

The Effect of Co-Regulated Learning Activities on the Improvement of Self-Regulated Learning Skills in Collaborative Learning Environments

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The purpose of this study was to investigate the effect of co-regulated learning on the improvement of self-regulated learning skills in collaborative learning environments. One group pretest-posttest design was used in this study. The subjects were 49 undergraduate students who enrolled in 'Educational Evaluation' course. To facilitate students' co-regulated learning activities, group worksheets were developed. Students performed collaborative tasks in group by using the group worksheets over the 6 weeks. The results showed that the difference between means of the pretest and posttest was no statistically significant. It indicates that co-regulated learning activities did not have a significant effect on the improvement of self-regulated learning skills in collaborative learning environments. However, the results of additional analysis revealed that the difference between means of the pretest and posttest in case of 19 students with low self-regulated learning level was statistically significant. On the other hand, there was no statistically significant difference between means of the pretest and posttest in case of 19 students with high self-regulated learning level. It is interpreted that co-regulated learning activities positively affected the improvement of self-regulated learning skills of students with low self-regulated learning level.

Keywords : Co-regulated learning, Self-regulated learning, Collaborative learning

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Introduction

Self-regulated learning (SRL) has been one of important educational issues because it is regarded as a significant factor that determines the success of learning. With the importance of SRL, much research on SRL has been conducted to enhance students' SRL skills. However, they have focused on the individuals' SRL process alone. According to social cognitive theory, it has been suggested that SRL is influenced by environment and behavioral events (Zimmerman, 1989). Thus, research on SRL has examined the relationship between social supports such as modeling and SRL (Azevedo et al., 2004; Manlove et al., 2006; Schunk and Hanson, 1985).

As a relationship between social environment and SRL has received attention, a new form of regulation was suggested. From a perspective of sociocultural theory of SRL (McCaslin, 2004, 2009; McCaslin and Hickey, 2001), the term *co-regulation* emerged. The definition of co-regulation varies and researchers have used the term both *co-regulation*, *shared regulation*, and *social regulation* without explicit distinction (Vauras et al., 2003; Volet et al., 2009; Whitebread et al., 2007). Generally, co-regulated learning (CoRL) refers to the coordination of self-regulatory process through interactions among self and others (Hadwin et al., 2011; McCaslin and Hickey, 2001). According to Hadwin et al. (2011), CoRL is grounded in Vygotsky, and Wertsch and Stone's concept of internalization. Vygotsky suggested that higher psychological processes are embedded or contextualized by social and cultural influence (Vygotsky, 1978). Wertsch and Stone (1985) explained that higher psychological processes are internalized through social interaction.

From the previous research, it was identified that co-regulatory process occurred in collaborative learning environments (DiDonato, 2012; Vauras et al., 2003; Hurme and Järvelä, 2005; Iiskala et al., 2004; Kempler and Linnenbrink-Garcia, 2007, Whitebread et al., 2007). The relationship between CoRL and collaborative learning can be theoretically explained. Volet & Gutierrez (2009) mentioned that the

characteristics of co-regulation are noted in the definition of collaboration. Dillenbourg (1999) also explained that “reduced cognitive load may explain why regulating partner’s process is easier than self-regulation and therefore why group members improve their regulatory” (Dillenbourg, 1999, p. 10). Additionally, CoRL activities were found in the previous research (DiDonato, 2012; Vauras et al., 2003; Hurme and Järvelä, 2005; Iiskala et al., 2004; Kempler and Linnenbrink-Garcia, 2007, Whitebread et al., 2007). In CoRL activities, students coordinate the components of SRL by using them together.

There are theoretical explanations of relationship between CoRL and SRL. According to Vygotsky, and Wertsch and Stone’s concept of internalization, CoRL promotes SRL skills (Hadwin et al., 2011; McCaslin and Hickey, 2001; Vygotsky, 1978; Wertsch and Stone, 1985). Students internalize self-regulatory process which is learned through interaction with other students. McCaslin and Hickey (2001) also theoretically explained that CoRL may enhance self-regulatory process in the sections of motivation, enactment and evaluation.

