

Learning Environments to Facilitate Students' Regulation in Knowledge Building

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Abstract: We designed a project-based learning environment with Knowledge Forum to facilitate students' regulation of collaboration and examined how they developed regulation scripts through their experience. Jigsaw activity structure was implemented in the PBL design as a macro script. In addition, micro-scripts were provided for students to reflect on their group work and individual contribution in KF notes. A clustering analysis of students' regulation scripts revealed that they developed scripts through a variety of trajectories. Further case studies suggested: (1) that students develop their scripts when they recognized meaningful challenges, (2) that they construct scripts of socially shared regulation when they recognize epistemic challenge whereas they do co-regulation scripts when they recognize socio-emotional challenge.

Keywords: scripts, regulation of collaborative learning, epistemic challenge, socio-emotional challenge

Introduction

Scardamalia and Bereiter (2003) explain the nature of knowledge building as one of the prominent models of the knowledge-creation metaphor by referring to two modes of learning: the belief mode and the design mode. In the belief mode, learners are concerned with what they or others believe or ought to believe, namely, with the mental states of individuals. On the contrary, in the design mode, learners are concerned with the usefulness, adequacy, improvability, and developmental potential of ideas. Learners in the design mode should be aware of whether their ideas are good enough to solve the problems to be addressed, and how they should contribute to improving those ideas. Knowledge building is a social process that engages both modes of learning. The belief mode is used by learners to investigate the current state of their community knowledge level in order to highlight any problems. Learning in the design mode thus enables the creation of knowledge to solve problems. Exchange between the learning modes is iterative, such that learners continuously participate in social practices of knowledge creation, and individuals generate knowledge that not only directly contributes to the advancement of community knowledge but also determines how best to contribute to this advancement.

Although the knowledge-creation practices have been emphasized in many CSCL studies (Stahl, Koschmann, & Suthers, 2014), few studies have been focused on and examined students' regulation of their own collaboration (e.g., Järvelä & Hadwin, 2013). When contributing to a collaborative task, learners have to regulate themselves, others, and the group as a whole. In self-regulated learning, learners regulate their own learning to contribute to group performance, based on their individual perception of tasks and their strategic knowledge. In co-regulated learning—another layer of metacognition—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 SSRL, learners are collaboratively involved in the planning, monitoring, evaluation, and regulation of social, cognitive, and behavioral aspects of their learning.

A promising approach to support and develop students' regulation of their collaboration is scripting (Fischer, Kollar, Stegmann, & Wecker, 2013). In their script theory of guidance, Fischer et al. discussed dynamic relations between learners' internal collaboration scripts and external scripts as instructional support. The internal collaboration scripts are students' internal representations of how to conduct collaboration. The scripts are described from the abstract level ("play") down to very concrete action level ("scriptlets"). Learners are expected to develop their internal collaboration scripts through their experiences in collaboration and other instructional interventions. The external scripts are used to scaffold learners' engagement in their collaboration and lead them to more productive collaborative outcomes. For the external scripts to be effective to improve students' internal scripts, we have to avoid the situation of over-scripting (Dillenbourg, 2002). An external collaboration script is most effective for students to develop their own internal scripts when it is directed at the highest possible hierarchical level of internal script and subordinate components are already available to the learner. Miller and Hadwin (2015) propose a conceptual design of CSCL environment for helping students to learn to regulate their own group work providing external scripts and awareness tools. Few studies, however, have discussed how

students develop their internal regulation scripts through their collaborative learning experiences under such an environment.

In this study, therefore, we attempted to design Knowledge Forum for supporting students to develop their regulation scripts and examine how their scripts are developed through their experiences of collaboration. It was used as a digital portfolio where students collaboratively reflect on their face-to-face project-based learning with an ill-structured task from the perspective of regulation. As a macro script (i.e. external scripts which loosely orchestrates the engagement in PBL), jigsaw activity structure was implemented. Students were first divided into four different expert groups where they studied the same problem from four different perspectives. Then they further continued their collaboration in jigsaw groups where students who studied four different resources collaboratively worked on their ideas to solve the problem. Micro-scripts were implemented as question prompts to support students' reflection on their group progress and individual contribution. We assessed students' regulation scripts before and after their jigsaw group work and examined how their scripts were changed through their collaboration experiences through case studies.

Methods

Design description

Forty-eight university freshmen (24 female) took the course for learning how to manage their collaborative learning through participating in project-based learning. They were randomly divided into groups of four or five then given a task to propose new solutions to reduce wastes at convenience stores for conservation.

Students' group work was designed based on the jigsaw activity structure as a macro script. They were provided with four sets of documents related to their solution task. Then students for the same sets of documents gathered and discussed in expert groups (from week 1 to 4). After learning documents, they further continued their projects in jigsaw groups (from week 5 to 11) by integrating knowledge resources from the four sets of documents and searching for new information to create their solutions. In this jigsaw group work, we implemented micro-scripts for them to reflect on their collaboration at SRL, CoRL, and SSRL level in Knowledge Forum.

