with the same form, and the 2013 class was the experiment group in this study. There were about fifty students in the 2012 class and the 2013 class. These students had their own laptop computers that were connected to the Internet. The second author was a class teacher, and the first author assisted him in both classes.

The activity for learning the merits of collaborative learning in the 2013 class differed from that in the 2012 class. We asked the students in the 2013 class to analyze a discourse of constructive interaction using KBDeX and DASK. The students in 2013 installed KBDeX on their own laptops along with sample discourse about a bobbin's rotation mechanism recorded by Yamanaka (2002). This bobbin problem looks simple but difficult to explain correctly. In the discourse, two master course's students discuss about the mechanism of a bobbin's rotation when its string is pulled (Figure 1). At first, their understanding levels of bobbin's mechanism were level 1 and 2, but at the end, both of them reached level 3 (highest) of understanding. The discourse was made by 235 lines. Each line was separated by the speakers' pause. The discourse could read on KBDeX, but we provide printed version to the students for improving its readability.

To emphasize characteristics of constructive interaction, twenty-seven keywords which were selected by the authors were loaded into KBDeX. These keywords were deeply concerned with the changing levels of understanding of two speakers. And we provided DASK to describe characteristics of each phase of the discourse using KBDeX. The discourse was separated into 11 phases based on the change in the speakers' levels of understanding, and KBDeX draw each phase of graphs.

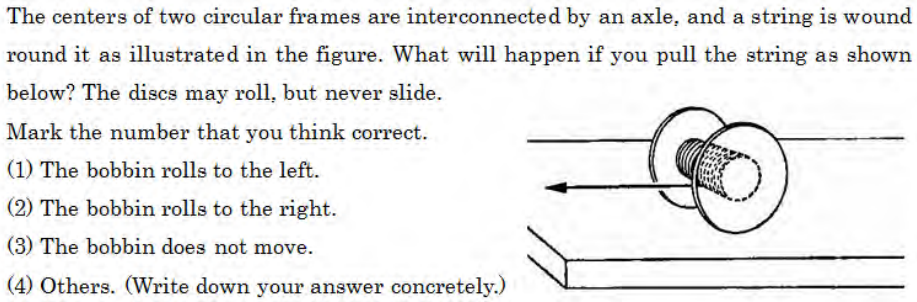

Figure 1. Bobbin problem.

On the other hand, we produced a collaborative text comprehension activity called "Jigsaw" (Aronson, 1978) for the 2012 class. In the jigsaw, the students were divided into four groups and provided one of four texts. Each text concerned the effects of collaborative knowledge building from the viewpoint of 21st-century skills (ITL Research, 2013). The students read the text within each group. After that, the students from each group made new groups and explained the texts to each other.

We provided "introduction activity" to both the 2012 and the 2013 classes before the jigsaw or discourse analysis. The activity was called "Collaborative Figure Description Building" (CFDB) (Araki *et al*., 2008) and its reflection. The objective of CFDB and its reflection is to present the students a variety of ways of understanding clearly; this diversity of understanding contributes to the creation of new ideas and to using KBDeX. It took 180 minutes for the activities in 2012 and 2013. We also provided "wrap-up activity" to both the classes; a jigsaw activity using four texts for learning how to make collaborative learning more effective. The four texts were the mechanism of constructive interaction, functional fixedness in collaborative problem solving, nursery kids' collaborative learning,

and the conformity experiment. After the jigsaw is over, we expected the students to gain skills of building an effective collaborative learning environment.

The target activities - jigsaw or discourse analysis -, introduction activity, and wrap-up activity were shown in figure 2. The target activity in the 2012 class took about 90 minutes, while the 2013 class took 120 minutes because the students solve the bobbin problem before the discourse analysis activity in 2013. Needless to say, there were a lot of differences between the 2012 class and the 2013 class about target activity, so we regards a difference of post-reports between 2012 and 2013 as summative data and show the results of detailed analysis in 2013 as the effect of discourse analysis activity.

