COMPUTER-SUPPORTED COOPERATIVE PREWRITING FOR ENHANCING YOUNG EFL LEARNERS' WRITING PERFORMANCE

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The current study investigated the effects of different computer-supported cooperative prewriting strategies (text-based brainstorming, drawing, and mind mapping) on the writing performance of elementary-school EFL (English as a foreign language) learners in Taiwan. Three intact classes of fifth graders (N = 81 students; 27 per prewriting strategy group) participated in this study. These subjects in different classes used different prewriting strategies at the prewriting stage. A quasi-experimental design was adopted in this study to collect experimental data, including the scores of English composition (two writing works), the level of grammar knowledge, and the level of English writing motivation. The analytical results indicated that in both the mind mapping group and the drawing group, the participants' English grammar knowledge had increased significantly after the treatment. It was also found that different computer-supported cooperative prewriting strategies benefited young EFL writers in different dimensions of English composition. The influence of using the mind mapping strategy seems most powerful on young EFL writers, followed by the drawing strategy and the text-based brainstorming strategy. As to English composition motivation, almost all of the participants appreciated the computer-supported cooperative prewriting activities and were also aware of how these activities benefited their English writing.

Language(s) Learned in Current Study: English

Keywords: Cooperative Learning, Computer-Assisted Language Learning, Writing, Prewriting Strategy

APA Citation: Lan, Y. J., Sung, Y. T., Cheng, C. C., & Chang, K. E. (2015). Computer-supported cooperative prewriting for enhancing young EFL learners' writing performance. *Language Learning & Technology 19*(2), 134–155. Retrieved from http://llt.msu.edu/issues/june2015/lansungchengchang.pdf

Received: December 12, 2013; **Accepted:** November 19, 2014; **Published:** June 1, 2015

INTRODUCTION

Writing is important for the instruction of second-language (L2) learners because it is not only an effective tool for the development of academic language proficiency and a vital skill for academic or occupational success, but it also allows L2 learners to raise their awareness of knowledge gaps (Warschauer, 2010). Additionally, writing is one kind of linguistic output that helps L2 learners notice a gap between what they want to say/write and what they can say/write, leading them to recognize what they do not know, or know only partially (Swain, 1995). Writing is an active, constructive process of the mind by which the writer creates meaning (Berthoff, 1981; Dechant, 1993, p. 72). It is also an interactive process that takes place between the writer and the reader via the text. Unfortunately, writing is also one skill that is difficult for L2 learners to master (Warschauer, 2010).

The writing process itself involves brainstorming for topics of interest, gathering information, allowing

that information to settle into some sort of overall plan with some prewriting techniques, putting the words down on paper, consulting with and getting feedback from others (such as teachers or peers), and revising (Kroll, 2001; Richard-Amato, 1996). Additionally, from the perspective of "writing as a process" (Gower, Phillips, & Walters, 1995; Richard-Amato, 1996), the above-mentioned processes involved in the prewriting stage, including working with ideas, planning, and drafting, are important to the writing quality and performance of L2 students because not knowing where or how to start would frustrate writers, especially inexperienced writers. Thus, writing instruction should not only help students to become active writers who produce products with accuracy, good organization, and meaning in an interactive context, but also should include the instruction of techniques for encouraging students to get started (Holmes, 2003; Kroll, 2001).

Numerous studies have confirmed that writing should be included as an integral part of L2 activities in elementary schools (Ediger, 2001; Fountas & Pinnell, 1996; Kroll, 2001), and research has also indicated that the production of output based on structured input provided by the writing teacher will enhance both the linguistic accuracy and conveyance of meaning among early L2 writers (Swain, 2005; VanPatten, 1996). It is highly desirable for students to achieve a balance between the accuracy and the conveyance of meaning in their writing. To cultivate citizens with a broader and more global perspective and competitiveness in the new era of globalization, English language is always highly valued as a prescribed course by elementary schools in many Asian countries, such as Taiwan and Singapore (Singapore's Ministry of Education, 2010; Taipei City Government's Department of Education, 2000). According to the Nine-Year Curriculum issued by the Ministry of Education, Taiwan (Taipei City Government's Department of Education, 2000), writing instruction in elementary schools should be integrated with the teaching of the other three basic language skills: listening, speaking, and reading. However, current elementary-school English programs most emphasize listening and speaking, followed by reading. Little attention is paid to the implementation of writing instruction (Zhou, 2012), let alone the provision of integrative instruction in all four skills. Furthermore, because of the extremely diverse English level of students of English as a foreign language (EFL) and the limited teaching hours (Lan, Sung, & Chang, 2007, 2009), writing instruction is usually omitted from regular EFL classes. Thus, many elementary-school students in Taiwan are deprived of the opportunities to first experience using the prewriting techniques in order to be aware that they have several different ways to begin an assigned writing task, as suggested by Kroll (2001) and then produce writing output.

To deal with the problems caused by the diversity of English abilities among students, computer-supported cooperative learning (CSCL) has been approved as an effective approach for enhancing the degree to which Taiwanese elementary-school students work together in order to successfully reach group learning goals (Lan et al., 2007, 2009; Lan, Sung, & Chang, 2013). Cooperative learning is the instructional use of small groups for the purpose of allowing students to work together to maximize each other's learning potential (Johnson & Johnson, 2004). In particular, it renews the confidence of low-ability writers (Kirkpatrick & Cuban, 1998), enhances the literacy of L2 learners (Wepner & Ray, 2000), and improves writing quantity, quality, and revision efforts (Bangert-Drowns, 1993; Daiute, 1986; Goldberg, Russell, & Cook, 2003). Current technology also provides L2 learners with approaches for improving their writing by visualizing their thinking processes, and they allow teachers to better understand the learning and cooperative writing patterns of their students, which in turn allow the teachers to determine the best way to improve their own writing instruction.

