

Exploring socially shared regulation of learning during creative problem-solving

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創造的な問題解決における社会的に共有された学習の調整についての検討

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Abstract: The purpose of this study was to clarify how the extent to which each person in the dyad evaluated themselves as a learner using socially shared regulation strategies was related to the creative problem-solving situation. Undergraduate and graduate students solved a puzzle collaboratively. The puzzle was stimulating to them but demanded creative thinking. Differences in the frequency of utterances related to socially shared regulation of learning (SSRL) at macro and micro levels in detail were analyzed and significant differences were observed. Especially, the results suggested that the “performance control” phase at the macro level can play a key role in SSRL. These results are discussed in terms of self-regulated learning theory and higher education practice.

Key Words: socially shared regulation of learning, creative problem-solving, self-regulated learning, higher education

抄録: 本研究の目的は、ペアでの学習において、社会的に共有された調整方略の使用に関する自己評価の程度と、創造的な問題解決状況との関連について明らかにすることであった。大学生と大学院生が協働的にパズルに取り組み、このパズルは、興味を惹く内容で、創造的な思考を要求するものでもあった。マクロレベルとミクロレベルにおいて社会的に共有された学習の調整（SSRL）に関する発話頻度の差異が詳細に分析され、有意差が見出された。とりわけ、マクロレベルでの「遂行コントロール」の段階が、SSRLにおいて重要な役割を果たしている可能性が示唆された。これらの結果について、自己調整学習理論と高等教育実践の観点から議論がなされた。

索引語: 社会的に共有された学習の調整、創造的な問題解決、自己調整学習、高等教育

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Purpose

The purpose of this study was to examine how self-regulated learning appears as a socially shared phenomenon in collaborative problem-solving processes of dyads of university students. Collaborative learning and peer tutoring should improve students' self-regulated learning as well as socially shared regulation of learning (cf. Hadwin, Järvelä, & Miller, 2011). This study examined differences in processes of socially shared regulation of learning using a task requiring creativity, focusing on regulation at macro and micro levels.

In recent years, socially shared regulation of learning (SSRL) has been recognized as a new and growing field (Hadwin, Järvelä, & Miller, 2011; Järvelä & Hadwin, 2013; Panadero & Järvelä, 2015; Schoor, Narciss, & Körndle, 2015). However, there is little research examining the relationship between SSRL and self-regulated learning (cf. Schunk & Zimmerman, 2008). Self-regulated learning (SRL) involves three significant phases: "forethought," "performance control," and "reflection." Learning is deepened through consecutive cycles of these three phases (Zimmerman & Schunk, 2001; Zimmerman & Schunk, 2011). On the other hand, SSRL refers to the ability to learn independently while cooperating with others, and it is assumed to involve the same phases in problem-solving processes.

To examine the SSRL process, this study employed qualitative and quantitative research methods. Quantitative methods were used to examine how students evaluated their socially shared learning strategies in a general situation. Thus, a questionnaire (cf. Ito, 2015) was developed to assess socially shared learning strategies, involving "socially shared monitoring" (e.g., "When we solve problems, we monitor each others' thoughts and ideas"), "socially shared cognition" (e.g. "When we solve problems, we use each others' knowledge and information"), and "socially shared effort regulation" (e.g., "We encourage each other and try to study hard"). In addition, qualitative methods were used to clarify socially shared regulation of the ongoing cognitive and motivational processes in a demanding collaborative problem-solving situation. Participants were undergraduate and graduate students. In dyads, they conducted tasks requiring high levels of creativity and cooperation, and their utterances and communications were analyzed. Furthermore, the three regulatory phases (forethought, performance control, and reflection) were examined at macro and micro levels.

Therefore, the aim of this study was to clarify how the extent to which each person in the dyad evaluated themselves as a learner using socially shared regulation strategies was related to the creative problem-solving situation.

Method

Participants

Sixteen undergraduate and graduate students, that is, eight dyads participated in the study. They completed questionnaires before an experiment task.

