Chapter 14
Group Scribbles-Supported Collaborative Learning in a Primary Grade 5 Science Class

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Introduction

Computer technologies can play an important role in supporting students' collaborative learning. Various research efforts have examined the effectiveness of technologies that support collaboration among learners, by providing rich opportunities for students to engage in group work and to share group artifacts. There is CSCL research centrally concerned with investigating group interaction processes in virtual online environments (Cakir, Zemel, & Stahl, 2009; Stahl & Hesse, 2010). There is relatively less research on how group interactions take place across multiple media in a networked environment, where face-to-face (F2F) and online interaction spaces are intertwined, even though their respective affordances have long been studied (Dillenbourg & Traum, 2006; Suthers & Hundhausen, 2003).

The data reported in this chapter is from a large-scale 3-year research project investigating how to design and support students' collaborative learning using a networked technology called Group Scribbles (GS) in a F2F classroom. A very common pattern in classroom talk is IRE: a teacher initiation (I) is followed by a student reply (R), followed by an evaluation of this reply (E) by the teacher (Mehan, 1979). IRE has been observed to account for up to 70 % of teacher–student classroom interactions in the classroom (Nassaji & Wells, 2000; Wells, 1999) and is continuously reproduced as part of institutionalized schooling. IRE has been criticized for leading to unrewarding and boring classroom discussions. Changing such deep-seated traditional patterns of classroom discourse poses a considerable degree of challenge for classroom reform. The aim of the project is to transform the traditional IRE patterns of classroom talk into more student-centered ones by connecting students together by GS. There are three actors in a GS classroom: the

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teacher as the facilitator, the student as the task performer/problem solver, and the different communication modes (GS and F2F interaction) as the mediator of the collaboration process. Introducing GS in the F2F classroom provides different kinds of scaffolding and support for the cognitive and social interactions between the participants involved.

Networked Technology: Group Scribbles

The CSCL technology used in classroom is GS 2.0, which was co-developed by SRI international and National Institute of Education Singapore. The GS user interface presents each user with a two-paned window (Fig. 14.1). The lower pane is the user's personal work area, or "private board," with a virtual pad of fresh "scribble sheets" on which the user can draw or type. A scribble can be shared by being dragged and dropped on the public board in the upper pane, which is synchronized across all devices. The essential feature of GS is the combination of the private board where students can work individually, engaging in the sense-making processes with the materials without being influenced by others (Vahey, Tatar, & Roschelle, 2004), and the public boards where students engage in group- or class-level interactions as they post and position their work relative to others, view others' posts, initiate discussion and critique ideas generated, and take items back to the private board for further elaboration. It is evident that GS technology scaffolds the process of different levels of interactions and the seamless switch between them, private interaction–group interaction–class interaction–group/private interaction, enabling a synergy between autonomy and collaboration by combining both private and collaborative learning. The F2F GS environment leverages resources such as shared screen, gestures, and conversation norms to help students jointly construct meaning, become more proficient in participating in representation-based interactions, and build a common understanding of the subject matter (Chen, Looi, & Tan, 2010; Vahey, Tatar, & Roschelle, 2004).

GS is a general-purpose collaboration tool in the sense that it does not assume a predefined topic or task but rather is intended to be appropriated for different tasks. GS enhances the characteristics of sticky paper notes and student response systems (SRS) by providing their key features for supporting brainstorming, idea response aggregation, and collaborative decision making while avoiding some of their physical constraints. It enables collaborative generation, pooling, and improvement of ideas through a synchronized public virtual space, eschewing the substantial manual work needed when paper sticky notes are used in classrooms (in terms of supplying, distributing, duplicating, moving, collecting, archiving, publishing, and sharing the notes). It complements other SRS technologies (e.g., Clickers and Classroom Presenter) in supporting coordinated use of the technology among students, liberating teachers from explicitly coordinating all classroom interactions.