However, there are only few studies that examined whether CoRL actually affects the improvement of SRL skills in collaborative learning environments. Most studies have qualitatively investigated co-regulatory processes alone (Hurme et al., 2005; Iiskala et al., 2004; Järvelä, S & Järvenoja, H., 2011; Kempler et al., 2007; Vauras et al., 2003). For example, Iiskala et al. (2004) documented four grade pair’s regulatory processes of cognition and metacognition during solving mathematical word problems by using flowchart. Furthermore, although CoRL activities can be used as an intervention in research because they were found in co-regulatory process, their effects on SRL have not been investigated.

In the relatively little quantitative research on CoRL, DiDonato (2012) examined whether students’ SRL scores changed after performing tasks in collaborative learning environments. Findings showed that students’ SRL scores increased over the course of team project, and co-regulatory process moderated the changes of students’ SRL scores. However, he examined the effects of CoRL on the

improvement of SRL skills in metacognitive regulation alone. Therefore, there is a need to investigate the effects of CoRL on the improvement of SRL skills in cognitive regulation, motivational regulation and behavioral regulation. The purpose of this study was to investigate the effects of CoRL activities on the improvement of SRL skills in collaborative learning environments. Do CoRL activities affect the improvement of SRL skills in collaborative learning environments?

Theoretical Background

Self-Regulated Learning

The components of Self-Regulated Learning

The concept of SRL emerged after self-regulation was applied to academic area. Many researchers have examined and defined SRL. Generally, Zimmerman and Martinez-Pons(1986) and Pintrich(2000)'s definition of SRL have been widely accepted. Zimmerman and Martinez-Pons (1986) defined SRL as process in which students metacognitively, motivationally, and behaviorally participate in their own learning as active participants. Pintrich(2000) defined SRL as “an active, constructive process whereby learners set goals for their learning and then attempt to monitor, regulate, and control their cognition, motivation, and behavior, guided and constrained by their goals and the contextual features of the environment” (p.453).

Many researchers have defined the component of SRL differently. Zimmerman and Martinez-Pons(1986) argued that SRL is a strategic behavior, and classified the components of SRL into four categories: cognitive regulation, motivational regulation, behavioral regulation, context regulation. Then, they categorized four factors into fifteen sub-strategies including non-self-regulated strategies (labeled as

“other”). Cognitive regulation is divided into six sub-strategies: reviewing records strategy, organizing and transforming strategy, rehearsing and memorizing strategy, goal-setting and planning strategy, keeping records and monitoring strategy, self-evaluation strategy. Self-consequences strategy is included in motivational regulation. Behavioral regulation is divided into two sub-strategies: seeking information strategy and seeking social assistance strategy. Environmental structuring strategy is included in context regulation.

Yang(2000) defined the component of SRL as three types of regulation: cognitive regulation, motivational regulation, behavioral regulation. First, cognitive regulation has two main strategies: cognitive strategy, metacognitive strategy. Cognitive strategy is divided into rehearsal, elaboration, and organization. Metacognitive strategy is divided into planning, monitoring, and regulation. Second, motivation regulation includes mastery goal orientation, self-efficacy, and achievement value. Finally, behavioral regulation includes action control, help-seeking, and time management.

Previous Research on Self-Regulated Learning

Researchers have found that SRL skills positively affect students' performance on task and achievement (Wolters and Pintrich, 1998; Zimmerman and Bandura, 1994; Zimmerman, 2002). With the importance of SRL skills, researches on SRL have been actively conducted. However, most research on SRL has focused on individual's self-regulatory process alone. From a social cognitive perspective of self-regulation, it is suggested that SRL does not occur merely in personal process. It is assumed to be influenced by environment and events. Zimmerman(1989) suggested a social cognitive model of SRL, which explains relationship among person, environment and behavior. Grounded in Zimmerman's social cognitive model of SRL(1989), research on SRL has been guided to relationship between social supports and SRL (Azevedo et al., 2004; Schunk & Hanson, 1985; Sporer & Brunstein, 2009). The social supports include modeling, scaffolding, and other

regulation such as assistance of peers and teachers.