In response to the urgent need to improve the EFL writing performance of elementary-school EFL learners in Taiwan, the authors of the current study conducted a pilot study (Lan, Cheng, Chang, & Sung, 2012) to investigate the effects of integrating the CSCL approach and the prewriting strategy on young EFL learners' writing performance. It was found that the learners who worked together with their peers at the CSCL prewriting stages made more remarkable progress in English writing performance than did those learning with non-CSCL approach at the prewriting stages. However, in the pilot study mentioned

above, it was also found that different prewriting strategies [BR (text-based brainstorming), DR (drawing), and MM (mind mapping)] were used by almost the same number of elementary-school EFL learners in both of the paper-and-pencil-based group (non-CSCL) and the CSCL group. Therefore, only the effect of the CSCL approach was preliminarily confirmed, but not the further understanding of how different prewriting strategies might benefit elementary-school EFL learners' writing performance and motivation. The current study was therefore designed to overcome this limitation by further comparing the effects of the three prewriting strategies with CSCL approach on young EFL learners' writing performance and motivation. The findings of this study could serve as a reference foundation for EFL educators and first-line teachers to design better writing instructions for elementary-school EFL learners.

LITERATURE REVIEW

Early Writing Instruction

Children's literacy development in an EFL context has gained increasing attention due to the growing number of Asia countries making English instruction mandatory from a young age (Ediger, 2001). In addition to L2 reading, which is always considered the most important skill for L2 learners in academic contexts (Grabe, 1991), early writing instruction is also becoming increasingly important (Holmes, 2003; Whitney et al., 2008).

Writing is not an activity that merely copies someone else's text or uses the prepared lists of words to create sentences or stories. It is a creation of meaning from one's own intellectual and linguistic resources and activity (Berthoff, 1981). In all writing, learners need to concentrate on the process and the evolving product simultaneously (Murray, 1982). In early writing, interactive writing, guided by and performed by interacting with teachers (Fountas & Pinnell, 1996), such as the provision of charts, letters, poems, recipes, stories, and retold group experiences, can help children to develop speech-to-print correspondence, left-to-right directionality, the concept of the word, word analysis, sound-to-print matching, letter formations, spelling patterns, capitalization, punctuation, and self-correcting (Fountas & Pinnell, 1996). Furthermore, the writing assignment should be carefully assigned, depending upon the students' ages, needs, and proficiency levels. It is generally best to begin with short pieces of writing before proceeding to longer ones (Richard-Amato, 1996). Given that short stories describe personal experiences and that riddles are easy for teachers to provide writing models, story writing and riddle creation are usually assigned in early writing instruction to stimulate L2 writers to create interactive writing (Lan et al., 2012).

Some studies have focused on prewriting strategies (e.g., Lin, 2010a; Xu, 2008) to English writing instruction in elementary schools in Taiwan, but few of them have revealed significant effects of prewriting strategy instruction on neither elementary-school students' English writing performance (specifically writing quality) nor writing motivation. Furthermore, most of these studies have been paper-and-pen-based, few are done with the support of technology, and cooperative writing activities have been virtually absent. Although technologies and cooperative learning have been shown to be effective for promoting the writing performance and writing motivation of learners (Bonk & King, 1998; Hayes & Ge, 2008; Lingnau, Hoppe, & Mannhaupt, 2003), the results obtained from the studies mentioned above are far from satisfactory, especially the understanding of CSCL for writing instructions in the elementary schools in Taiwan. Therefore, more efforts should be made to take into account the value of CSCL for enhancing L2 writing in the EFL settings in the elementary school in Taiwan.

Learning Strategies and Prewriting Strategy Instruction

Learning strategies are actions performed by learners to aid the acquisition, storage, subsequent retrieval, and use of information (Dansereau, 1985). Additionally, L2 learning strategies are specific actions that L2 learners use as tools for active and self-directed involvement to enhance their own L2 learning (Oxford, 2003). Research has repeatedly shown that appropriate L2 strategies result in improved proficiency and greater self-confidence (Chamot, 2005; Hong-Nam & Leavell, 2006). After a certain amount of practice

and use, L2 strategies—like any other skills or behaviors—can become automatic. In a word, L2 strategies can be taught and modified through strategy training (Lan, 2013). Thus, it is recommended that L2 strategy instruction should be included in language education (Oxford, 2003; RAND, 2002).

A writing process can be roughly divided into three stages: before writing, while writing, and when revising (Petrić & Czárl, 2003). Prewriting strategies are the strategies used by L2 writers at the "before writing" stage for generating ideas to accomplish a writing task. Similar to quick sketches made by an artist before painting, prewriting strategies are used by L2 writers to test ideas, list ideas, and explore a range of topics for their writing. The importance of the prewriting stage lies in its vital role to help writers set their writing goals, brainstorm and organize ideas, as well as decide article structures (Flower & Hayes, 1981), especially for the beginners who easily struggle with looking for the words they need, remembering grammatical conventions, and linking their ideas with coherence and producing appropriate L2 writing (Chamot, 2005). Therefore, the lack of this planning process might lead to poor writing performance. Research evidences also show that prewriting strategies help L2 writers save time by quickly determining which ideas are worth developing and improve writing performances (Saddler, Moran, Graham, & Harris, 2004). Given that L2 writing can be the most difficult modalities in which learners achieve communicative competence (Chamot, 2005), incorporating prewriting into regular L2 writing instruction should be highly valued in L2 education.