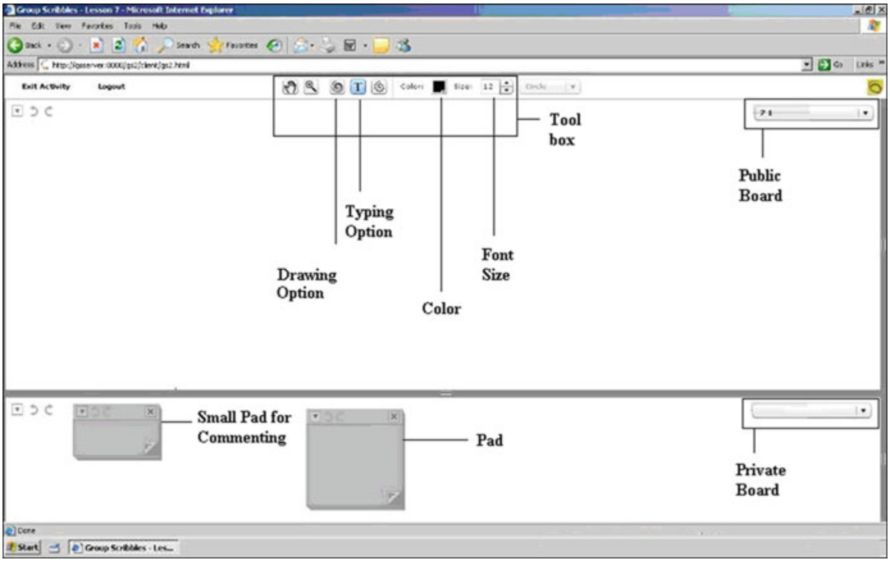

Fig. 14.1 The user interface of GS with a two-paned window

Context and Participants

In a 3-year school-based research project, we have worked with one primary school and three secondary schools in Singapore, systematically designing and implementing collaborative learning supported by GS for mathematics, science, and English and Chinese language learning (Chen & Looi, 2011; Looi & Chen, 2010). A design-research approach is adopted to address complex problems in real-classroom contexts in collaboration with practitioners and to integrate design principles with technological affordances to render plausible solutions (Brown, 1992; Collins, 1992). The GS lessons are integrated tightly with the national-mandated curriculum and co-designed by the researchers and the teachers.

In our work with a primary (elementary) school in Singapore, students from two primary grade 5 classes (one high-ability class and one mixed-ability class, each class having 40 students) have used GS technology in learning science, mathematics, and the Chinese language for 1.5 years (Chen, Looi, & Chen, 2009; Looi, Chen, & Ng, 2010) at the time of data collection. During each week, they had 1–2 sessions (1 h per session) of GS-based science lessons in the computer laboratory (Fig. 14.2).

In a 1-h GS-based lesson, about half of the time was devoted to students using GS to do collaborative learning tasks with the facilitation of the teacher. One session can have 1–2 collaborative activities, depending on the complexity of the tasks. When doing a collaborative task, students worked in groups of four. In the computer lab, there was an interactive whiteboard in the front so that the teacher and the students could write or draw on the large screen directly. Each student was equipped with a Tablet PC with GS

Fig. 14.2 GS classroom

Fig. 14.3 Seating arrangement of the target group

Agnes	Serena
Bruno	Joel

client software installed. As the students had been using the Tablet PCs as a learning tool for more than a year, they were used to them as part of the repertoire in class lessons.

The data reported in this chapter and analyzed in subsequent chapters is from a primary grade 5 science class. The data is from one target group (two target groups were chosen randomly from the ten groups formed in the high-ability GS class) and comprises four students: Agnes, Serena, Bruno, and Joel (all pseudonyms). They sat together at a separate desk with Agnes and Serena facing Bruno and Joel. The seating arrangement is as shown in Fig. 14.3. This is a group in which the abilities of the members were considered diversified, as it consisted of two students (Joel and Bruno) who had high scores of 81–90 % from previous science tests, one student (Serena) with a score of 71–80 %, and one student (Agnes) with a lower score of 61–70 %.