Co-Regulated Learning

The Concept of Co-Regulated Learning

The term *co-regulation* emerged from sociocultural perspective of SRL. Sociocultural theory focuses on individuals' internalization processes of social and cultural influences. Co-regulated learning(CoRL) is theoretically grounded in the Vygotsky's view(1978), and Wertsch and Stone's notion(1985). Vygotsky argued that higher psychological processes are formed in social and cultural environments(Vygotsky, 1978). Wertsch and Stone(1985) insisted that higher psychological processes are internalized through social interaction.

The term *co-regulation* has been used in the literature. However, concepts of co-regulation have been a little different. Researchers have defined co-regulation with different point of view. McCaslin(2004, 2009) defined co-regulation as dynamic regulatory processes in which individuals internalize social and cultural influences by the support of social environment. Järvenoja and Järvelä(2009) viewed co-regulation as process in which individual supports other people's regulatory process. Hadwin and Oshige(Hadwin & Oshige, 2011) defined co-regulation as "a transitional process in a learner's acquisition of SRL, within which learners and others share a common problem-solving plane"(p.247). Following above definitions of co-regulation, Hadwin et al.(2011) defined CoRL as "temporary coordination of self-regulation amongst self and others" (Hadwin et al., 2011, p.68). Additionally, Hadwin et al. (2011) explained that the goals of CoRL are (1) a transition toward self-regulation and (2) coordination of self-regulatory processes among group members.

Additionally, there is a relationship between CoRL and collaborative learning. Collaborative learning refers to "a situation in which two or more people learn or attempt to learn something together" (Dillenbourg, 1999, p.1). It is theoretically

explained that CoRL may occur in collaborative learning. Volet & Gutierrez (2009) mentioned that the definition of collaboration includes the characteristics of CoRL, which are 'coordination' and 'interaction'. Collaboration is defined as a "coordinated, synchronous activity that is the result of a continued attempt to construct and maintain a shared conception of a problem" (Roschelle and Teasley, 1995, p. 70). Coordinated activity includes the process of coordinating self-regulatory processes considering that co-regulation is coordination of SRL processes through interaction. Cognitive load also explains that regulatory process may occur in the collaborative learning. Dillenbourg (1999) explained four specific mechanisms in collaborative learning: Induction, cognitive load, self-explanation, and conflict. Among them, "reduced cognitive load may explain why regulating partner's process is easier than self-regulation and therefore why group members improve their regulatory skills (Blaye, 1988)" (Dillenbourg, 1999, p.10)

Previous Research on Co-Regulated Learning

Research on CoRL has mainly focused on how co-regulatory process occurs. Most researchers have examined co-regulatory process qualitatively. Findings have shown that interaction with other students mediates self-regulatory processes (Iiskala et al., 2004; Vauras et al., 2003; Hurme and Järvelä, 2005; Kempler and Linnenbrink-Garcia, 2007; Whitebread et al., 2007). From the previous research, three implications were drawn. First, the subjects are from preschool children (Whitebread et al., 2007) to graduate students (Järvelä and Järvenoja, 2011) in research on CoRL. Although CoRL is derived from Vygotsky's (1978) concept of internalization which explains children's language development, co-regulatory process occurs in diverse ages. Second, co-regulatory process occurs in the collaborative learning environments. Previous research has shown that co-regulatory process occurs when students performed collaborative tasks. Finally, CoRL activities in which students use the components of SRL together to perform the tasks were found. CoRL activities are divided into the category of cognitive

regulation, behavioral regulation, and motivational regulation. Metacognitive strategies were identified in the category of cognitive regulation: planning, monitoring. In motivational regulation strategies, goal setting and task value/interest were identified. Action control strategy was identified in the category of behavioral regulation.

Relationship between Co-Regulated Learning and Self-Regulated Learning

The relationship between CoRL and SRL is explained both theoretically and empirically. CoRL is derived from Vygotsky's view, and Wertsch and Stone's view (Vygotsky, 1978; Wertsch and Stone, 1985). According to these views, students bring different kinds of self-regulatory processes and coordinate them by interacting with other students while working together. In this process, students recognize the occurrence of expert self-regulatory process and internalize it. Therefore, students can improve SRL skills through CoRL (Hadwin et al., 2011; McCaslin and Hickey, 2001, Vygotsky, 1978). McCaslin and Hickey (2001) theoretically explained that co-regulation promotes self-regulatory process. They delineated self-regulatory process which is able to be enhanced by co-regulation in three sections: motivation, enactment, evaluation.