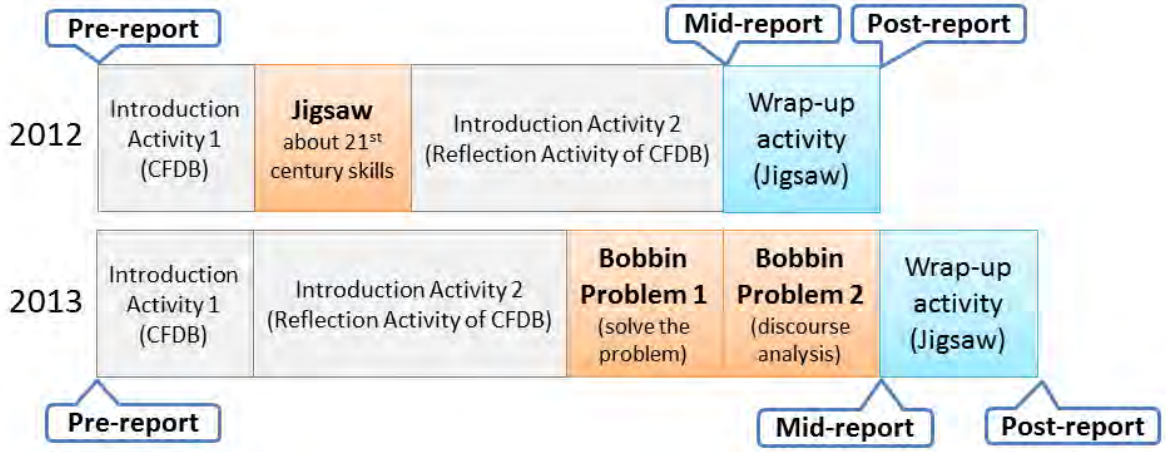

Figure 2. Activities in the 2012 and the 2013 classes.

3. Support Tools

KBDeX supports discourse analysis in collaborative learning from the perspective of complex network science (Oshima, Oshima and Matsuzawa, 2012) by visualizing network structures of discourse based on a bipartite graph of words × discourse units (e.g., conversation turns or sentences). The network structures are: (1) the speakers' network structure, (2) the unit network structure, and (3) the network structure of the target words (Figure. 3). We input discourse data (in .csv format) and a list of target words for bipartite graph creation (a text file). If we click a speaker in (1), KBDeX will mark units using red color in (2) and words in (3) which were referred by the selected speaker. Red nodes in figure 3