Additionally, for EFL children and inexperienced writers, L2 writing is a great challenge because they need to cope with the competing attention demands while writing, such as using the L2 writing system, deciding on content knowledge related to a writing topic, selecting proper vocabulary and grammar to form correct sentences, organizing sentences into a paragraph or even into a whole passage with good structure. All the demands above are extra burdens, overwhelming the limited capacity of young and novice writers' short-term memory (Flower & Hayes, 1981). However, the prewriting stage is usually the most ignored part in the writing process.

Although drawing (Lin, 2010a; Olson, 1992), mind mapping (Lin, 2010b; Pishghadam & Ghanizadeh, 2006), brainstorming and listing (Kroll, 2001) are among the most used prewriting strategies in L2 writing, they are usually implemented in paper-and-pencil- or individual learning-based approaches. How the integration of those prewriting strategies and the CSCL approach would benefit elementary-school EFL writers' writing performance and motivation is worthy of further investigation.

CSCL in Writing Instruction

Technology-supported writing has been shown to improve the quality of work produced by students. According to the research findings obtained from word processing in writing instruction, students who wrote with the word processor on computers have improved the quality of their writings (Bangert-Drowns, 1993) and have corrected more errors (Daiute, 1986). Results obtained from a five-year project of conducted in Maine with middle school students (Silvernail & Gritter, 2007) indicated that a one-to-one ubiquitous laptop program had a positive impact on middle school students' writing. Furthermore, the evidence of the project also indicated that the participating students (more than 100,000 middle school students) became better writers in general, not just better writers using laptops. Another meta-analysis conducted by Goldberg et al., (2003) also supported the abovementioned research findings that students who use computers when learning to write are not only more engaged and motivated in their writing, but they also produce written work that is of greater length and higher quality.

Additionally, when students write on computers, writing becomes a more social process by which students share their works with one another as compared with paper-and-pencil environments (Goldberg et al., 2003). These findings echo some educators' claim that such an online environment is particularly appropriate for cooperative learning approaches that emphasize group interaction (Harasim, 1990). Bonk, Medury, and Reynolds (1994) also argued that computer-supported cooperative tools for student cooperation are elevating writing beyond silent and solitary activities to environments rich in discussion

and interchange. Some researches on CSCL for writing had approved the effects of CSCL on FL/L2 writing, such as those conducted by Lingnau et al., (2003), Woo, Chu, Ho, and Li (2011), Hayes and Ge (2008), and Liu (2011).

Lingnau et al., (2003) evaluated the effects of a cooperative writing task facilitated by a shared workspace system on the German writing performance of a group of first graders of non-native German speakers. Their findings showed that the outcomes of learning through cooperative activities are greater than those of learning through non-cooperative activities. Furthermore, they also indicated that children mostly refrained from seeking the teacher's help during peer cooperation. Woo and her colleagues (2011) investigated how the 5th graders in Hong Kong used Wiki in the writing of English as a second language (ESL). They found that the students in their case study enjoyed using the Wiki in the team work and benefited from the collaborative writing activities. Hayes and Ge (2008) used a mixed research method to investigate the writing performance of American fifth graders in a CSCL environment. The results showed greater gains in writing performance and motivation to write from the students using the software than from the control group using paper and pencil. Hayes and Ge's study demonstrated the technological affordances of CSCL augment cooperative learning and showed the visualization of the individual's thinking while posting ideas and interacting with one another in a knowledge forum. .

Unlike the abovementioned research focusing on the CSCL approach for elementary-school students' writing, Liu (2011) examined the effects of two types of computer-based concept maps, individual and cooperative, on the writing performance of 94 EFL freshmen with a variety of writing proficiencies. She found that the writing performance was significantly better for low- and middle-level learners using individual and cooperative computer-based concept maps than for those not using such maps, especially with respect to the argumentation traits. However, high-level learners performed better with the individual-mapping treatment than those with the cooperative-mapping treatment. Wu (2007) compared two types of group composition of 60 college students and the effects on cooperative learning of EFL writing, and found that the learning outcomes could be greatly improved when less-capable learners cooperated with more-capable learners in small-group learning activities.