As an empirical research on CoRL, DiDonato (2012) examined whether students' SRL scores changed over the course and, CoRL scores moderated SRL scores. The results of the study showed that students' SRL scores increased over the course of projects and CRL scores moderated SRL scores. Additionally, the research found that students used planning, monitoring, and evaluation strategies in the categories of SRL components.

Co-Regulated Learning in Collaborative Learning

Collaborative learning refers to “a situation in which two or more people learn or attempt to learn something together”(Dillenbourg, 1999, p.1). There is a relationship between CoRL and collaborative learning. It is theoretically explained that CoRL may occur in collaborative learning. Volet & Gutierrez(2009) mentioned that the definition of collaboration includes the characteristics of CoRL, which are ‘coordination’ and ‘interaction’. Collaboration is defined as a “coordinated, synchronous activity that is the result of a continued attempt to construct and maintain a shared conception of a problem”(Roschelle and Teasley, 1995, p. 70). Coordinated activity includes the process of coordinating self-regulatory processes considering that co-regulation is coordination of SRL processes through interaction. Cognitive load also explains that regulatory process may occur in the collaborative learning. Dillenbourg(1999) explained specific four mechanisms in collaborative learning: Induction, cognitive load, self-explanation, conflict. Among them, “reduced cognitive load may explain why regulating partner’s process is easier than self-regulation and therefore why group members improve their regulatory skills”(Dillenbourg, 1999, p.10).

Research Methods

Participants

The participants of the present study were 49 undergraduate students at mid-sized university in Korea, enrolled in ‘Educational Evaluation’ course for 2012 semester. One class for ‘Educational Evaluation’ course was selected for the present study. Participants were randomly assigned into a small group which consists of three or four, based on random number. 16 groups were formed and

performed the collaborative tasks.

Design

Pre-experimental design was used to investigate the effect of CoRL activities on the improvement of SRL skills in collaborative learning environments. In the present study, dependent variable was 'SRL skills' and independent variable was 'CoRL activities'. Among pre-experimental designs, 'one group pretest-posttest design' was used based on available population.

Instrument

SRL Questionnaire which was made by Yang (2000) was used to measure the use of SRL skills in the present study with some revised terms. The SRL Questionnaire has 84 items which are categorized into three sections; cognitive regulation, motivation regulation, and behavioral regulation. The instrument is scored on five point Likert scales (1, not at all to 5, great extent). According to Yang (2000), Cronbach's alpha of the instrument was .95.

Procedure

Research was conducted over the 6 weeks from September 11, 2012 to October 16, 2012. In the first week, students were given the SRL Questionnaire as a pretest. Additionally, the instructor explained to the students about collaborative task and group worksheets that students should write over the 5 weeks. The task was to complete Bloom's 'table of specification' after selecting subject and analyzing educational objects related to the subject. Students were required to complete group worksheets and submit them in Blackboard Learning Management System (LMS) every week 49 students were randomly assigned into a small group which

consists of three or four students by using random numbers. In the second week, students started to perform the collaborative task in group using the group worksheets. In the last week, they were tested the SRL questionnaire as a posttest.

Materials

To let students do CoRL activities, group worksheets facilitating co-regulate learning activities were developed. To develop the group worksheets, design guidelines and realization were developed according to the components of SRL, which were observed in co-regulatory process from previous research. The design guidelines and realization were developed based on activities which were observed in co-regulatory process from previous research (Iiskala et al., 2004; Vauras et al., 2003; Hurme and Järvelä, 2005; Kempler and Linnenbrink-Garcia, 2007; Whitebread et al., 2007).

