Student Regulation of Collaborative Learning in Multiple Document Integration

Jun Oshima, Ritsuko Oshima amd Keita Fujii
Graduate School of Informatics, Shizuoka University, 3-5-1 Johoku, Naka-ku, Hamamatsu-shi, Japan
joshima@inf.shizuoka.ac.jp, roshima@inf.shizuoka.ac.jp, kfujii@kai.cs.inf.shizuoka.ac.jp

Abstract: We designed a learning environment for facilitating students' regulation of their collaborative learning in a pre-service teacher course, based on a theoretical model of learning regulation and the jigsaw method. Each student in a group read a different document related to learning environment principles (expert group work). Then, students worked together to integrate the ideas in the documents through discussion (jigsaw group work). We examined the proposed design by analyzing the types of regulation that students used and by interpreting their means of solving social conflicts. Furthermore, the relationship between group characteristics and learning outcomes was explored. Results show that stable engagement in socially shared regulation of learning in the jigsaw group was related to better learning outcomes. In addition, students failed to maintain their socially shared regulation when members had different regulation strategies for solving their social conflicts in groups.

Theoretical Background and Research Aims

When contributing to a collaborative task, learners have to regulate themselves, others, and the group as a whole (Winne, Hadwin, & Perry, 2013). In self-regulated learning, learners regulate their own learning in order to contribute to group performance, based on their individual perception of tasks and their strategic knowledge. In another layer of metacognition, namely, co-regulated learning, learners also regulate themselves in relation to others. Each learner in a group monitors the task perception, goals, and standards of other group members and considers ways their actions and interactions influence one another and the task. In the final layer of metacognition, learners engaged in a collaborative task collectively regulate their group cognition: this is socially shared regulation of learning (SSRL). In Hadwin, Jäevelä, and Miller (2011), SSRL is defined as "interdependent or collectively shared regulatory processes, beliefs, and knowledge orchestrated in the service of a co-constructed or shared outcome/product" (p. 69). In SSRL, learners are collaboratively involved in the planning, monitoring, evaluation, and regulation of social, cognitive, and behavioral aspects of their learning. The importance of social regulatory processes for learning in small group settings has been preliminarily but empirically supported by several studies in the last decade. For instance, Järvenoja and Järvelä (2009) found that individual, shared, and other forms of regulation during group interactions can be differentiated and that these different types of regulation are used to maintain group work when students encounter a challenge. Moreover, social regulation of learning is associated with the use of deep-level learning strategies and learning transfer.

By drawing on recent findings on SSRL, it is possible to conduct a more systematic study of how collaboration should be designed. Here, we employ design-based research methodology to investigate how collaboration can lead learners to more successful learning. Based on the reported mechanism of regulation of collaborative learning (Hadwin et al., 2011; Winne et al., 2013), we designed a learning environment to facilitate university students' regulation of collaborative learning in a task called "collaborative reading comprehension" (Oshima & Oshima, 2011); we then analyzed how our design elements helped learners to regulate their collaboration for deeper conceptual understanding.

In collaborative reading comprehension, there are two types of group work. The first type is expert group work, in which learners in a group share the same content (here, a document) and attempt to construct their *own* understanding of it through their interaction. In the expert group, therefore, learners are required to engage appropriately in reciprocal co-regulated learning (named as two-way Co-RL later). A learner must understand the document in order to explain it to others who are unfamiliar with it in the subsequent jigsaw group; consequently, each individual learner in the expert group is more oriented toward their individual perception and goal. Their interaction with other members who study the same document facilitates reciprocal co-regulated learning where learners monitor each other's understanding by expressing their ideas and receiving feedback from others. The second type is jigsaw group work, in which members who studied different documents share and collaboratively integrate ideas from different documents. Each learner is required of contributing to the construction of shared understanding by referring to others' ideas as well as their own ideas. In this group work, each learner is required to engage appropriately in SSRL.

