# A Scaffolded Software Tool for L2 Vocabulary Learning: GroupScribbles with Graphic Organizers

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**Abstract:** Understanding technology from the perspective of the scaffolding can help us bridge the gap between abstract or general CSCL design principles and the design and enactment of concrete CSCL practices. This study addresses this issue by describing and discussing how we use GroupScribbles (GS) technology coupled with appropriate pedagogical graphic organizers to scaffold effective collaborative learning in the context of L2 students' vocabulary learning in Singapore classrooms. It is found that the GS technology and pedagogical graphic organizers can jointly scaffold students' collaborative vocabulary learning to achieve desired learning outcomes. When equipped with graphic organizers to help students plan and organize their problem solving, GS is transformed from a general tool for enabling seamless interactions to a scaffolded software tool integrated with pedagogical design for supporting specific learning, by problematizing important disciplinary content.

## Introduction

There has been a discursive shift from knowledge transmission to knowledge construction in second language (L2) learning literature (Warschauer, 1997; Warschauer & Kern, 2000) since the late 1990s. The integration of collaborative learning into L2 learning has been emphasized (e.g., Belz, 2002; Lee, 2004) concomitant with the shift which regards knowledge as not something eternal or unchanging or that exists apart from humans but something that is the product of human activity. Learners are able to ultimately enhance their lexical ability through generating, sharing and improving their conceptual artifacts (e.g. grammatical rules or meaning of words) by interacting with each other. Learners can improve both syntactic ability as well as lexical ability through the collaboration with others.

This shift of the epistemological perspective prompts much needed changes in traditional classrooms. One such change is to seek in a more seamless way the integration and orchestration of individual learning, small-group and whole-class interactions in the classroom. Various technologies are used in classrooms to enhance the teacher-student and student-student interactions with the belief that technologies promotes productive meaningful interaction for L2 learner's (e.g., Belz, & Kinginger, 2002; Lan, Sung, & Chang, 2007). The scaffolding metaphor has been used to describe additional forms of support and contexts for enabling interaction. How to design or implement technology to scaffold learners' language learning through CSCL has long been a challenge for both researchers and teacher facilitators. This is particularly true in real classroom learning where the context for CSCL is complex and dynamic. Understanding technology from the perspective of the scaffolding can help us bridge the possible gap between abstract or general design principles and enactment of concrete CSCL practices. This study describes and discusses how we use GroupScribbles technology equipped with pedagogical graphic organizers as a scaffolded software tool to enhance L2 students' vocabulary learning in Singapore classrooms.

## Literature Review

### Scaffolded Software Tools

Scaffolding situations are those in which the learner gets assistance or support to perform a task beyond his or her own reach if pursued independently when "unassisted" (Wood, Brunet & Ross,1976, p. 90). This is related to Vygotsky's concept of Zone of Proximal Development (ZPD, defined as the zone of activity in which a person can produce with assistance what they cannot produce alone (or can only produce with difficulty). Traditional views of scaffolding focused on the social dimension - interactions with other people (teachers or peers) as the source of assistance articulating how a more knowledgeable person can help (Hogan & Pressley, 1997; Wood et al., 1976). In the past decade, many researchers started to investigate the scaffolding functions of the technological tools (Davis & Linn, 2000; Edelson et al., 1999; Guzdial, 1994; Quintana et al., 1999; Reiser et al., 2001). The technology dimension of scaffolding examines how technology changes the task in some way so that learners can accomplish tasks that would otherwise be out of their reach. The technology scaffolding include providing prompts to encourage or remind students what steps to take (Davis & Linn, 2000), graphical organizers or other notations to help students plan and organize their problem solving (Quintana et al., 1999), or representations that help learners track what steps they have taken (Collins & Brown, 1988; Koedinger & Anderson, 1993).

Pea (2004) summarized the 2 general properties for how scaffolding functions for the learner: 1) channeling and focusing - reducing the degrees of freedom for the task at hand by providing constraints that increase the likelihood of the learner's effective action; recruiting and focusing attention of the learner by marking relevant task features, with the result of maintaining directedness of the learner's activity toward task achievement, and 2) modeling: modeling more advanced solutions to the task. Reiser (2004) explained the "mechanisms" that a technology provides scaffolding for learners by differentiating between *task structuring* ("guiding learners through key components and supporting their planning and performance" [p. 273]) and *content problematizing* ("tools can shape students' performance and understanding of the task in terms of key disciplinary content and strategies and thus problematize this important content" [p. 273]).