To identify content validity of the components of SRL, design guidelines, and realization, expert review was conducted. Two experts were asked to evaluate them for aspect of content validity. Each expert was provided with expert review evaluation questions which were developed based on adequacy as an evaluation criteria. Evaluation questions consist of a total of 19 items; 18 items which are scored on four point Likert scale (1, very much so to 4, not at all), and 1 item consists of open-ended question. There are 6 sections which are the components of SRL in the evaluation questions. Each section has 3 items which measure the adequacy of components of SRL, CoRL activities, guidelines, and realization. There is one item which is an open-ended question to measure expert's opinion. The Content Validity for the components of SRL, design guidelines, and realization was computed according to the Lawshe (1975)'s method. Content validity for the components of SRL, design guidelines, and realization was established as 1.0. Table 1 shows design guidelines and realization of CoRL activities.

Table 1. Design Guidelines and Realization of CoRL activities

The components of SRL	Design guidelines of CoRL	Realization
Goal setting	<ul style="list-style-type: none"> - Guide students to set goals together specifically. 	<ul style="list-style-type: none"> - Provide a method to set goals based on five standards. - Provide a space for students to set and write group's goal together. - Provide an example of performance goal that students should achieve together. - Provide a space for checking whether students achieved the goals together.
Achievement value	<ul style="list-style-type: none"> - Let students think together about value of task in the aspect of importance and application. 	<ul style="list-style-type: none"> - Provide a space for writing value of task in the aspect of importance and application together.
Planning	<ul style="list-style-type: none"> - Let students assign roles of group members together. - Let students skim content of task and discuss it together. - Let students think together about how to perform task. - Let students determine together orders to complete tasks. 	<ul style="list-style-type: none"> - Provide a space for students to skim content of task and write what they understand briefly together. - Provide a space for students to think about how to perform task and write it together. - Provide a space for students to decide and write orders to complete tasks together. - Provide a space for students to assign and write roles of group members. - Provide a space for students to set weekly plan together. - Provide a space for students to check and write whether they carried out the plan together.
Action control	<ul style="list-style-type: none"> - Let students write factors which distract performing task and control together. - Let students set rules for performing task. 	<ul style="list-style-type: none"> - Provide a space for students to discuss and write factors which distract performing task together. - Provide a space for students to set rules for performing task together.

Monitoring	<ul style="list-style-type: none"> - Let students monitor wrong information together and provide feedback each other. - Let students identify whether or not there are things that should be modified together. - Let students compare their progress with other groups' progress. 	<ul style="list-style-type: none"> - Provide a space for students to check and write whether or not they gave feedback each other through checklist together. - Provide a space for students to identify and write whether or not there are things that should be modified together through checklist. - Provide a space for students to identify and write their progress by comparing with other groups' progress through checklist together.
Self-Evaluation	<ul style="list-style-type: none"> - Let students evaluate the process of performing task together. - Let students evaluate output together. 	<ul style="list-style-type: none"> - Provide a space for students to evaluate and write the process of performing task. - Provide a space for students to evaluate and write their output.

Data Analysis

Once data were collected by SRL questionnaire, data of 38 students who tested both pretest and posttest were analyzed by using SPSS program (version 12.0). Data of 11 students among total 49 students were excluded in analysis because they did not take both pretest and posttest. Paired *t*-test was used to compare the means of pretest score and posttest score. Alpha level of .05 was used.

Results

Table 2 presents the results of the paired *t*-test for means of the pretest and posttest for students. The mean difference for the paired *t*-test was .05 with an SD of 0.18. However, the difference between means of the pretest and posttest was not statistically significant at an alpha level of .05 ($t = 1.62$, $df = 37$; $p = .11$)

Table 2. Paired t-test for Means of the Pretest and Posttest for Students

	<i>N</i>	<i>M</i>	<i>SD</i>	<i>df</i>	<i>t</i>	<i>P</i>
pretest	38	3.52	.33	37	1.62	.11
posttest	38	3.57	.31	37		

Additional analysis was conducted to identify whether there were differences between students who got low scores and those who got high scores at the pretest. According to median, 38 students were divided into 19 students with low SRL test scores and 19 students with high SRL test scores at pretest. Each data was analyzed using paired *t*-test.