Before students started their group work in the jigsaw group work, a pre-questionnaire was conducted for evaluating students' internal scripts of regulating collaboration. Based on their experiences in the expert group, students were asked to describe their own evaluation of group work and individual contribution to it. During the jigsaw group work, students came to the classroom every week to discuss their work in progress and spend time for searching new resources and collaboratively integrating their ideas from different resources. At the end of class every week, students reported work in progress as a group note on Knowledge Forum and their individual evaluations on their group progress as "build-on" notes (Figure 1). When writing their group notes, scripts for planning, monitoring, evaluating and revising were provided as scaffolds in Knowledge Forum notes ("What was today's plan to do as a group?" "How much did you as a group achieve?" "Did you decide each individual's task(s) for the next week?" "Plan to do in the next class"). In their individual "build-on" notes, scripts for monitoring, evaluating and revising were provided for facilitating each student's involvement in her group work (e.g., "Was the goal shared among members?" "Were members aware of their own roles?" "Did you have rules facilitating group work? Did you follow them?"). Another post-questionnaire was again conducted as their reflection-on-action after the jigsaw group work.

Analysis plan

First, based on students' writing of collaboration in their group work in the pre- and post-questionnaire, we assessed each student's regulation script with respect to which aspects (planning, monitoring, and revising) and levels (SRL, CoRL, and SSRL) were represented. When a student referred to an aspect (planning, monitoring, or revising) at each level of regulation (SRL, CoRL, or SSRL) in her writing, we assigned 1 for that category, and we aggregated three numbers at each regulation level. So when students wrote all aspects at all levels, they were given 3-3-3. With this procedure, we coded students' pre-questionnaire as pre-script, and pre- and post-questionnaire collectively as post-script. Two authors (the first and the second) independently coded students' writing and reached 80% agreement. The disagreement was resolved through their discussion. After this assessment, we conducted a clustering analysis for categorizing students' scripts into different types.

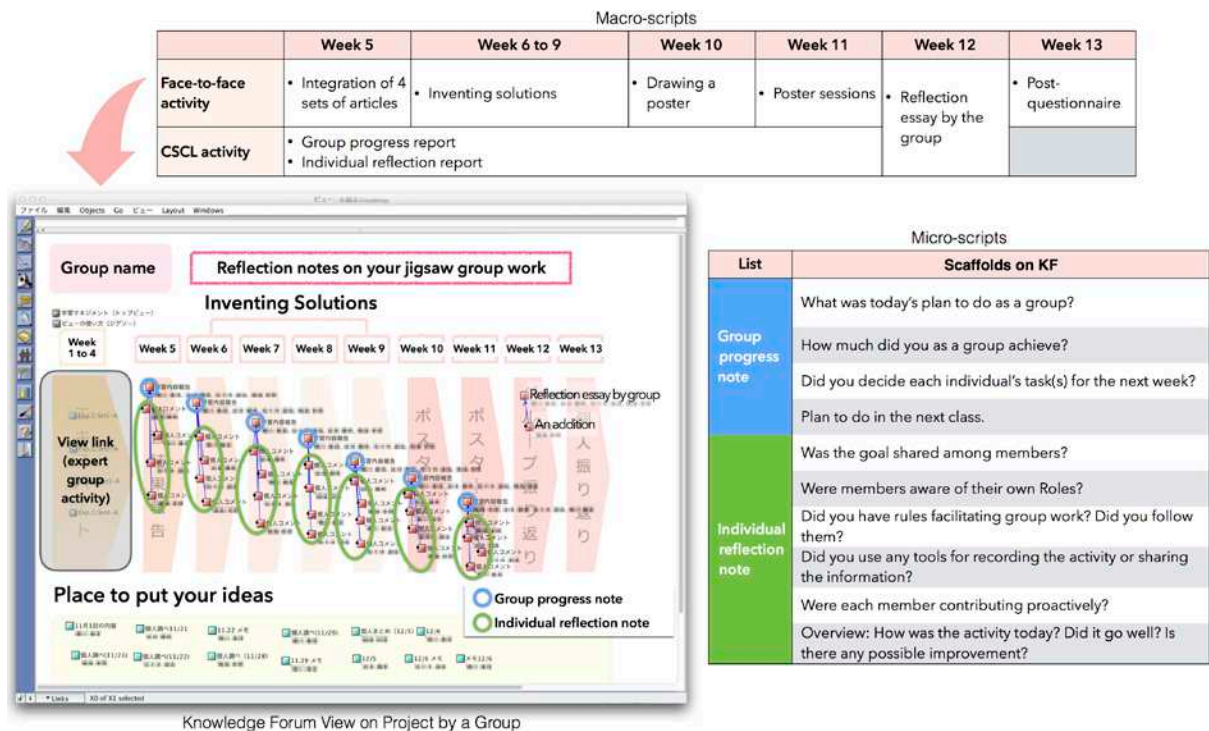


Figure 1. Jigsaw activity structure represented in Knowledge Forum as macro script and scaffolds in KF notes as micro-scripts.