Contents of the survey

Socially Shared Learning Strategy Scales. Socially shared learning strategy scales including

“socially shared monitoring” (4 items), “socially shared cognition” (4 items), and “socially shared effort regulation,” (5 items) were developed originally (cf. Ito, 2015). The questionnaires were conducted before starting a task. These items were presented on a 6-point scale, i.e. (1) Very untrue, (2) Untrue, (3) Rather untrue, (4) Rather true, (5) True, and (6) Very true. Using the numbers in the brackets, responses were scored.

Procedures

Eight dyads of students solved a puzzle collaboratively for about 10 minutes. The puzzle was attractive to them but demanded creative thinking. It involved constructing a flying object using various colorful parts of a puzzle. Before starting the task, participants were instructed as follows: “Please create a flying object using parts of the puzzle. If possible, make several objects. Please cooperate with each other and create as many ideas as possible.” All participants performed the tasks requiring creativity cooperatively. Participants’ voice while conducting the tasks was recorded using a digital voice recorder. Their speech was transcribed and utterance analysis was conducted to examine differences in SSRL processes.

When encoding utterances, the functions of their speech were classified at two levels, i.e., macro and micro levels, in terms of three phases (forethought, performance control, and reflection). Macro-level regulation involves setting up an ultimate goal and making a plan for the group as a whole, e.g., using brainstorming to generate many ideas, choosing better strategies, setting a final goal, and so on. Micro-level regulation involves pursuing sub-goals and carrying out each plan. After regulation at macro level, group members regulate each other at micro level. If they cannot solve the problem by choosing strategies at micro level, they reconsider their overall goals, plans, and ideas at macro level.

Moreover, each episode of socially shared regulation at micro level was analyzed in terms of self-regulated learning strategies: “monitoring,” “control,” “cognitive strategy,” and “motivational regulation.” The definitions of these strategies were based on self-regulated learning theory (cf. Pintrich, Smith, Garcia, & McKeachie, 1993). Utterance functions at both levels were coded to clarify the dynamic process of socially shared regulation.

Results

Socially shared learning strategy scales consisted of “socially shared cognition,” “socially shared monitoring,” and “socially shared effort regulation.” Total scores were calculated to categorize dyads in terms of high or low SSRL. The overall average total score was 59.0 (Max = 62.5, Min = 55.5). The average total scores of high SSRL dyad was 62.5. On the other hand, both the average total scores of low SSRL dyad was 55.5.

The verbal protocols of all students were coded by two coders. The concordance rate was calculated to determine inter-rater reliability, which was 95.8%. Subsequently, observational data of both low and high SSRL dyads were analyzed. The frequency of occurrence of all regulation strategies was calculated for the low and high SSRL groups according to the coding categories.

Differences in SSRL utterance frequency at macro level

A χ^2 test was conducted to investigate the differences in the frequency of utterances related to SSRL at macro level. The results indicated the frequency of SSRL utterances in high SSRL dyads was significantly higher than in low SSRL dyads, regarding the “performance control” phase at macro level ($\chi^2 = 12.00$, $df = 1$, $p < .01$). Other phases were not significant. Table 1 and Figure 1 shows these results.

Table 1

Frequency of SSRL utterances at macro level

Macro-level regulation	Low SSRL Group	High SSRL Group
	Freq.	Freq.
Forethought	13	9
Performance control	0	12 **
Reflection	0	0