The social dimension and the technological dimension of scaffolding is complementary – they work together in helping learners learn better in the sense that certain scaffolding activities can be the responsibility of the people (teacher or peers) and other scaffolding activities provided by the technology (Reiser, 2004). In this way, a scaffolding synergy (Tabak, 2004) could be achieved in support of student learning. This paper focuses on the technology dimension of the scaffolding for L2 vocabulary learning.

### CSCL and L2 Language Learning

Collaborative learning has been considered to be one of the effective instructional strategies in language learning (Cohen, 1994; Dagenais, & Walsh, 2008; Wen, Looi, & Chen, 2011). It "has a 'social constructivist' philosophical base, which views learning as construction of knowledge within a social context and which therefore encourages acculturation of individuals into a learning community" (Oxford, 1997, p 443). The learners co-construct knowledge by working on joint problems or tasks, including making individual contributions, partaking in discussion and arriving at joint solutions. In the literature on Second Language Acquisition, learners' active involvement in interaction with other learners of the target language has been identified as a fundamental aspect of the learning process as it provides opportunities for students to engage in negotiation of meaning (Gutierrez, 2003). In doing so, they adopt ideas from their peers and share specific conceptions after collaborating. They influence one another, and converge or diverge with respect to language knowledge.

When learners learn together, members of the group are becoming similar with respect to their knowledge, as knowledge equivalence and as shared knowledge prior to, during, and subsequent to collaborative learning (Weinberger *et al.* 2007). This will lead to knowledge convergence, which is an increase in common knowledge that all collaborating learners had (Jeong & Chi, 2007). Learners who converge in knowledge have been found to benefit more from collaborating than learners who do not (Fischer & Mandl, 2005).

Computer technologies play an important role in supporting students' collaborative learning. Networked technologies offer the potential to bring collaborative learning to new heights. In a CSCL environment, participants are actively and collaboratively engaged in creating knowledge, and the collaboration is taking place through a computer network They engage in a coordinated effort to perform a task together to establish common knowledge (Littleton & Häkkinen,1999).

The lexicon may be the most important component for language learners (Gass & Selinker, 2001). Vocabulary is recognized a fundamental to the development of L2 proficiency (Harley, 1996). The vocabulary learning activities through CSCL approach can be classified into 2 categories: incidental and intentional vocabulary learning. "Incidental learning is said to occur when a word is acquired as a by-product of the learner being engaged in some language learning activity" (Smith, 2004, p.368). There is fairly solid evidence supporting the view that computer-assisted collaborative reading and writing benefits students' vocabulary acquisition, in which environment they have less anxiety and more opportunities to negotiate around anew or problematic words (e.g, Ghaith, 2003). Intentional vocabulary learning is task-based which focuses on vocabulary learning. Most classroom vocabulary learning activities are intentional learning activities. Existing CSCL research in language learning focuses more on incidental learning than intentional learning. This paper discusses the intentional vocabulary learning in a F2F (face-to-face) CSCL environment in real classrooms.

## Background of the Study

### Chinese as L2 in Singapore

Singapore is a multiethnic and multilingual country, in which bilingualism refers to proficiency in English which is recognized as the L1, and the L2 known as a "Mother Tongue Language" (MTL). Chinese or Mandarin is Chinese students' MTL. The Ministry of Education in Singapore defines MTL not by the language used at home or the first language learned by the student but by ethnicity (Tan, 2006). Hence, one of the characteristics of L2 learning in Singapore is the difference of students' language abilities in a class due to their different MTL backgrounds. For typical ethnic Chinese students in Singapore, their lack of motivation and limited basic linguistic capability continue to be the fundamental challenges to their learning in Chinese Language (Sim,

2005). Our school-based research is to address the typical linguistic weaknesses of younger Chinese in their L2 proficiency especially their command of vocabulary.

Chinese is a character-based language. To be literate in Chinese, one needs to know over a thousand Chinese characters (Wing, et al., 2003). From the perspective of linguists, the Chinese script, due to its logographic nature, is considered the most difficult script to learn by non-native learners (Shen, 2004). Shen (2002) attributes the challenge to the retention of the combination of the three elements of a character, that is, its sound, shape and meaning in learner's long-term memory, and the instant retrieval of these three elements. Innovations in language education have been targeted towards a more comprehensive understanding of the development of children's capability in handling the script of Chinese, and ways of enhancing learners' structural understanding of the writing system beyond rote learning and mechanical practice (Tse, 2002).