The Learning Task

The weekly GS lessons covered topics in line with the Science Syllabus Primary 2008. The topics include Cycles in Plants and Animals, Cycles in Water and Matter, Plant System, Human System, Electricity System, Interaction of Forces, Interactions within the Environment, Energy Forms and Uses, and Energy Conversion (Ministry of Education, Singapore, 2007). The reported lesson was the first GS lesson on the

Table 14.1 GS lesson flow: Electricity system lesson 1

	"Electricity System" GS activity	Time
1	Teacher divides the pupils into groups of four. Teacher gives the instruction of the learning activity: students need to find for themselves the different arrangements possible to light a bulb.	1 min
2	Students draw as many possible arrangements of bulb, wires, and battery in 5 min on GS group board.	10 min
3	Teacher distributes the materials (each group gets four wires, two bulbs, and two batteries). Students construct the circuits according to the diagrams created on GS. If the bulb lights up, they put a check next to the diagrams (successful diagrams).	10 min
4	Students browse through their classmates' group boards and view the diagrams created, endorsing the correct ones and commenting on the incorrect ones.	10 min
5	Students comment on and discuss the correct arrangements and give reasons why the incorrect arrangements failed to light up. Teacher randomly selects two groups to come up to the front of the class to present their circuits.	14 min

topic of "Electricity System." It was also the first GS lesson of the term (lessons, both with and without GS, were on different topics in the previous term). The lesson was intended to achieve two main objectives: (1) students would understand the internal arrangements of wires in a bulb and (2) students would construct a circuit to light a bulb. The collaborative learning activity was called "Bulbs and Circuits." It required the students to discuss configurations of connecting a light bulb with batteries in a circuit so that the bulb would light up (GS lesson plan, see Table 14.1). Before the lesson, students had learnt in previous lessons or in grade 4 that (1) electrical current can only flow through a closed circuit; (2) an electric circuit is an unbroken chain of conductors; and (3) an electric circuit consisting of an energy source (battery or batteries with positive and negative poles) and other circuit components (wire, bulb, and switch) forms an electrical system. The teacher had not taught the students that they need to connect the wire to the metal casing and to the metal tip of the light bulb. Therefore, the teacher expected that the students would learn through a process of trial and error to find the correct way of connecting the light bulb.

The activity started by getting the students to individually sketch out their initial impressions of how to connect closed circuits with a light bulb in their GS private board. They contributed their scribble sheets to their own GS group board and then discussed as a group. This task of consolidating the ideas on the same platform was intended to help them to infer the key similarities in constructing a working closed circuit from the various contributions posted in their group board. The students were also provided with some electrical components (batteries, light bulb, and wires) to physically connect the circuits following the manner they had sketched earlier in GS and to test if they would work. In testing the circuits, they could work freely as individuals, in pairs, or even as a group. Later, they had opportunities to look at other GS boards to be exposed to the different ideas contributed by the other groups. They could also comment on other GS posts if they desired to do so. This would reinforce their newly learnt concept of a closed circuit with a light bulb. The teacher followed the GS lesson plan closely when enacting it in the classroom.

Data Collection

When collecting data on the collaborative learning of this group, one video camera was set behind the classroom to record the whole classroom, while another camera recorded the interactions in the target group. The group video captured students' interactions and activities outside the GS boards. The screen capturing software Morae 2.0 was installed on the Tablet PCs of all the four group members to capture the process of each student's work on the Tablet PC and their verbal talk, facial expressions, and nonverbal behaviors via each laptop's webcam. Six videotapes were available in the data set: one for whole-class interaction, one for target group interaction, and one for each member of the group. The classroom interaction video was the longest with about 35 min in length, but the rest of the videos were all around 28 min long.

The data and materials provided to our colleagues in the Productive Multivocality project include the group video, student Morae videos, screenshots, GS inscriptions, GS lesson plan, and four Morae transcripts. The transcriptions were done by one of the researchers in the team. The researcher watched the Morae videos of each group member carefully and transcribed the actions captured (four Morae Transcripts). Then, she checked the accuracy of the transcripts by comparing the group video, Morae videos, and transcripts. In the transcripts provided, there are incidences of utterances in Chinese. The researcher has translated them literally into English.

We were aware that the requirements of researchers for the transcription would be different due to their different methodological approaches. The transcripts provided were not intended to serve their needs for analysis but to serve as a resource for obtaining a better understanding of the data (e.g., the students' language spoken in a colloquial manner is simplified). Researchers may need to generate their own transcripts, which serve their own different purposes from the raw data provided.

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