Table 3 shows the results of paired *t*-test for 19 students who got low SRL test scores at pretest. The mean difference for the paired *t*-test was 0.12 with an SD of 0.04. The difference between the means of the pretest and posttest was statistically significant at an alpha level of .05 ($t = 3.27$; $df = 18$; $p = .00$).

Table 3. Paired t-test for Means of the Pretest and Posttest for Students with Low SRL Level

	<i>N</i>	<i>M</i>	<i>SD</i>	<i>df</i>	<i>t</i>	<i>p</i>
Pretest	19	3.27	.19	18	3.27	.00
Posttest	19	3.39	.23	18		

Table 4 shows additional results of paired *t*-test for 19 students who got high SRL test scores at pretest. The mean difference for the paired *t*-test was -0.05 with an SD of 0.04. The difference between the means of the pre-test and posttest was not statistically significant at an alpha level of .05 ($t = -.58$; $df = 18$; $p = .57$).

Table 4. Paired t-test for Means of the Pretest and Posttest for Students with High SRL Level

	<i>N</i>	<i>M</i>	<i>SD</i>	<i>df</i>	<i>t</i>	<i>p</i>
Pretest	19	3.77	.24	18	-.58	.57
Posttest	19	3.75	.28	18		

Discussion and Conclusion

The findings showed no significant difference between the means of the pretest score and the posttest score. It indicates that CoRL activities did not significantly affect the improvement of SRL skills in collaborative learning environments. The findings are not consistent with the results of previous research. However, it was identified that students' SRL scores at pretest were low in previous research (DiDonato, 2012). Therefore, it was inferred that CoRL activities may significantly affect students with low SRL level. To identify whether there were also the difference of mean score between the pretest and posttest according to students' SRL level, additional analysis was conducted. The results of the analysis showed that SRL scores of students with low SRL level significantly increased from pretest to posttest. On the other hand, SRL scores of students with high SRL level did not increase. It indicates that CoRL activities have a significant effect on the improvement of SRL skills of students with low SRL level.

Additionally, CoRL checklist was used to identify whether co-regulatory process occurred through CoRL activities. The results showed that students participated in co-regulatory process through CoRL activities. Because there is no existing CoRL Questionnaire available, CoRL checklist was made in the present study. Content validity for CoRL checklist was established as 1.0 by the expert review. Cronbach's alpha for this scale was .83. The means of the pretest score and posttest score for CoRL checklist were compared. The results showed that the difference between the means of the pretest scores and posttest scores was statistically significant at an alpha level of .05 ($t = 3.29$, $df = 37$; $p = .00$). Therefore, students participated in co-regulatory process through CoRL activities.

In summary, CoRL activities did not significantly affect the students' improvement of SRL skills. It is because CoRL activities significantly affected students with low SRL level alone. Through additional analysis, it was identified that there was a significant difference between the means of the pretest and posttest scores of students with low SRL level. It is interpreted that students with low SRL

level improved their SRL skills through co-regulatory process. These results are consistent with Vygotsky's view and Wertch and Stone's notion of internalization. Additionally, it empirically supports McCaslin and Hickey's theoretical explanation about relationship between SRL and CoRL(McCaslin and Hickey, 2001).

There are some implications about CoRL in the present study. Research examining the relationship between CoRL and SRL quantitatively is relatively little compared to qualitative research. The present study extended quantitative research on CoRL by examining the effect of CoRL activities on SRL skills in cognitive regulation, motivational regulation, and behavioral regulation overall and by suggesting CoRL activities as a new instructional intervention. The findings in the present study can also guide quantitative research on CoRL. CoRL activities did not significantly affect all students' improvement of SRL. However, it was identified that CoRL activities are effective for students with low SRL level to improve their SRL skills in cognitive regulation, motivational regulation, and behavioral regulation overall.

The present study has a couple of limitations. First, since there has been no model for CoRL, CoRL activities were designed and developed based on activities which were found in co-regulatory process in previous research. And second, one-group pretest and posttest design which was used in the present study has its shortcomings. There may be some threats to internal validity such as history and maturation etc. in the present study.