### Research Design and Participants

We introduced CSCL in F2F Chinese language classrooms to help the students learn better by collaboratively constructing language knowledge together through authentic verbal discussion (in Chinese) mediated and enhanced by GroupScribbles. 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). In the 3 year school-based research, we have worked with one primary school and 3 secondary schools in Singapore in systematically designing and implementing collaborative learning supported by GroupScribbles for Maths, Chinese, and English language learning (see Chen & Looi, 2010; Looi & Chen, 2010) . The research reported in this paper focuses on Chinese language learning, and specifically vocabulary learning.

All the GS-based collaborative activities were co-designed by the teachers and researchers. The students work on groups of four in their collaborative discussions. The students in a group are seated next to each other with a Tablet PC, and they engage in face-to-face talk. The Chinese language learning curriculum in Singapore Primary schools focuses on vocabulary (Liu & Zhao, 2008) whereas the Chinese language curriculum in secondary schools emphasizes textual or discourse structure and grammar. To be aligned with the specific lesson objectives as stated in the syllabus, our GS-based activities for primary school students were designed to assist students to learn new characters and word formation. In secondary schools, the GS activities on vocabulary were designed to help students review characters and words that they had learnt before. This paper will describe two activity designs for vocabulary learning at the primary and secondary school levels respectively.

## GroupScribbles (GS)

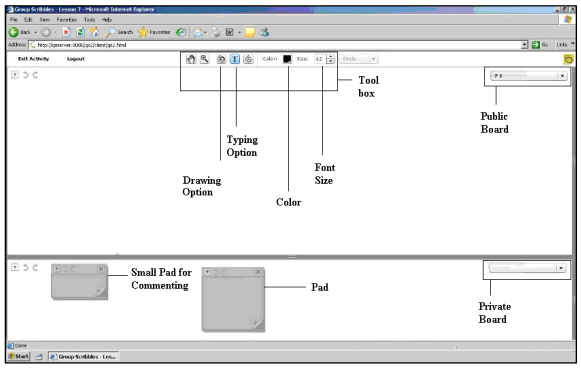


Figure 1. The User Interface of GS with a Two-Paned Window.

The technology tool we used to support students' collaborative learning is GroupScribbles (GS), 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. 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 (see Figure 1). When the scribble sheet is moved to the public board, it can be synchronized to all the Tablet PC's public board so that all the members can view it. The essential feature of the GS client is the combination of the private board (where students can work individually) and group boards or public boards (where students can post their work and position them relative to the work of others, view others' work and take items back to the private board for further elaboration. It enables collaborative generation, collection and aggregation of ideas through a shared space based upon individual effort and social sharing of notes in graphical and textual forms. In our school-based research, GS is used routinely in F2F classroom setting. Effectively supporting students' F2F interactions as well as coordination in collaborative learning becomes possible with the use of GS.

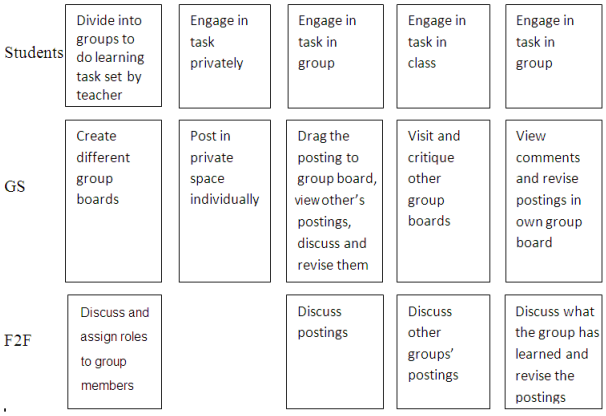


Figure 2. A Generalized Student Activity Pattern in GS Classroom.

Figure 2 shows a generalized student activity pattern supported by GS which we have found to be effective for productive language learning. One particular set of affordances of the GS-based learning environment is the ability for students to engage in private interactions in the GS private board, group interactions in the group board together with F2F verbal discussion, and class-level interactions through GS. When students work in the GS private space without others being able to see or directly impact them, they can engage with their materials and sense-making processes individually in a focused way (Vahey, Tatar, & Roschelle, 2007). We believe that it is very important to allow the student to complete as much of the vocabulary task as possible individually. When they drag the posting to the group board, they engage in the group interaction by constructing and discussing about the product or their work (Vahey et al., 2007). Then they visit other group boards to engage in class interactions where they are exposed with full range of ideas and artifacts, and they critique these ideas/artifacts. At the end of this activity, they go back to their own group board to engage in group or private interactions where they improve their ideas/artifacts after seeing other groups ideas/artifacts and comments. 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. It enables 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 et al., 2007).