** $p < .01$

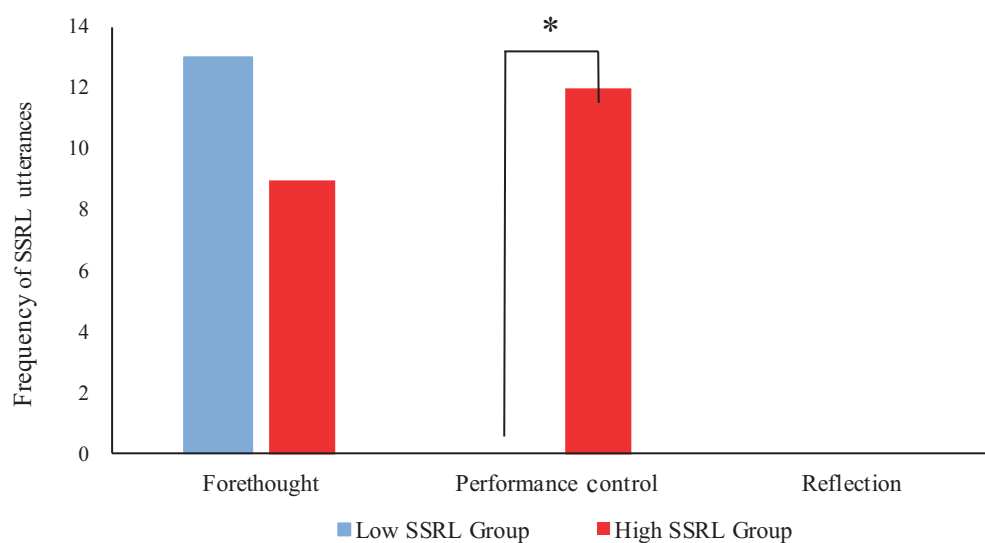


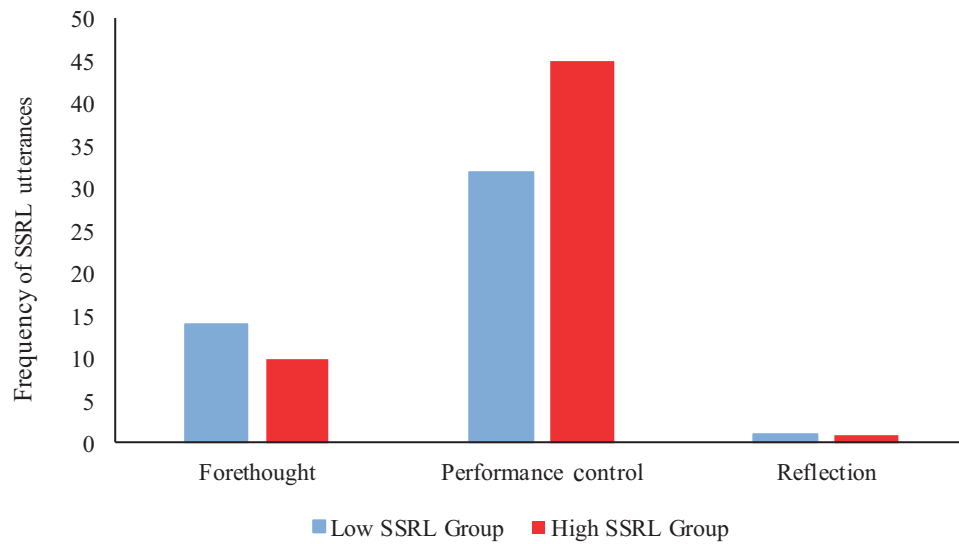
Figure 1. Frequency of SSRL utterances at macro level.

Differences in SSRL utterance frequency at micro level

A χ^2 test was conducted to investigate the differences in the frequency of utterances related to SSRL at micro level. All phases were not significant. Table 2 and Figure 2 shows these results.

Table 2*Frequency of SSRL utterances at micro level*

Micro-level regulation	Low SSRL Group	High SSRL Group
	Freq.	Freq.
Forethought	14	10
Performance control	32	45
Reflection	1	1

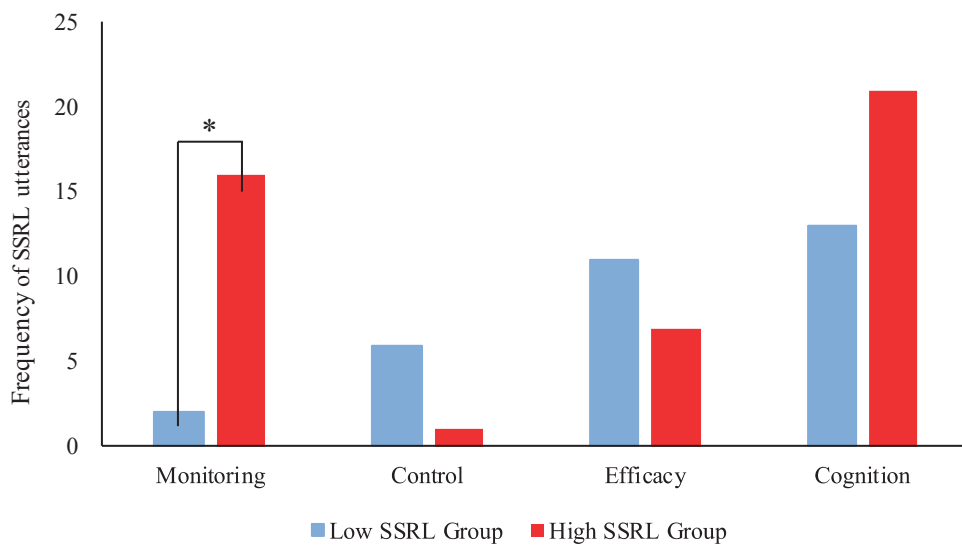
**Figure 2. Frequency of SSRL utterances at micro level.**