Taking a comprehensive view of the above-mentioned literature, it can be found that the participants of most of the studies were secondary or college students (Kuo, Wible, & Tsao, 2001, Liu, 2011; Wu, 2007). As indicated by Goldberg et al. (2003), computers had a greater impact on writing for middle and high school students than on elementary-school students, in terms of both the quantity and the quality of writing. The meta-analysis research conducted by Bangert-Drowns (1993) also showed that the participants of most studies (21 out of 28) on computers in writing were older than elementary-school students. However, the small portions of studies aimed at investigating CSCL for elementary-school students' writing seem to go against the arguments made by Wepner and Ray (2000), who indicated that computer-supported writing tools offer several advantages that are not available with the traditional paper-and-pencil approach for young writers. The advantages of computer-supported writing include the use of prewriting prompts (like graphics, photographs, and questions that emerging piece of writing), the prewriting tools (like drawing tool, brainstorming area, and electrical note for collecting ideas), text-to-speech tools, writing supports (like rhyming or picture dictionary), and writing mechanics (like spelling check) that encourage students to expand, revise, and edit their works (Wepner & Ray, 2000). Given that computer-supported writing is supposed to be helpful to elementary-school students' writing, the low proportion of studies aiming at applying a CSCL approach to elementary-school students' writing may be due to the fact that the generally used tools are not appropriate for young writers. In fact, most of the tools used in the above-mentioned studies were not particularly designed for elementary-school students' writing activities. To increase the usage of CSCL for young writers, thus, a user-friendly interface should be emphasized when developing a computer-assisted writing tool for elementary-school students as suggested by Wepner and Ray (2000). Furthermore, although some elementary-school students participating in CSCL writing were included in some studies (Hayes & Ge, 2008; Lingnau et al., 2003;

Woo et al., 2011), they were not EFL students. Given that prewriting is important for beginning writers (e.g., Kroll, 2001), how the CSCL approach could be integrated with the prewriting strategies to enhance elementary-school learners' EFL writing performances is needed to be studied by investigating the effects of the combination of CSCL and prewriting strategies on the performance and motivation of young EFL writers.

Based on the results obtained in our pilot study (Lan et al., 2012), the integration of CSCL and prewriting strategies has great potential in enhancing the writing performance of elementary-school EFL learners, but more efforts are needed to confirm the above-mentioned differences among different prewriting strategies. Additionally, the prewriting strategies of interest are as follows: (a) text-based brainstorming (BS) which focuses on listing as many words related to the assigned topic as possible, (b) drawing (DR) which focuses on using pictures to express the idea for the assigned topic, and (c) mind mapping (MM) which focuses on hierarchically labeling nodes and links to express the structure of the assigned topic. The purpose of this study, therefore, is to confirm the effects of the integration of CSCL approach and different prewriting strategies. The research aims are reached via addressing two research questions: in CSCL environment, how do different prewriting strategies affect (a) English writing performance (including grammar knowledge and writing quality) and (b) English writing motivation of elementary-school EFL learners?

METHODS

Participants

This study used convenience sampling to recruit 3 intact classes of fifth-grade students from an elementary school in Taipei City, with 27 students in each class. Each class was randomly assigned to one of the three prewriting-strategy groups: BS, DR, and MM. The students in the three groups received identical instruction in CSCL English writing, except that each group was taught to use different prewriting strategies to collect ideas and organize their writing structure at the prewriting stage of the EFL writing process.

When conducting CSCL writing activities, the participants in each class were further divided into heterogeneous writing groups based on their English achievement scores in the first semester of the fifth grade. Those achieving grade A, grade B or C, and grade D or F were classified as high-, medium-, and low-ability learners, respectively. Each group consisted of four students: one high-ability learner and three medium- or low-ability learners. Each class comprised seven cooperative writing groups.

Instruments

English writing tests

The writing performance of the participants was assessed using two tests designed by the present authors (Lan et al., 2012): the Grammaticality Judgment Test (GJT) (available for downloading from http://tell.aclc.ntnu.edu.tw/images/tools/Grammaticality_Judgement_Test.pdf) and the English Composition Test (ECT). The former mainly focused on testing students' knowledge of English grammars taught in their regular EFL classes, especially the 10 target English forms taught in this study. On the other hand, the latter aimed at evaluating students' overall writing quality, including all the dimensions listed in the writing rubrics, which will be described later. The two tests were reviewed by 3 experts in the teaching of EFL writing and administered to 165 fifth graders at the same school in a pilot study. Additionally, both the ECT and the GJT were administered to all of the participants before and after the treatment as the pre- and posttests. The topic of this written test (ECT) was "A Bad Day," which asked the participants to describe one of their daily life experiences that were relevant to the everyday lives of students.

English writing motivation scale

The English writing motivation scale (EWMS) (available for downloading from http://tell.aclc.ntnu.edu.tw/images/tools/English_Writing_Motivation_Scale.pdf) used in this study for measuring the motivation of the participants for writing English compositions was a revised version of the writing motivation scale reported by Yeşilyurt (2008). The EWMS was piloted by administering it to 165 fifth-grade students from the same school (Lan et al., 2012); this produced a reliability coefficient of .93 for the 29-item scale.

Teaching materials

Three teaching packages designed by the authors were used in this study. The structure of the teaching materials, which was based on the guidelines given by Gower et al., (1995), focused on the writing process rather than simply on final output, and included five steps: introduction, working with ideas, planning, drafting, and reviewing/editing. Each package consisted of structured teaching materials and detailed instructions to help students produce writing output, such as English riddles and English stories.

Writing rubrics

This study adopted the detailed scoring guidelines of Jacob, Zingraf, Wormuth, Hartfiel, and Hughey (1981) to assess the qualities of the writing compositions of the learners using five writing rubrics: writing content (WC), writing organization (WO), vocabulary and word choice (WV), language use (grammar) (WF), and writing mechanics (WM). The complete rubrics are available for downloading from http://tell.aclc.ntnu.edu.tw/images/tools/Writing_Rubrics.pdf.

