Collaboration Script Appropriation in a Science Class

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Abstract: This paper presents how a collaboration script informed by the Funnel Model was appropriated by a class of students in a secondary science class lesson. Based on the script, a class of 33 tenth grade students enacted four stages of a technology-supported collaborative learning activity: individual construction, intra-group construction, inter-group rating, and intra-group refining. Quantitative and qualitative analyses of students' behaviors and perceptions were conducted to identify and explain how students appropriated the collaboration script.

Introduction

Collaboration script is an important topic in the field of computer-supported collaborative learning (CSCL) (Fischer, Kollar, Stegmann, & Wecker, 2013; Yun & Kim, 2015). While collaborative learning when aptly designed and enacted has been shown to be helpful for students' higher-order thinking (Lazarou, Sutherland, & Erduran, 2016), students may not be substantively engaged in the process of sharing, communication or negotiation. The embedded collaboration script can help to provide a structured collaborative learning scenario, such as associating group learners with specific tasks, roles, and resources, or designing an interactive structure for group learning (Tsovaltzi, Puhl, Judele, & Weinberger, 2014). Many researches focus on scripting individual and collective regulatory processes (Borge, Ong, & Rosé, 2018; Wang, Kollar, & Stegmann, 2017), learners' appropriation (perception, understanding and embodiment) of the script was also an important factor influencing their collaboration learning (Tchounikine, 2016). In this context, we worked with a school teacher to implement a collaborative learning lesson, and studied how each group appropriated the collaboration script.

We propose a script based on Funnel Model that is a pedagogical model guiding for collective knowledge improvement (Chen, Wen, & Looi, 2012; Wen, Looi, & Chen, 2011). This model abstracts the process of group interactions into three stages: "brainstorm", "rise above", and "advance." We developed an online system called AppleTree to tightly embody Funnel Model (Chen, Looi, Wen, & Xie, 2013) in the system design. In this study, we focus on investigating: 1. Whether and how was the use of AppleTree system with the collaboration script helpful for improving students' conceptual knowledge learning? 2. How did the students appropriate the collaboration script and what factors affected their appropriation of the script?

Research design

We employed design-based research to design and implement collaborative learning activities using AppleTree for secondary grade ten class with 33 students in Singapore. These students studied physics phenomena over three weeks (one lesson per week and each lesson was a cycle of the design-based research) using the AppleTree system. All the 33 students were heterogeneously grouped by the teacher according to their previous test scores on Science. There were nine groups of 3-4. The data analyzed in this paper were from lesson 3 on the topic of electromagnetic induction phenomenon. In this lesson, students in each group first conducted their own hands-on experiment to observe the induced current flowed in a solenoid over time when a magnet fell through it. Each student in groups needed to sketch a current-time graph based on what she observed in the experiment. To deepen the students' understanding on electromagnetic induction phenomenon, the teacher provided students opportunities to inquire and explain the phenomena that they observed on the AppleTree system. The purpose of collaborative learning is to integrate the conceptual knowledge of group and class members to facilitate complete and reasonable explanations. Below are the details of students' activities.

Stage 1: Every student was asked to provide explanations to elaborate the current-time graph on their group space in AppleTree system.

Stage 2: After each member of a group provided at least one explanation, they negotiated, challenged and revised their explanations (Figure 1).

Stage 3: Students went to the workspace of other groups to review their group artefacts and provide comments. Students were asked not only to rate others' explanations, but also to provide comments for others to improve. In this lesson, the teacher asked group 2 to visit group 1; group 3 to visit group 2, and so on.

Stage 4: All the students returned to their own group to further revise and refine their own group's artefact based on the feedbacks provided by others.

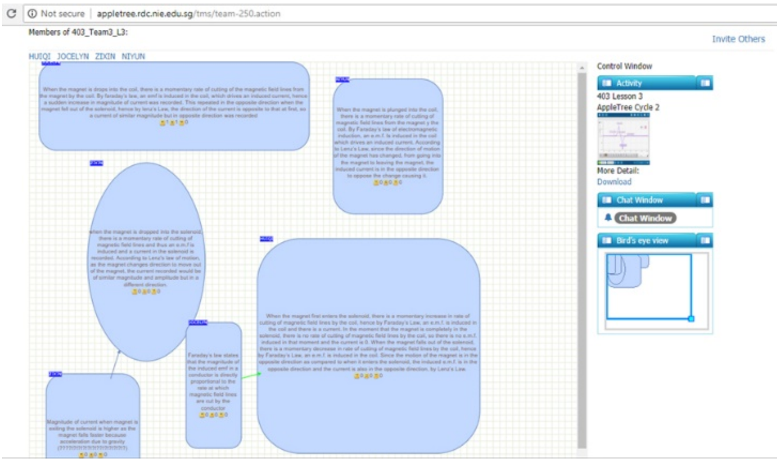

Figure 1. The interface of stage 2.

Coding scheme for analyzing students' revision behavior

The first author analyzed all of students' revisions several times and created open codes. Then, these open codes were clustered as primary themes. Third, the obtained themes were validated again by checking the data against the themes and were merged and modified. The final coding scheme is shown in Table 1.

Table 1: The coding scheme for students' revision of explanations

Add (+)		Modification	Delete (-)
Post	Link	Content	
• Explanation	• Knowledge support	• Partial modification	• Post
• Data	• Emotional support	• Completely modification	• Link
• Reasoning	• Knowledge against		
• Irrelevant content	• Query		

Coding scheme for analyzing students' comments

The coding scheme adapted from Lu & Law (2012)'s studies was used to code students' comments. Content analysis was conducted to examine the categories of comments (e.g., identifying problems or providing suggestions). The unit of content analysis in this study was a comment. The first and third authors independently coded all the comments, with an inter-rater reliability of 0.736 (Cohen's Kappa).