Second, to further examine how students constructed their regulation scripts through their experiences of jigsaw group work, we conducted case studies of students: (1) who did not change their scripts from the pre- to the post-questionnaire, (2) who successfully constructed their scripts across SRL, CoRL and SSRL, and (3) who constructed their scripts in different orientations based on the same socio-emotional challenge. In our case study, we constructed narratives of what challenges the students attempted to solve based on their group progress reports, individual reflection, and the mentors' field notes.

Results and discussion

Students' regulation scripts after their jigsaw group work

Forty-three students appropriately answered both the pre- and post-questionnaire. Thirty-nine students were found to construct new category of scripts in their post-questionnaire and the proportion was significant by Binominal test ($p < .01$). We further conducted a clustering analysis with Ward method for the forty-three students' post-scripts and divided them into the following five categories: (1) SSRL-oriented ($N = 5$), (2) SSRL-, CoRL- and SRL-oriented ($N = 11$), (3) insufficient ($N = 8$), (4) SRL-oriented ($N = 7$), and (5) CoRL- and SRL-oriented ($N = 12$). When they described more than two aspects of planning, monitoring, and revising at the level of regulation, students were identified as being oriented at a level of regulation (SRL, CoRL or SSRL).

Case studies: How students constructed their scripts through their experiences

As we expected, development trajectories of students' regulation scripts were various even within the same groups because of differences in students' pre-scripts and recognition of collaboration experiences. For examining how their pre-scripts and their experiences influenced students' construction of regulation scripts, we analyzed their group progress notes and individual reflection notes in Knowledge Forum during their jigsaw group work.

Why students' scripts were not changed

Among four students who did not manifest any change in their regulation scripts, two students (A1 and A3) worked in the same group. Their group progress reports revealed that they had an epistemic challenge that their group had not agreed on any solution ideas among members and failed to collect evidence to back up their solution. Whereas two other members (A2 and A4) described the problem and considered how to solve the epistemic

challenge by revising their regulation in their reflection notes, A1 and A3 did not show any notion of the problem in their notes.

How students could reconfigure their regulation scripts through engaging in their group challenges

In a group, three of four students successfully reconfigured their regulation scripts at SRL, CoRL and SSRL levels. In this group, they recognized an epistemic challenge in sharing their ideas among members because they decided to work separately as subgroups of two students each. In their individual reflection notes, they were so much concerned with this epistemic challenge by describing their group work from the perspective of goal and planning, monitoring, and revising.

How students' regulation scripts were reconfigured in different orientations

In groups of students who reconfigured their regulation scripts in different orientations, we found that students recognized different challenges (epistemic or socio-emotional) and did not share their recognition in the articulate ways. They did not discuss in their group work and report their challenges (or problems) in their group progress notes. Each individual recognized different challenges in their individual reflection notes. When they recognized epistemic challenges, they attempted to apply regulatory strategies at SSRL level. On the other hand, they did more individual (SRL or CoRL) regulatory strategies when they recognized the socio-emotional challenge.

Discussion

This study was aimed at investigating how students' regulation in collaboration could be facilitated by designing a learning environment with CSCL as a digital portfolio. Based on studies of regulation in collaboration (Järvelä & Hadwin, 2013) and script theory of guidance (Fischer et al., 2013), we designed activity structure as a macro-script and scaffolds in students' group progress report and individual reflection notes as micro-scripts. Results revealed that significantly more students reconfigured their regulation scripts through their collaboration experiences in this learning environment. Although the external scripts we designed were effective for students, further studies are needed for examining the effectiveness more rigorously. First, our assessment of students' regulation scripts was focused on aspects (planning, monitoring and revising) at three levels (SRL, CoRL, and SSRL) but not an elaboration of each script (i.e., play, scene, roles and scriptlets). We must further conduct studies of how hierarchical structure of regulation scripts is reconfigured through students' experiences in their collaboration. Second, from our case studies of students' group progress reports and individual reflection notes in Knowledge Forum every week, we found a hypothetical relationship between the reconfiguration of regulation scripts and types of challenges students faced in their collaboration. Results of our case studies suggest that students would reconfigure their regulation scripts at SSRL level when they recognized epistemic challenges and shared them among members. Although it is difficult to control kinds of challenges as a design element, we need to further consider how students' reports during collaboration can modify our design in progress.

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