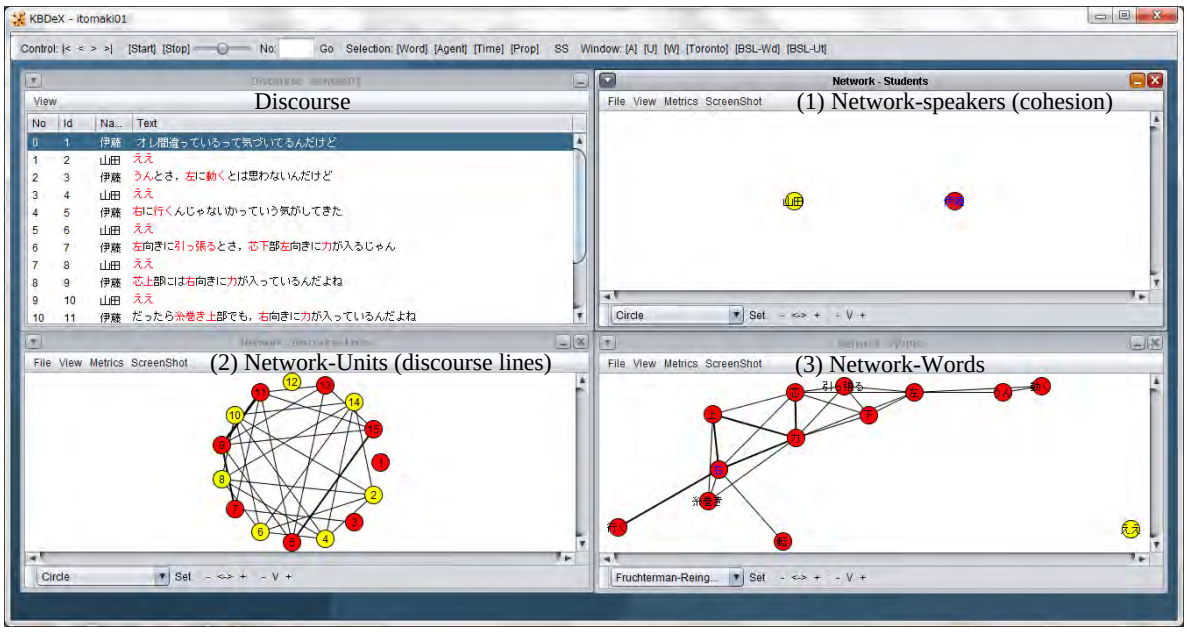

Figure 3. KBDeX Software Interface.

show units and words referred by “Itoh”, and we could guess that Itoh is a main speaker of this phase.

DASK supports emphasizing characteristics of constructive interaction of the discourse. First, DASK provides a graph indicating the speakers’ understanding level of each phase (Figure. 4) which was analyzed by the first author. Second, DASK required the students to find the characteristics of each phase based on the appearance of target words, remarkable statements, and the degree of cohesion between the speakers (Table 1). The students picked up some words from target words which were frequently appeared in each phase. Remarkable statement which is pointed by Id number was also selected by the students. The students selected one of three options such as loose, medium and tight for the degree of cohesion.

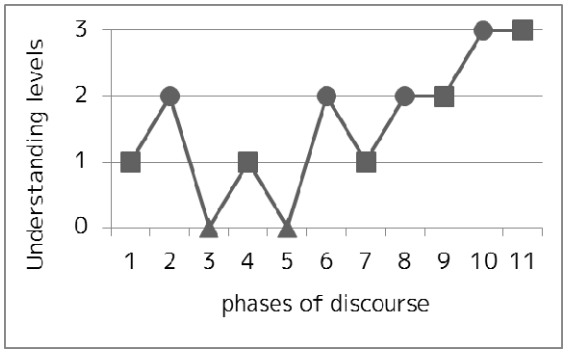

Figure 4. Graph of understanding level shown in DASK.
(■: Speaker A, ●: Speaker B, ▲: Both speakers)

We categorized explanations of a phase which is based on simple rotation model (e.g. “If the bottom is pulled left, the top will move right.”) into level 1. Explanations of a phase which is based on incomplete model of “bottom‘s axis” (e.g. “There is fulcrum point at the bottom of the axis, so if the bottom of the axis is pulled left the bobbin will be rotated to the left.”) into level 2. We categorized explanations which are based on complete axis model (e.g. “The axis is in the center of the bobbin, so wherever we pull the axis to the left, the bobbin will be rotated to the left.”) into level 3. Explanations not categorized into level 1, 2, or 3 were assigned to level 0.

Table 1. Worksheet for finding characteristics of discourse in DASK example.

Phase	frequently appearing target words	Selected Id # from the discourse	degree of association of the speakers	characteristics of the phase
(1)	power, right	Id: 9	(loose) medium tight	Itoh's explanation
(2)	rotate, bottom	Id: 30	loose medium (tight)	Yamada's explanation

4. Analyzing

We analyzed the three kinds of students’ reports and DASK which were written by the students in 2013. The students wrote reports at the initial phase, before the wrap-up jigsaw, and after the wrap-up jigsaw (Figure 3). The question in the pre-report was “what is the ideal group work for you?” and the question in the mid-report was “what will you do making your group work ideal?” We believe responses to these questions reflect the students’ thinking about what collaborative learning is. If the students wrote that externalizing their own thinking and revising it repeatedly in collaborative discussion is important, they may understand the relationship between collaborative learning and deepening understanding.

Students who gave us all the reports were selected as subjects. There were 38 such students in the 2012 class and 41 in the 2013 class. The first author as well as other staff members who worked at Japanese university analyzed these reports independently. The two results were 80% matched.