In this paper, we report our first year attempt to design collaborative reading comprehension based on the theoretical framework of learning regulation. We focus our attention on design conjecture rather than on theoretical conjecture (Sandoval, in press). In the early stage of design-based research, the main issue is to examine whether the implemented design would work as expected rather than whether the design would lead to

successful outcomes. To evaluate our design, we take up the following research questions. First, how do students engage in regulation of learning in the expert group and the jigsaw group, and are there any differences in learning regulation between groups? We examined regulation of learning by identifying which level of regulation learners engaged in. In addition, we conducted finer-grained discourse analysis by applying conversation analysis (Schegloff, 2007) to conversation segments that were representative of unique group characteristics. Second, if there are differences between the groups, what learning outcomes result from group differences in regulation of learning? We evaluated the following learning outcomes: learners' written discourse summarizing their ideas in a computer-supported collaborative learning (CSCL) system after collaborative reading comprehension.

Learning Context of This Study

Collaborative reading comprehension was implemented as a part of an intensive course during the summer term of a teacher certification program at a Japanese public university. The course was four consecutive days, and the activity was conducted during the first day and a half. The second author was the instructor. Toward fulfilling the course requirements, 7 third-year undergraduate students and 1 graduate student participated in this study. The goal of the course for students was to understand basic concepts of CSCL in order to apply lesson plans appropriately. The goal for students in the collaborative reading comprehension was to understand basic principles of how to design learning environments (Bransford, Brown, & Cocking, 1999).

Collaborative reading comprehension is an activity structure designed based on the jigsaw method (Aronson & Patnoe, 2011). It encourages learners to engage in collaborative knowledge construction through building an understanding of multiple document resources (see left in Figure 1). Students were first placed in expert groups after listening to an instructor's brief lecture on "the learning environment," the target concept. In each expert group, four students collaboratively read and constructed an understanding of one document, which they explained to others afterward in jigsaw groups. Through expert group collaboration, each student produced a summary by using a prepared worksheet, which would be used as a handout for the explanation in jigsaw groups. After the expert groups finished, jigsaw groups were formed; these groups consisted of one student from each expert group. Students in the jigsaw groups worked to integrate the ideas contained in the four different documents from explanations by the student expert for each document. After discussing the four documents, the students reported how ideas from the documents were related to one another and interpreted them with reference to the basic framework of learning environments in the Knowledge Forum CSCL system.
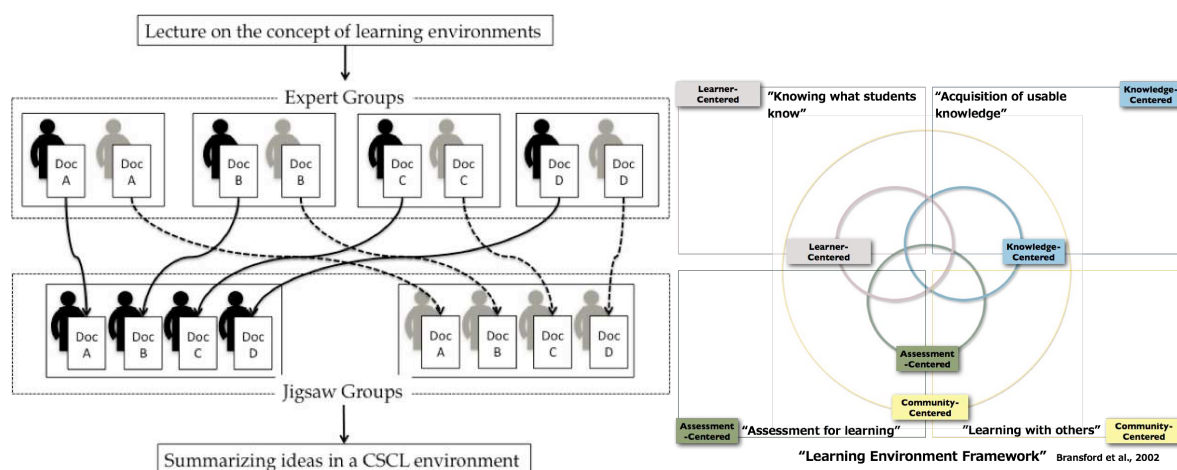

Figure 1. Participatory structure of collaborative reading comprehension (left) and worksheet for students to organize their ideas from documents (right).