Based on the findings in the present study, some further research is suggested. First, the effect of CoRL activities on students with low SRL level in collaborative learning environments could be investigated. Considering the shortcomings of pre-experimental design, which was used in the present study, further research could investigate the relationship between CoRL and SRL according to SRL level. Second, diverse factors which could affect relationship between CoRL and SRL in collaborative learning environments could be considered in further research. Finally, it is needed to investigate the effect of CoRL on the improvement of SRL by designing CoRL activities which reflect other components of SRL.

References

- Azevedo, R., Cromley, J. G., & Seibert, D. (2004). Does adaptive scaffolding facilitate students' ability to regulate their learning with hypermedia. *Contemporary Educational Psychology, 29*, 344-370.
- Boekaerts, M., Pintrich, P. R., & Zeidner, M. (2000). Self-regulation: An introductory overview. In M. Boekaerts, P. Paul, & M. Zeidner(Eds.), *Handbook of self-regulation*(pp. 1-9). San Diego, CA: Academic Press.
- DiDonato, N. C. (2012). Effective self- and co-regulation in collaborative learning groups: An analysis of how students regulate problem solving of authentic interdisciplinary tasks. *Instructional science*. Available at <http://www.springerlink.com/content/2h521n882j50vt2g/fulltext.pdf>.
- Dillenbourg P. (1999). What do you mean by collaborative learning? In P. Dillenbourg(Ed.) *Collaborative-learning: Cognitive and Computational Approaches* (pp.1-19). Oxford: Elsevier.
- Grau, V., & Whitebread, D. (2012). Self and social regulation of learning during collaborative activities in the classroom: The interplay of individual and group cognition. *Learning and Instruction, 22*(6), 401-412.
- Hadwin, A. F., Järvelä, S., & Miller, M. (2011). Self-regulated, co-regulated, and socially shared regulation of learning. In D. H. Schunk, and B. J. Zimmerman(Eds.), *Handbook of self-regulation of learning and performance*(pp.65-84). New York: Routledge.
- Hadwin, A. F., & Oshige, M. (2011). Self-regulation, co-regulation, and socially shared regulation: Exploring perspectives of social in self-regulated learning theory. *Teachers College Record, 113*(2), 240-264.
- Hadwin, A., Wozney, L., & Pontin, O. (2005). Scaffolding the appropriation of self-regulatory activity: A social constructivist analysis of changes in student-teacher discourse about a graduate student portfolio. *Special Issue of Instructional Science, 33*, 413-450.

- Hiltz, S. R. (1994). *The virtual classroom: learning without limits via computer networks*. Norwood, NJ: Ablex Publishing Corporation.
- Hurme, T.-R., & Järvelä, S. (2005). Students' activity in computer supported collaborative problem solving in mathematics. *International Journal of Computers for Mathematical Learning*, 10, 49-73.
- Iiskala, T., Vauras, M., & Lehtinen, E. (2004). Socially-shared metacognition in peer learning? *Hellenic Journal of Psychology*, 2, 147-178.
- Järvelä, S., & Järvenoja, H. (2011). Socially constructed self-regulated learning and motivation regulation in collaborative learning groups. *Teachers College Record*, 113(2), 350-374.
- Järvenoja, H., & Järvelä, S. (2009). Emotion control in collaborative learning situation - Do students regulate emotions evoked from social challenges? *British Journal of Educational Psychology*, 79(3), 463-481.
- Johnson, D. W., & Johnson, R. T. (1999). *Learning together and alone: cooperative, competitive, and individualistic learning*(5th ed.). Boston, MA: Allyn & Bacon.
- Johnson, D. W., & Johnson, R. T. (1989). *Cooperation and learning: theory and research*. Edina, MN: Interaction Book Company.
- Kempler, T., & Linnenbrink-Garcia, L. (2007, July). Exploring self-regulation in group contexts. *Paper presented at the Computer Supported Collaborative Learning Conference*, New Brunswick, New Jersey.
- McCaslin, M. (1996). The informal curriculum. In D. Berliner & R. Calfee (Eds.), *Handbook of Educational Psychology* (pp.622-673). New York: Macmillan.
- McCaslin, M. (2004). Coregulation of opportunity, activity, and identity in student motivation. In D. McInerney, & S. Van Etten (Eds). *Big theories revisited* (Vol 4, pp.249-274). Greenwich, CT: Information Age.
- McCaslin, M. (2009). Co-regulation of student motivation and emergent identity. *Educational Psychologist*, 44(2), 137-146.
- Mccaslin, M., & Hickey, D. T. (2001). Self-regulated learning and academic achievement: A Vygotskian view. In B. Zimmerman and D. Schunk (Eds.),