CSCL writing platform

Poetry Zone, the CSCL writing platform used in the study, was developed by the authors. It includes six modules as shown in Figure 1, aimed at providing L2 learners with explicit grammatical instruction and opportunities to produce their written work. Figures 1, 2, and 3 show the homepage of the CSCL writing platform, a snapshot of the module of the Poem Hunt Team, and the three prewriting strategies taught in this study, respectively. The functions of each module also briefly listed under each module in Figure 1. Detailed information about Poetry Zone can be found at http://tell.aclc.ntnu.edu.tw/images/tools/Poetry_Zone.pdf.

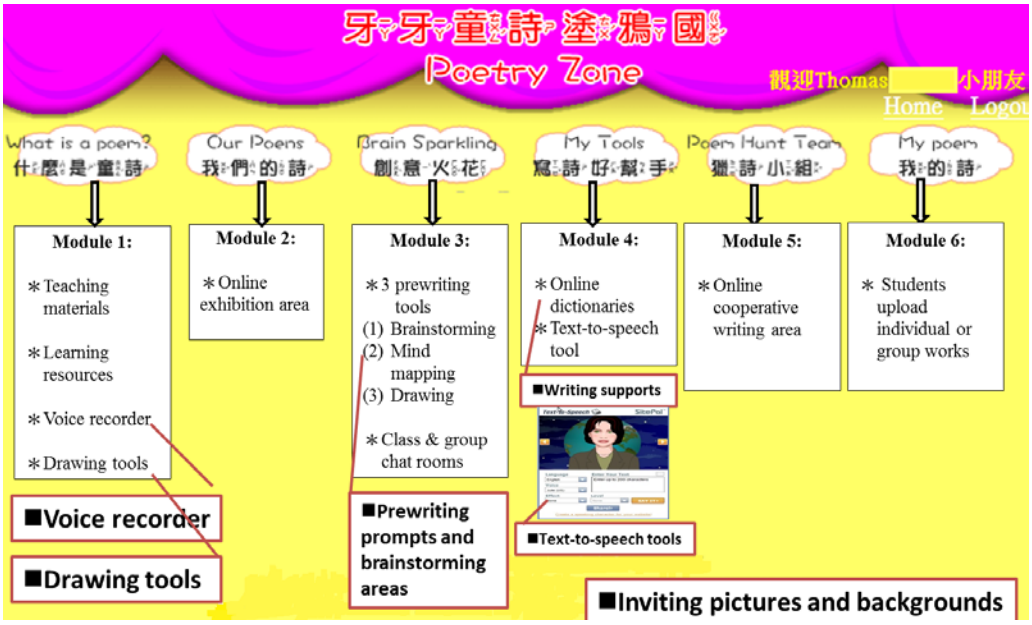

Figure 1. The CSCL writing platform homepage.

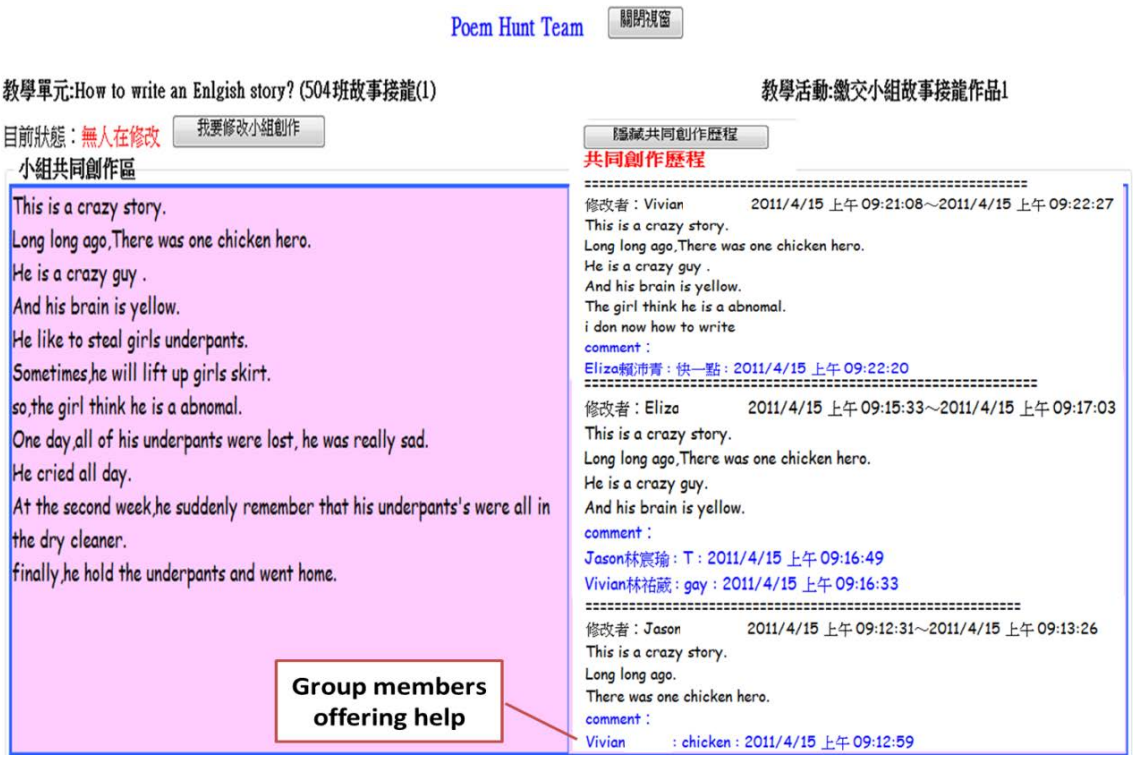

Figure 2. The Poem Hunt Team module.