Documents used in the activity came from a book on how people learn in Japanese (Inagaki & Hatano, 1989). We selected four chapters of the book, covering four basic principles of learning environments: learner-centered, knowledge-centered, assessment-centered, and community-centered. Each chapter was transcribed to electronic form and reprinted as a standalone document. These documents were given as reading assignments to the expert groups, and we provided students with a worksheet to organize ideas from their document in relation to the learning environments concept (see right panel in Figure 1). In jigsaw groups, students brought the ideas summarized from the documents on their worksheets and discussed how the ideas from different documents could be integrated for advancing their understanding of the principles of learning environments. To facilitate SSRL, we further provided students with a whiteboard, on which a large Venn diagram of the learning environment was drawn and sticky notes so that they could externalize and manipulate their ideas on the shared space.

Results

Data Collection

To examine student regulation in collaborative learning, we collected data in the following way. First, we collected each student worksheet and made an electronic copy (in Portable Document Format). Second, we took pictures of the whiteboard, where they had recorded their ideas by placing sticky notes on the learning environment diagram. Third, we video-recorded the conversations in the expert and jigsaw groups and transcribed them. Finally, students' written thoughts on integrating their ideas from documents in the CSCL system were included. In this study, the transcription of student conversations and the writings in the CSCL system were used for discourse analysis.

Regulation of Collaborative Learning for Students in Expert and Jigsaw Groups: Group Differences

Student conversation was first divided into segments by tasks that learners engaged in. Each segment of conversation was then categorized as one-way co-regulated learning, two-way co-regulated learning, or SSRL. Whenever a specific student intended to regulate collaborative learning and the others followed (whether or not they were willing to), the segment was categorized as one-way co-regulated learning. If the regulation was reciprocal in constructing understanding, the segment was categorized as two-way co-regulated learning. When students shared problems and collaboratively regulated their learning, this was categorized as SSRL. The first and third authors collaboratively conducted the segmentation of transcripts and independently categorized segments. The authors agreed on 70% of categorizations, with disagreements resolved through discussion.

We calculated how much time students spent in regulating their collaborative learning and found the following group differences: (1) two expert groups were more likely to engage in co-regulated learning (98% of total time for expert group 1 and 84% for expert group 4), and the other two were more likely to engage in SSRL (87% for expert group 2 and 79% for expert group 3) and (2) both jigsaw groups spent more than a half of the time on engaging in SSRL (58% in jigsaw group A and 63% in B). These results suggest that our design of participatory structure appropriately promoted learners' regulation in their collaborative learning. On the other hand, we also found that every expert group and jigsaw group A engaged in one-way Co-RL. To further investigate why and how learners performed the unexpected regulation of their collaborative learning, we focused on how regulation of collaboration was related to social conflict. As Järvenoja and Järvelä (2009) demonstrated in their work, students apply different levels of regulation strategies when confronted with social challenges within their groups. In the next section, we analyze segments of conversation in which learners had social conflicts and a learner exerted her/his one-way Co-RL strategy to terminate sequences of conversation turns.

How Students Regulated Social Interaction

We identified segments of conversation where social conflicts were found. The first example was from expert group 1, which was oriented to co-regulated learning. In the following segment, they discussed how a description in their document was related to the learning environment principles. The original conversation was in Japanese; we have provided an English translation below the original.

1 A1:   だからその、そこ-そういう見方をすればそれが学習:::者の特性で
        /Well, so…if we take the perspective we discussed, this might be related to learner characteristics…/
2 B1:   =ああ(1.0)なるほど。（　）それは学習者単独で[いいかな？評価も入ってる？]
        /Oh, I see.　　　　　So is it OK to say that this is directly related to the learner-centered idea? Or do you think that it might be closer to the assessment-centered idea?
3 A1:   [う:::::::::ん]
        /Hmmmm/
4 :   (8.0)((B1は話を振った後メモを取っている。A1は枠組みの資料を見ながら考えている))
        /B1 is taking notes after uttering line #2. A1 is thinking while looking at his framework worksheet./
5 A1:   いいよ、そんな細かく分けなくて
        /No, you (B1) need not think in such a strict way./
6 B1:   =まあね
        /Oh, yeah./
7 :   (1.0)
8 A1:   主張がぶれる
        /We would be confused./
9 B2:   うん
        /OK./