## Graphic Organizers

It is not the technology that is the innovation in student learning, but the integration of technology and pedagogical practices in scaffolding the meaningful vocabulary leaning activities. Here we present 2 pedagogical graphic organizers in GS that help students' vocabulary learning. Figure 3 displays an organizer for guiding primary school students to learning new words/characters. The purpose of this graphic organizer is to enhance students' awareness of the character components, and to help students learn the usage of the words in authentic context by composing sentences that make use of the words. Different groups were responsible for different new words. They could learn individual new word through visiting one another's group board. Group students first were required to write down in the centre of the GS board the character/phrase they work with. In this case it was a phrase "不理不睬" (meaning "to completely ignore"). The space surrounding the phrase was divided into 7 sections, each of which was dedicated for one task. Starting from the top right in clockwise order, the tasks were: 1) to explain the meaning of the phase; 2) to give a few similar characters as the last character of the phrase; 3) to give a few homophones of the last character of the phrase; 4) to use the last character of the phrase to form words (word formation); 5) comments from other groups (similarly this group was required to give comments on other groups' work); 6) to expand the phrase into a sentence, and 7) to collocate the phrase with other words (word collocations).

Figure 4 shows a group board with the organizer completed by one of the groups. With the sub-tasks in different themes, all group members have an opportunity to contribute their individual knowledge and ideas to the group, no matter what language proficiency they have. Students who are not good at Chinese language can post the meaning of the phrase/word with the help of a dictionary. Students with higher Chinese language capability can take the responsibility for making sentences. All students can contribute homophones and similar characters for the given characters based on their different prior knowledge of the characters. Within the group, the task is not dominated by one or two students. Rather, all the students play their part to complete the task. At the class level, when the teacher asks students to visit other group boards to learn other words and give their

comments to help others refine their group products, students with different Chinese language proficiency have an equal opportunity to give and receive constructive comments. In Figure 4, we can see the constructive comments (as circled out) from other groups which help them correct the wrongly formed Chinese characters.

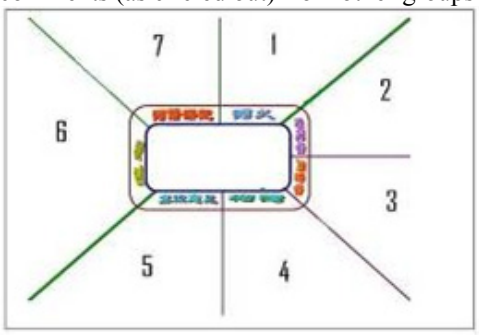


Figure 3. A Graphic Organizer for New Character & Word Learning.

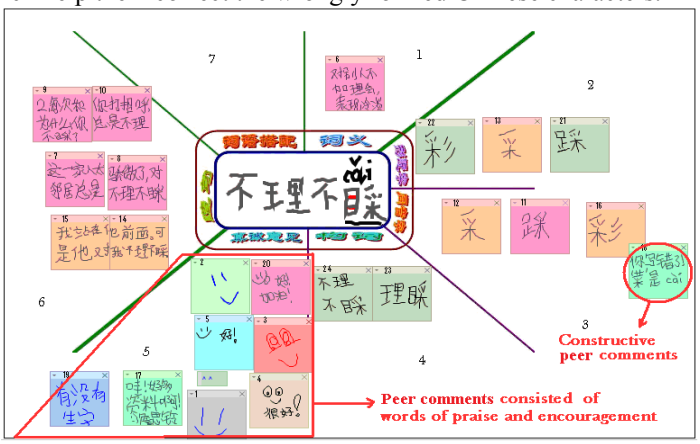


Figure 4. A Completed Group Board with Organizer (Primary School Example).

Next we describe the graphic organizer for the vocabulary learning of secondary school students. The Chinese script system is a principled- and rule-based system. Each Chinese character is comprised of one or more components, spatially arranged with certain principles (Liang, 2004). There are different standards to classify the basic spatial configurations for individual characters. In this activity we adopt a regular categorization, by which all the Chinese characters can be classified into 5 groups. They are up-down, up-mid-down; left-right; left-mid-right and full/half enclosed structure.