(a)

(b)

(c)

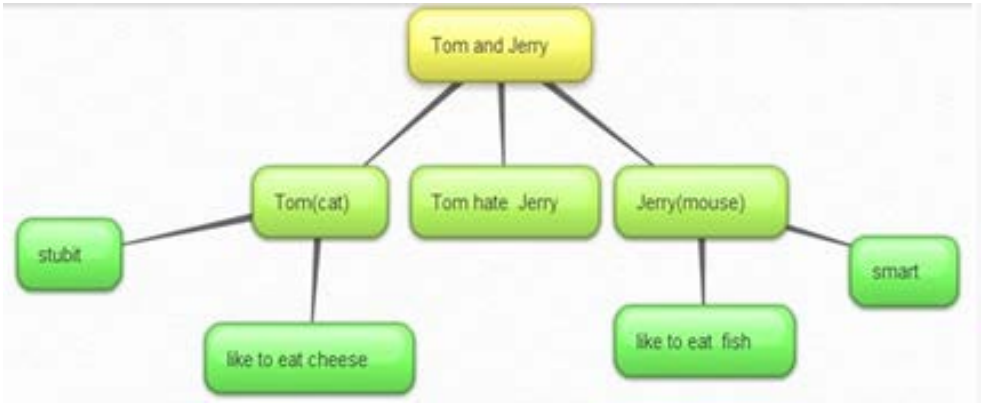

Figure 3. The three prewriting strategies: (a) BS, (b) DR, and (c) MM.

Design

This study adopted a quasi-experimental design to investigate the effects of the three different prewriting strategies on the writing performance and motivation of elementary-school EFL learners. The pre- and posttest scores of the writing tests and motivation questionnaire were analyzed using a two-way mixed-design ANCOVA to determine how the participants in the BS, DR, and MM groups differed in terms of their writing performance and English writing motivation. The covariate was the English scores of the participants obtained in the previous semester. The level of statistical significance was set at $\alpha = .05$.

Procedure

The treatment lasted for 6 weeks, with each class period lasting 40 minutes and was performed twice weekly. Figure 4 shows the research procedure of this study. Before the treatment, the participants completed the EWMS questionnaire and took both English writing tests to determine their pretreatment EFL writing motivation and performance. They were also asked to set up cooperative learning rules for their own English writing class. All of the participants then received training on using the CSCL writing platform.

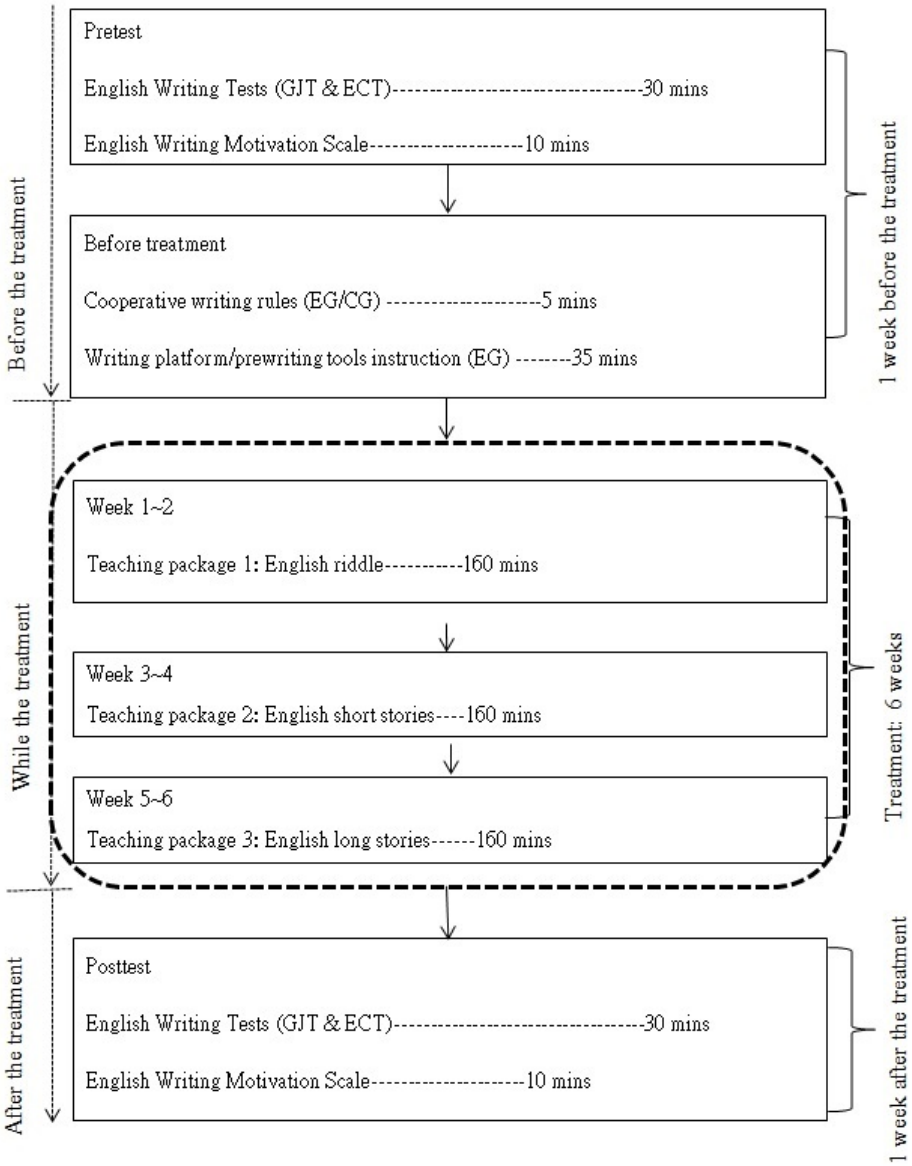

Figure 4. Research procedure.