10　：　(23.0)((B1はメモを取っている。A1もメモを取っている様子))
　　　　　/B1 is taking notes. A1 is also taking notes./
11 A1:　ただこの視点は(1.0)え:::この本文全体の大筋からはずれてるか
　　　　/This perspective does not seem to be related to the main message in the document, does it?/
12 B1:　う:::ん(。)まあ、でもある。(2.0)°どうしよ。°
　　　　/Ummm, yeah, but what should we do about it?/
13　：　(4.0)
14 A1:　まあ、いいよ
　　　　/Well, it's alright./

In the conversation above, the two students had conflicting learning goals. B1 was attempting to understand deeply how the ideas in their document were related to learning environment principles; A1 was focused on task completion. In lines 2 and 12, B1 expressed concern about the relationship between the document ideas and the learning environment principles, but A1 ignored B1's requests for discussion and tried to end the discussion (lines 5, 8, and 14). Although these segments were categorized as one-way co-regulated learning during the previous analysis, here we found through fine-grained conversation analysis that these two students applied different regulation strategies to the conflict in goals. B1 challenged the task-completion goal held by A1 several times, trying an ultimately unsuccessful SSRL strategy. We found similar conversation segments across expert groups oriented to co-regulated learning.

Another example of conversation is given below. In this segment, students in jigsaw group A were examining each other's ideas in front of the whiteboard; these ideas had been written on sticky notes and placed on the whiteboard. A1 explained his idea by referring to his sticky note, and A2 raised a question about A1's original idea and proposed a different interpretation (lines 8 and 9). A2's proposal was then shared with A3 and A4, who responded (lines 10, 11, and 12). However, A1 did not discuss A2's proposal, simply moving his sticky note to the section that A2 had suggested. In the video of this conversation, the other three members seem surprised by A1's act of moving his sticky note. A3 expressed his surprise immediately after noticing A1's act (line 13). This segment of conversation was also categorized as one-way co-regulated learning because A1 was regulated by other group members (particularly by A2). Conversation analysis, however, presents a more detailed picture of what was happening. Three group members used the SSRL strategy to scrutinize A1's original idea and A2's proposed a new interpretation (lines 8–12), A1 applied the co-regulated learning strategy by accepting A2's proposal without discussion (line 13). Thus, we see conflicting regulation strategies, with different goals among group members. Through conversation analysis of expert group and jigsaw group activities, we found that conflicts in the learning goals of members might lead group members to failing to pursue the SSRL strategy.

1 A1:　見方によれば，自分の英語能力の低さを::人に見せないようにする，(本人の見えない壁)
　　　　/In a sense, she does not like it when others notice her low level of English literacy./
2　：　そういう見方もできるわけで，それは学習者によって違うから，学習者の特性による
3　：　え::
4　：　(1.0)よって起こった(　　)
　　　　/We may usually think so. But, she may have a different perspective, too. It's totally
　　　　dependent on her learner characteristics.
5 A3:　(.)あ::::
6 A1:　で:((自分で貼った付箋紙を確認する))
　　　　/So, ((A1 is looking at his sticky note to confirm what he said.))/
7　：　(3.0)
8 A2:　えっ，でもそれって結局自分で，自分のことをなんか評価してるんで::，ここ((評価中心))らへんじゃ
9　　　ないんですか？
　　　　/Oh, but in this example the person assesses herself. Isn't this close to the assessment-centered
　　　　idea?/
10 A3:　=あ::なるほどね，評価が入ってるか
　　　　/I see. I also think that it might be related to the assessment-centered idea./
11 A4:　(.)う:::ん
　　　　/Let me see…/
12 A3:　=あ::はいはいはい
　　　　/Uh, yeah, I got you (A2)./
13　：　(6.0)((A1は何も言わず付箋紙を動かす))
　　　　/((A1 quickly moved his sticky note, which had been placed on the learner-centered section, to