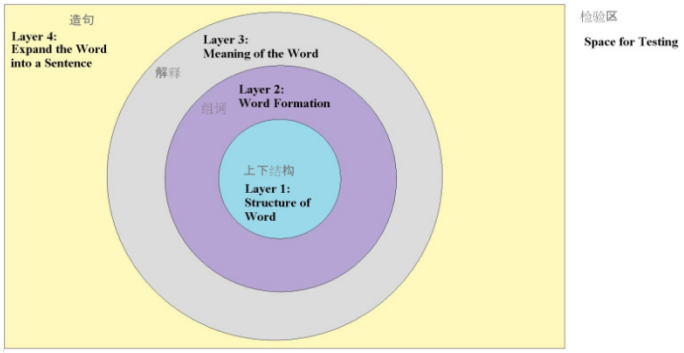


Figure 5. Graphic Organizer for New Character & Word Learning (Secondary School Example).

Figure 5 shows an organizer for helping students review vocabulary that they have learnt in the past semester. The centre of the figure is a solid circle with the instruction "上下结构" (meaning "up-down structure"). Students need to post characters with up-down structure onto this area. The three outer layers, working outward, are layer 2 "word formation"; layer 3 "meaning of the word"; layer 4 "expand the word into a sentence". Students are required to use the posted characters to form words; to give their own explanation for the words and to make proper sentence using the words. During this process, the students in a group can share their individual vocabulary knowledge and get a better understanding of the use of the words by negotiating their meanings in different context. Some blank space of the figure is left for assembling comments from the students from other groups.

*Round Robin* is suggested to be used together with this organizer in activity design, with the aim of knowledge sharing and construction during the whole class. Different groups are responsible for different tasks in the beginning. For example (see the protocol showed in Figure 6), group 1 students are responsible for picking up characters with up-down structures from the words list, and posting them onto the central circle, group 2 students are responsible for those up-mid-down structured characters, and so on. After all the groups complete their task in round 1, followed the protocol of round robin, group 1's students go to group 2's board to post related words onto the task of word formation. At this moment, group 2's students are working at group 3's board on left-right structured new characters. In round 3, group 1's students enter into group 3's public board for explaining the meaning of the words. A whole activity completes until all the groups finish checking the propriety of the postings from all other groups in round 5. Figure 7 displays the screenshot of a group board with artefacts.

| Round / Group | Round 1: Pool Characters | Round 2: Form words | Round 3: Express meanings | Round 4: Create sentences | Round 5: Do a test |
|---|---|---|---|---|---|
| 1 | Public board 1（up-down） | Public board 2 | Public board 3 | Public board 4 | Public board 5 |
| 2 | Public board 2（up-mid-down） | Public board 3 | Public board 4 | Public board 5 | Public board 1 |
| 3 | Public board 3（left-right） | Public board 4 | Public board 5 | Public board 1 | Public board 2 |
| 4 | Public board 4（left-mid-right） | Public board 5 | Public board 1 | Public board 2 | Public board 3 |
| 5 | Public board 5（full/half enclosed） | Public board 1 | Public board 2 | Public board 3 | Public board 4 |

Figure 6. Protocol of Round Robin.

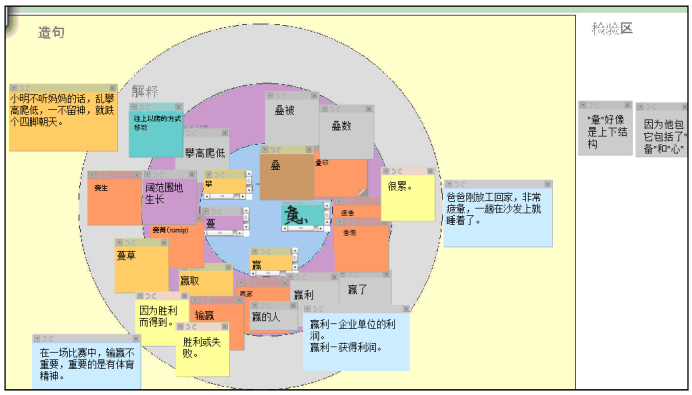


Figure 7. A Completed Group Board with Organizer for Reviewing Vocabulary.