During the four periods in the two weeks of each teaching package, the participants first received instructions on how to write a riddle or a story based on a five-step writing process (in the first two periods). The instructions given to the three groups (BS, DR, and MM) were identical, except each group was asked to use different prewriting strategies on the CSCL writing platform while collecting ideas and making writing plans during the prewriting stage. As shown in Figure 3, while using BS, all group members could type, edit and share their ideas with peers at the same time. The DR tool is capable of providing the similar functions as the BS, except what students create are pictures rather than texts. The MM tool also provides students with a user-friendly environment to cooperate with peers to plan their writing via adding idea nodes and typing tags for each node and organizing the relationship among those cooperatively created idea nodes. Soon after they finished idea collection, they worked on their own, writing their own individual written tasks according to the group discussions, before submitted their works to the CSCL writing platform. In the second two periods they started their cooperative writing tasks. They had to submit their group written work and conduct peer assessment. Each group presented

and shared their riddles or stories with the whole class.

One week after the 6-week treatment, all the participants again took the English writing tests and completed the EWMS questionnaire. During the whole treatment, the procedures, time limits, and the contents in the English writing tests, as well as the EWMS questionnaire provided for the three groups were the same.

RESULTS

The collected data included the scores from the two English writing tests (both the grammar and the composition tests, i.e., the GJT and the ECT) and the EWMS (motivation scale). Table 1 lists the results of the three tests. All three scores were further analyzed via a two-way mixed-design ANCOVA. The independent variables were the group (MM, DR, and BS) and test (pre- and posttests); the dependent variables were the scores from the ECT, the GJT, and the EWMS; the covariant was the score of the latest English achievement test which was administered in the participants' original English classes before the current study. The homogeneity tests of regression coefficients were all non-significant (GJT: $F = 1.509$, $p = 1.211$; and ECT: $F = 1.092$, $p = .170$; EWMS: $F = .643$, $p = .529$). More detailed explanation of the analysis results is provided below.

Table 1. *Descriptive Statistics of English Writing Tests (GJT & ECT) and Writing Motivation (EWMS)*

Test	Group ($N = 27$)	GJT		ECT		EWMS	
		M	*SD*	*M*	*SD*	*M*	*SD*
Pretest	MM	46	16.22	12.71	7.11	4.03	0.86
	DR	47.44	15.12	12.22	8.28	3.67	0.75
	BS	43.78	19.64	11.38	8.91	3.53	1.03
Posttest	MM	55.33	12.29	15.98	6.70	4.35	0.74
	DR	57.93	15.85	14.81	7.33	4.12	0.92
	BS	51.89	19.39	13.01	8.31	3.61	0.97

Note. MM=mind mapping group; DR=drawing group; BS=text-based brainstorming group; GJT=Grammaticality Judgement Test; ECT=English Composition Test; EWMS=English writing motivation scale.

Comparison of Learning Gains on English Grammaticality Judgement (GJT)

Table 2 lists the results of the two-way ANCOVA analysis, which shows insignificant effects for group and group-by-test interaction. On the other hand, the results of the GJT reached a significant level ($F = 115.89$, $p < .001$) due to the significant improvement made by both the MM and the DR groups, as shown in Table 3 of the main-effect analysis results (MM: $F = 5.68$, $p = .021$; DR: $F = 6.18$, $p = .016$). The results indicate that the CSCL prewriting strategies the MM and DR groups both significantly benefited EFL writers' grammar judgement ability, while the CSCL text-based brainstorming strategy did not.

Table 2. *Two-way ANCOVA for the Grammaticality Judgement Test (GJT)*

Factors	Type III *SS*	*df*	*MS*	*F*	*Sig.*
Group (three prewriting strategies)	847.61	2	423.80	2.62	.077
Test (GJT)	3509.36	1	3509.36	115.89	.000***
Group × Test	37.94	2	18.97	0.12	.889
Errors	787.31	26	30.28		

*Note. df=degrees of freedom, *p < .05, **p < .01, ***p < .001.*

Table 3. *Main-Effect Analysis of the Prewriting Strategies and the Grammaticality Judgement Test*

Factor	*SS*	*df*	*MS*	*F*	*Sig.*
Group (three prewriting strategies)					
GJT at pretest	424.40	2	212.20	1.51	.225
GJT at posttest	475.87	2	237.93	1.69	.188
Test (GJT)					
MM	1176.00	1	1176.00	5.68	.021*
DR	1483.13	1	1483.13	6.18	.016*
BS	888.17	1	888.17	2.33	.133

*Note. df=degrees of freedom, *p < .05, **p < .01, ***p < .001.*

Comparison of Learning Gains on English Composition (ECT)

Whole composition comparison

For scoring the ECT pre and posttests, two raters received training on how to score written texts before performing the formal ratings. The Pearson product-moment correlation of the scores from the two raters was .997.