5. Results

5.1 Result 1: Students' thinking about what collaborative learning is

We categorized reports into "task dividing" or "exchange opinions." Students who think of collaborative learning as task dividing were categorized into "task dividing." Students who think that the importance of collaborative learning is exchanging one's opinions were categorized into "exchange opinions." The result of categorization of the 2012 class is presented in Figure 4, and the 2013 class's result is seen in Figure 5. The number of mid-reports and post-reports in the "exchange opinions" category in the 2013 class was much higher than in the 2012 class even though the number of pre-reports in the 2012 class was almost the same as in the 2013 class. We checked the difference between the results of the pre- and mid-reports within each class using a chi-squared analysis. There was no significance in the 2012 class (χ^2=0.95, *df*=1, *n.s.*), but it was significantly different in the 2013 class (χ^2=20.09, *df*=1, p<.01). We also checked the difference between the results of the pre- and post-reports, there were significantly different both in the 2012 class (χ^2=6.08, *df*=1, p<.05) and the 2013 class (χ^2=35.56, *df*=1, p<.01). These results show that the discourse analysis activity helped the students' learning about exchanging opinions is important in collaborative learning. The wrap-up activity was also effective in each class, but its effect was limited.

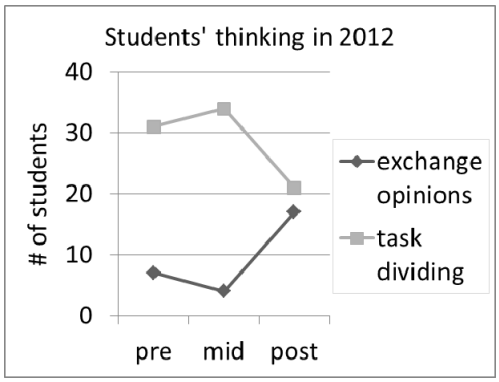

Figure 4. Students' thinking about collaborative learning in the 2012 class.

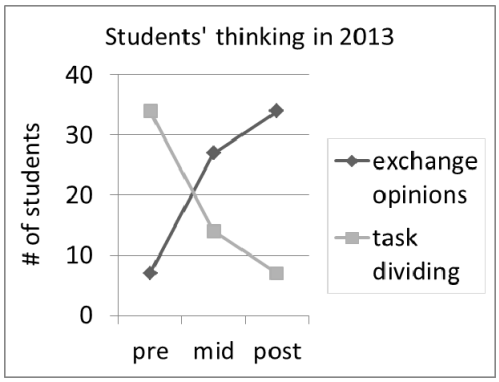

Figure 5. Students' thinking about collaborative learning in the 2013 class.

5.2 Result 2: Students' activities with DASK

We analyzed "characteristics of the phase" of written DASK to analyze the detailed activities of discourse analysis. Five students wrote that discussion is analyzed as a process that can lead to convergence of understanding. All of the five students wrote "task dividing" in the mid-reports. It suggests that the five students misunderstood the characteristics of constructive interaction. There was no significant difference about the frequently appeared words between the speaker A and the speaker B in each phase, but in detail, how to use the words were different each other. It seems KBDeX and DASK are limited to show the difference of detailed discourse. Moreover, two other students wrote that collaboration is iterations of questioning and answering. These two students also wrote "task dividing"

in the mid-reports. It is known that such iterations are important to improve deepening understanding in collaborative learning, but the two students only observed superficial form of discussion without a viewpoint of understanding level. These results suggest that KBDeX and DASK should show varieties of participants' understandings than ever.

6. Discussion

Students recognized that collaborative learning is effective as a deepening understanding activity through the discourse analysis activity using KBDeX and DASK, but the students who learned the characteristics of collaborative learning through text-based activity difficult to recognize this. The students who analyzed discourse with KBDeX and DASK noticed that externalizing their own thinking is necessary for deepening their own understanding because this is needed when they start a constructive interaction. These results suggest that students could change their beliefs when they are scaffold. KBDeX and DASK may help students overviewing of the process of collaborative interaction. However, these scaffolds were particularly ineffective because it misled some students to understand the characteristics of constructive interaction.

KBDeX is a powerful visualization tool, but how to interpret the characteristics of the graphs shown in KBDeX is not easy especially discourses are complicated like constructive interaction. We will continue to explore how to support qualitative analysis of discourses using KBDeX for finding more effective ways to the students.

This research is the first step in our plan. Our final goal is building the students' skills for collaborative learning which deepen the students' understanding. In the future, we hope to revise our Learning Management class with more appropriate use of KBDeX.

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