- Self-regulated learning and academic achievement: Theory, research, and practice, second edition* (pp.227-252). Mahwah, NJ: Erlbaum.
- Pintrich, P. R. (2000). The Role of goal orientation in Self-Regulated Learning. In M. Boekaerts, P. Pintrich, & M. Zeidner (Eds.), *Handbook of Self-regulation*(pp. 451-502). San Diego, CA: Academic Press.
- Roschelle, J., & Teasley, S. D. (1995). The construction of shared knowledge in collaborative problem solving. In C.E. O'Malley (Ed), *Computer-Supported Collaborative Learning*(pp.69-197). Berlin: Springer-Verlag.
- Salomon, G., & Perkins, D. N. (1998). Individual and social aspects of learning. *Review of Research in Education*, 23, 1-24.
- Schunk, D. H., & Hanson, A. R. (1985). Peer models: Influence on children's self-efficacy and achievement. *Journal of Educational Psychology*, 77, 313-322.
- Schunk D. H., & Zimmerman B. J. (1997). Social origins of self-regulatory competence. *Educational psychologist*, 32(4), 195-208.
- Schunk D. H., Zimmerman, B. J. (2008). *Motivation and self-regulated learning: Theory, research, and applications*. New York: Taylor & Francis.
- Sporer, N., & Brunstein, J. (2009). Fostering the reading comprehension of secondary school students through peer-assisted learning: Effects on strategy knowledge, strategy use, and task performance. *Contemporary Educational Psychology*, 34, 289-297.
- Vauras, M., Iiskala, T., Kajamies, A., Kinnunen, R., & Lehtinen, E. (2003). Shared-regulation and motivation of collaborating peers: A case analysis. *Psychologia*, 46, 19-37.
- Volet, S., Summers, M., & Thurman, J. (2009). High-level co-regulation in collaborative learning: How does it emerge and how is it sustained? *Learning and Instruction*, 19, 128-143.
- Vygotsky, L. S. (1978). *Mind in society*. Cambridge, MA: Harvard University Press.
- Wersch, J., & Stone, C. (1985). The concept of internalization in Vygotsky's account of the genesis of higher mental functions. In J. Wertsch (Ed.), *Culture*,

- communication, and cognition: Vygotskian perspectives* (pp.162-182). New York: Cambridge University Press.
- Whitebread, D., Bingham, S., Grau, V., Pasternak, D., & Sangster, C. (2007). Development of metacognition and self-regulated learning in young children: Role of collaborative and peer-assisted learning. *Journal of Cognitive Education and Psychology, 6*, 433-455.
- Wolters, C. A., & Pintrich, P. R. (1998). Contextual differences in student motivation and self-regulated learning in mathematics, English, and social studies classrooms. *Instructional Science, 26*, 27-47.
- Yang, M. H. (2000). The study on Development and Validation of a Self-regulated Learning Model. Unpublished doctoral dissertation, Seoul National University, Seoul., Korea.
- Zimmerman, B. J. (1989). A Social cognitive view of self-regulated academic learning. *Journal of Educational Psychology, 81*(3), 329-339.
- Zimmerman, B. J. (2002). Becoming a self-regulated learner: an overview, *Theory into practice, 41*(2), 64-70.
- Zimmerman, B. J., & Bandura, A. (1994). Impact of self-regulatory influences on writing course attainment. *American Educational Research Journal, 31*, 845-862.
- Zimmerman, B. J., & Martinez-Pons, M. (1986). Development of a structured interview for assessing student use of self-regulated learning strategies. *American Educational Research Journal, 23*, 614-628.



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