## Conclusion and Discussion

The teaching of L2 to young students, which involves complex linguistic skills and is thus cognitively demanding, has always been a great challenge to language teachers and researchers. The collaborative learning activity scaffolded by GS technology and graphic organizers was developed with the pragmatic aim of addressing the fundamental linguistic difficulties and challenges of younger students in learning L2 vocabulary. As Collins (1997) argued, "learning difficulties reflect differences, not deficiencies" (p. 3). Collaborative learning can help address the learning difficulties because students are more motivated to help each other when they work together, and they feel less threatened when they made mistakes, as their group-mates will help them. Consequently, they achieve improvement as a group together. GS activities help address the different language ability of students. It is hoped that this phenomenon of ability differentiation will be gradually faded out as all students will overcome their respective weaknesses, and therefore could contribute to the collaborative vocabulary learning. In these 2 learning scenarios, the GS technology and graphic organizers play important roles in scaffolding students to collaboratively learn vocabulary better.

From the perspective of Reiser's (2004) framework of scaffolding mechanisms, GS technology provides scaffolding for learners more by *task structuring* whereas graphic organizers serve as scaffolding by *content problematizing.* The design of GS technology supports the seamless switch between different types of cognition (private cognition – group cognition – class cognition – group cognition – private cognition") during the collaborative learning process. It guides students through the key collaboration procedures and supports their vocabulary learning planning and performance. Each individual student is not only responsible for his individual learning, but also for the group learning and class learning. Students must make their vocabulary knowledge public through GS that represent diverse knowledge explicitly. The artifacts created by students in GS become a vehicle for negotiation of understanding about the vocabulary knowledge. The shared representation can serve as a catalyst for negotiation of ideas.

With the graphic organizer, the students were provided with a pedagogical structure to scaffold their vocabulary learning. The mechanism of scaffolding by graphic organizers serves more as content problematizing by "shaping students' performance and understanding of the task in terms of key disciplinary content and strategies and thus problematizing this important content" (Reiser, 2004, p. 273). Chinese vocabulary learning is complex. There are different ways in learn such a character-based language. Traditionally, the students learn the characters by listening to a teacher's lecturing which focuses on one or two components (e.g., phonetics, structure, radicals) of the characters. This approach is not systematic and ignores the use of the characters or words in authentic contexts. The graphic organizers were designed to alleviate the problem by changing the nature of the vocabulary learning task through highlighting the key disciplinary content and strategies for vocabulary learning. They can scaffold vocabulary learning by "channelling and focusing" (Pea, 2004). In the GS activity, the organizers help to reduce the degrees of freedom for the task by providing constraints that increase the likelihood of the learner's effective action (focusing on all key components of vocabulary learning such as the meaning, structure, homophones, similar characters, uses in authentic sentences etc). The graphic organizers help recruit and focus attention of the learner on the relevant task features so that students are guided on a track toward task achievement. They help learners to perform by potentially enabling them to focus on more productive parts of the tasks. In our interview with the teacher, she expressed her view: "[with the graphic organisers] as time goes on, not only can students' interest of Chinese characters learning improve, they can internalize these strategies to learn Chinese vocabulary. They can also apply these strategies when they come across a new character or word. After some time, the students may no longer need these tangible scaffolding organizers anymore because they have learned what to do when they learn other new

characters or words". Thus, the teacher's view is consistent with the expertise reversal effect (Kalyuga, Ayres, Chandler, & Sweller, 2003).

Scaffolding is distributed across the tools and context in which learning is happening. GS technology and graphic organizers jointly scaffold students' collaborative vocabulary learning to achieve the desired learning outcomes with technological scaffolding synergistically provided by the GS technology and by the pedagogical graphic organizers. The GS technology scaffolds students' collaboration and distributed cognition occurring across activities, artifacts, within group and across groups. The GS is a shared workspace for all the students to share knowledge and ideas. Students are able to view the artefacts generated by other students. They provide feedback to other groups' artefacts, question each other and argue about the meanings, which in turn build community knowledge. Therefore, in this F2F CSCL environment, vocabulary knowledge is not an object that is acquired and possessed by individuals, but becomes embedded in the conversations and social discourse. Without the graphic organizers, GS is a general collaboration tool that supports different level of interactions by taking in to account both individual and social processes in CSCL. It scaffolds students in both knowledge acquisition and knowledge as participation (Sfard, 1998). When equipped with graphic organizers to help students plan and organize their problem solving, GS is transformed from a general tool for enabling seamless interactions to a scaffolded software tool integrated with pedagogical design for supporting specific learning goals by problematizing important disciplinary content. Therefore by having both GS tool and appropriate graphic organizers, scaffolding synergy could be achieved in support of the learner's advances by allowing greater opportunities for vocabulary learning that otherwise would not be possible in the classroom.

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