Subsequently, a χ^2 test was conducted to investigate the differences in the subcategories of the self-regulated learning process at micro level. The results indicated that the frequency of SSRL utterances regarding “monitoring” ($\chi^2 = 10.89, df = 1, p < .01$) in high SSRL dyads was significantly higher than in low SSRL dyads. Other subcategories were not significant. Table 3 and Figure 3 shows these results.

As a result of their performance, high SSRL dyads generated three ideas. On the other hand, low SSRL dyads came out with two ideas.

Table 3*Frequency of SSRL utterances in the subcategories at micro level*

Micro-level regulation	Low SSRL Group	High SSRL Group	
	Freq.	Freq.	
Monitoring	2	16	**
Control	6	1	
Efficacy	11	7	
Cognition	13	21	

** $p < .01$ **Figure 3. Frequency of SSRL utterances in the subcategories at micro level.**

Discussion

According to observational data, the first regulation cycle at macro level ended, and then the mode of regulation switched to micro-level regulation. When dyads accomplished the given sub-goal and plan, the mode of regulation switched to social regulation at macro level again. A pair who self-evaluated higher on SSRL in general showed a higher function of socially shared regulation in the actual problem-solving situation. In addition, they generated more ideas and performed better.

Differences in the frequency of utterances related to SSRL at macro and micro levels in detail were analyzed and significant differences were observed. Especially, the results suggest that the “performance control” phase at macro level can play a key role in SSRL. On the other hand, there were no significant differences at micro level. This study yielded a new finding that the mode of regulation at macro level had a

significant function in collaborative learning processes. In the cycle of self-regulated learning, forethought functions work in the phase of setting goals, and self-reflection functions work in the phase of self-assessment. In performing activities creatively and cooperatively, performance control functions were considered to be the most necessary compared to the other two functions. Performance control involves executing problem-solving strategies, as well as keeping the attention on the activities and instructing each other. Utterances at macro level included content such as switching and controlling transition of micro- and macro-level regulation. These functions require high metacognitive ability. Therefore, these utterances are considered as mutual regulation at a rather high level.

Subsequently, differences in the frequency of utterances depending on the subcategories of self-regulated learning process at micro level were analyzed. As a result, significant differences were shown in “monitoring.” “Monitoring” utterances were very important in the creative problem-solving process and this result is similar to past research findings (e.g., Backer, Keer, & Valcke, 2015). Backer et al. (2015) examined the effect of reciprocal peer tutoring through the think-aloud task, which comprised a theoretical text and a real-life case relevant to the course “Instructional Science.” The results demonstrated that reciprocal peer tutoring has the potential to foster university students’ metacognitive regulation, more specifically “monitoring.” “Monitoring” utterances promoted each others’ reflective thinking. For example, the monitoring process supports building knowledge, prompting deeper thinking, and asking critical questions. These metacognitive activities bring about superior performance.

Based on these results, higher education instructors should allow students the necessary time to practice deep-level metacognitive regulation, especially performance control at macro level and monitoring at micro level. In addition, teachers should assess the three phases and both levels of SSRL in students, and scaffold their effective self-regulated cycle in dyads. It may be desirable that teachers design a practice based on students’ self-reported assessment. It is important to evaluate their SSRL trait in order to create learning groups or dyads.

The present study was not conducted in a naturalistic setting. University instructors need to think about ways to integrate SSRL into course designs. In order to increase the representativeness of these findings, future research should involve other populations and learning settings. This study focused on dyad-level data. More research is needed to understand how groups and individuals in groups monitor and regulate peer learning processes.

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