Pre-test and post-test design

Pretest and posttest used the same text paper, which contained 4 questions, one point for each question. The test questions were closely related to the knowledge points in this lesson.

Data collection and analysis

The data collected in this study included 1) students' pre-test and post-test scores on their scientific knowledge of the concepts; 2) all group artifacts generated on AppleTree and; 3) students' post-intervention interview data. We echo with Tchounikine (2016) that learners would appropriate the script and its technology both as individuals and as a group. "With respect to appropriation, we do not see individual and collective perspective as incoherent." (Tchounikine, 2016, p.366). Therefore, in this study, we investigated how students appropriated a collaboration script as a group based on their learning process data. Meanwhile, we required individual students to reflect on their experiences of collaborative learning based on two guiding questions in the post-intervention interview: 1. What did you do at each stage of collaborative learning activity? 2. What factors may affect the revision of your explanations at each stage of collaborative learning activity?

Findings

The improvement of conceptual knowledge.

Descriptive statistics and the Wilcoxon signed Ranks test was used to detect differences between pretest and posttest. The results showed that the students' post-test score (M=3.70, SD=0.83, Z=-4.647, *df*=32, p<0.001) was significantly higher than the pre-test score (M=2.58, SD=0.529, Z=-4.647, *df*=32, p<0.001).

The observable behaviors of the script appropriation

All the groups were engaged in the activity, but not all the groups followed all the stages. We calculated the number of explanations posted by students as a group at stages 1, 2, and 4 respectively. All the groups, except for group 2, revised their group artifacts and contributed new ideas after the intra-group discussion. Only group 7 and group 8 contributed new postings at stage 4. For those groups who did not generate new postings, they revised their existing postings. Students revised group artefacts 56 times in stage 2 and 4 (see Figure 2).

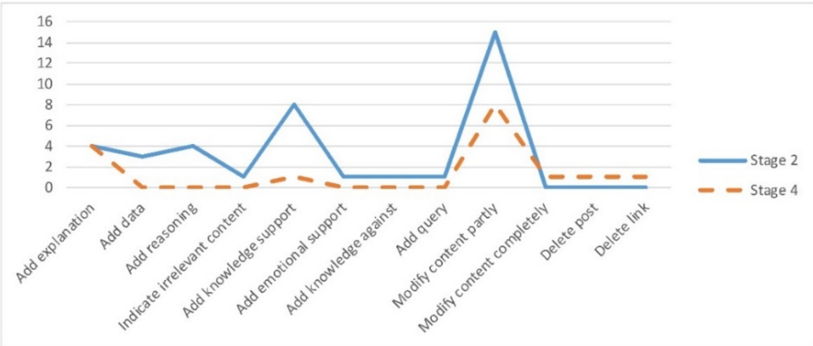

Figure 2. The number of changes in stage 2 and stage 4.

All the groups provided comments for others but the quality of comments was uneven. A total of 79 comments were provided in stage 3, see Table 2. Students provided more comments related to "Identifying problems" and "Positive". Comments related to "Editing language" were rare, and negative comments did not appear.

Table 2: The number of comments (by type)

	Categories	Example	Number
Cognitive	Identifying problems	"Why does the direction change?"	31
	Providing suggestions	"Talk about different direction of currents."	11
	Providing explanations	"It becomes zero cos there is no more cutting of magnetic field lines!"	2
	Editing language	"Wrong SIN spelling."	1
Affective	Negative	"You did not even do it!"	0
	Positive	"Very detailed explanation.", "Good explanation."	38

Note. 4 of 79 comments were double-coded as belonging to two categories.

The perception of the collaboration script

Students' reflections on collaborative learning experiences in the post-interview were analyzed. In stage 1, students independently expressed their ideas and input them into the AppleTree platform directly until the end of this stage. Each group member gave only one or two explanations in this stage. In stage 2, students mainly revised their own explanations. They only gave a suggestion for revision rather than revised the explanation directly. In stage 3, students actively commented on other group's explanation and brought good explanations back to their own group. In stage 4, students carefully read the comments given by other group members. But, some factors hindered students' revision of their explanations, such as students' understanding of the scientific conceptual knowledge, and the limited time of this stage.

Discussion and conclusion

This study elaborates how students appropriate the collaboration script based on the empirical data from students' behaviors and perception, as well as explores out the factors that may affect students' appropriation of collaboration script. Firstly, the findings show that students' conceptual knowledge influences their appreciation of collaboration script. As far as science is concerned, students need to judge the validity of explanations or comments in the process of deleting, revising and integrating. If students cannot judge the validity of the conceptual knowledge, they will find difficult to complete the task in stage 2 and 4. Secondly, time is an important factor influencing students' appropriation of collaboration script. As shown in the study, even if the students had been well aware of the collaborative learning process, they did not have enough time to further refine their explanations. Thirdly, students' appropriation of collaboration script may be influenced by other factors such as culture. In the Asian culture, it is usually considered not polite to point out others' mistakes directly. It is observed that even if there was inconsistency among students' explanations within the group, students did not take the initiative to revise other group members' explanations, but they would modify the postings that originally posted by themselves if necessary. Nevertheless, this may be also because the students were still in the early stage of collaboration, so they still lacked sufficient group-awareness. A future longitudinal study will be conducted to further explore it. The current study provides insights on the factors that need to be considered when designing and implementing collaboration script for school students.

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