the assessment-centered section without consulting other members.))/

14 A3:   あ:::
　　　　　/Oh…/

How Group Differences in Regulation Were Related to Learning Outcome

Learning outcome was measured by evaluating the quality of written discourse in the CSCL system after collaborative learning. The reasoning in the written discourse was categorized as either best-fit strategy or knowledge transformation (Bereiter & Scardamalia, 1993). When groups simply wrote how their ideas from documents were fitted to one or more of the four learning environment principles, their reasoning was categorized as a best-fit strategy. When a group attempted to describe the four principles in their own words based on their ideas from the documents, their reasoning was categorized as knowledge transformation. We found that jigsaw group B outperformed A in their number of knowledge transformation ($\chi^2 = 3.07$, $df = 1$, $p < .10$).

Discussion

We designed a collaborative reading comprehension exercise to facilitate knowledge integration in reading documents; this was done on the basis of cognitive models of collaborative learning regulation. Our preliminary analysis for the first year of implementation suggested that students were engaged in socially shared regulation within the designed learning environment (jigsaw participatory structure with shared worksheets and whiteboard), and that they were able to integrate their knowledge from multiple documents when they regulated collaborative learning in the socially shared way. Although we found positive effect from the designed learning environments, our analysis also revealed a problem that kept learners from productive collaboration. As suggested in previous research (e.g., Järvenoja & Järvelä, 2009), learners held and attempted to resolve social conflicts in their group work by exerting their different regulation strategies. The new finding in our study is a description of how group members attempted to solve conflicts but could not maintain the SSRL when members had different regulation strategies or different goals in collaborative learning. Thus, to improve collaborative reading comprehension, a socially shared goal in collaborative learning could be further promoted, and students could be instructed on how to learn collaboratively in a more successful way. In future studies on implementation, we plan to design goal instructions and scaffolds in expert and jigsaw groups.

References

Aronson, E. & Patnoe, S. (2011). *Cooperation in the classroom: The jigsaw method (3rd ed.)*. London: Pinter & Martin, Ltd.

Bereiter, C. and Scardamalia, M (1993). *Surpassing Ourselves: An Inquiry into the Nature and Implications of Expertise*. Chicago, IL: Open Court.

Bransford, J. D., Brown, A. L., & Cocking, R. R. (Eds.) (1999). *How people learn: Brain, mind, experience, and school*. Washington, DC: National Academies Press.

Hadwin, A. F., Jäevelä, S., & Miller, M. (2011). Self-regulated, co-regulated, and socially shared regulation of learning. In B. J. Zimmerman & D. H. Schunk (Eds.), *Handbook of Self-Regulation of Learning and Performance* (pp. 65-84). New York, NY: Routledge.

Inagaki, K. & Hatano, G. (1989). How people learn—the world of everyday cognition. Tokyo: Chuo-koronsha. [in Japanese].

Järvenoja, H. & Järvelä, S. (2009). Emotion control in collaborative learning situations? Do students regulate emotions evoked from social challenges? *British Journal of Educational Psychology*, *79*, 463–481.

Oshima, R. & Oshima, J. (2011, April). Knowledge building for pre-service teachers through collaborative reading comprehension. *Paper presented at the Annual Meeting of the American Educational Research Association, New Orleans, LA*.

Sandoval, W. (2014). Conjecture mapping: An approach to systematic educational design research. *The Journal of the Learning Sciences*, 23, 18–36.

Schegloff, E. (2007). *Sequence organization in interaction: A primer in Conversation Analysis*. New York: Cambridge University Press.

Winne, P. H., Hadwin, A. F., & Perry, N. E. (2013). Metacognition and computer-supported collaborative learning. In C. Hmelo-Silver, C. Chinn, C. Chan, & A. O'Donnell (Eds.). (2013). *The international handbook of collaborative learning* (pp. 462–479). New York, NY: Routledge.