A second two-way ANCOVA was run for the ECT results, as listed in Tables 4 and 5. The results listed in Table 4 indicated that no significant group or test-by-group effects were found, contrary to the results of the ECT (F = 52.70, p = <.001). However, the significant effect was due to the significant improvement made only by the MM group as shown in the main-effect analysis results (Table 5, MM: F = 4.91, p = .028).

Table 4. *Two-Way ANCOVA for the English Composition Test (ECT)*

Factors	Type III *SS*	*df*	*MS*	*F*	*Sig.*
Group (three prewriting strategies)	48.55	2	24.27	0.71	.492
Test (ECT)	251.88	1	251.88	52.70	.000***
Group × Test	18.29	2	9.15	0.27	.765
Errors	124.27	26	4.78		

*Note. df=degrees of freedom, *p < .05, **p < .01, ***p < .001.*

Table 5. *Main-Effect Analysis of the Prewriting Strategies and the English Composition Test (ECT) (df=degrees of freedom)*

Factor	*SS*	*df*	*MS*	*F*	*Sig.*
Group (three prewriting strategies)					
ECT at pretest	63.35	2	31.68	1.08	.342
ECT at posttest	4.46	2	2.23	0.08	.927
Test (ECT)					
MM	144.22	1	144.22	4.91	.028*
DR	90.09	1	90.09	3.07	.082
BS	35.85	1	35.85	1.22	.271

*Note. df=degrees of freedom,*p < .05, **p < .01, ***p < .001.*

Detailed comparison of English composition based on five writing scoring dimensions

A detailed comparison of individual dimensions of English composition was conducted. Table 6 lists the descriptive statistics of the five dimensions of English composition, writing content (WC), writing organization (WO), English vocabulary used and word choice in a composition (WV), writing form (WF), which is evaluated as EFL writers' English grammar ability in a composition, and writing mechanics (WM). Both the two-way ANCOVA analysis results and the main-effect analysis of the individual dimension are listed in Tables 7 and 8, respectively.

Based on the data listed in Table 7, the two-way ANCOVA analysis results of individual dimensions are as follows: the significant effects are identified for Test (pre- and posttest) factors in all the dimensions, while both Group (three CSCL prewriting strategies) and test-by-group effects are not. The main-effect analysis results (Table 8) indicate that those significant results were due to the significant improvement in WV (MM group: $F = 6.75$, $p = .010$), WF (MM group: $F = 4.64$, $p = .033$), and WM (MM group: $F = 6.57$, $p = .011$; DR group: $F = 4.05$, $p = .016$). Regarding WC and WO, although the three CSCL prewriting groups all made improvements in posttests, the improvements did not reach significant level.

Table 6. *Descriptive Statistics of ECT Results for the MM, DR, and BS Groups Based on Five Writing Rubrics (N=27 for all groups)*

Test & Group	WC		WO		WV		WF		WM	
	M	*SD*	*M*	*SD*	*M*	*SD*	*M*	*SD*	*M*	*SD*
Pretest MM	2.81	1.49	2.77	1.50	2.49	1.49	2.39	1.35	2.26	1.39
DR	2.71	1.72	2.61	1.71	2.43	1.68	2.27	1.64	2.20	1.61
BS	2.53	1.83	2.44	1.90	2.25	1.82	2.06	1.74	2.09	1.68
Posttest MM	3.35	1.41	3.34	1.40	3.27	1.28	3.03	1.37	2.99	1.28
DR	3.19	1.57	3.15	1.60	2.94	1.41	2.74	1.49	2.78	1.34
BS	2.81	1.75	2.80	1.75	2.56	1.58	2.40	1.65	2.45	1.64

Note. MM=mind mapping group; DR=drawing group; BS=test-based brainstorming group; WC= writing content; WO= writing organization; WV= vocabulary and word choice; WF= grammar/forms; WM= writing mechanics; M= mean; SD=standard deviation

Table 7. *Two-Way ANCOVA for the Prewriting Strategy Group (PwSG) and the English Composition Test (individual dimensions)*

Factors		Type III *SS*	*df*	*MS*	*F*	*Sig.*
Content	Group	2.82	2	1.41	0.95	.388
	Test	7.67	1	7.67	35.28	.000***
	Group × Test	0.53	2	0.27	0.18	.836
	Errors	5.65	26	0.22		
Organization	Group	2.42	2	1.21	0.79	.456
	Test	9.63	1	9.63	43.44	.000***
	Group × Test	0.38	2	0.19	0.13	.883
	Errors	5.76	26	0.22		
Vocabulary	Group	1.14	2	0.57	0.41	.664
	Test	11.55	1	11.55	43.11	.000***
	Group × Test	1.51	2	0.76	0.54	.582
	Errors	6.96	26	0.27		
Form	Group	1.13	2	0.57	0.41	.664

	Test	9.39	1	9.39	51.54	.000***
	Group × Test	0.63	2	0.32	0.23	.796
	Errors	4.74	26	0.18		
Mechanics	Group	2.60	2	1.30	1.03	.360
	Test	12.50	1	12.50	51.15	.000***
	Group × Test	0.93	2	0.47	0.37	.692
	Errors	6.35	26	0.24		

*Note. df=degrees of freedom,*p < .05, **p < .01, ***p < .001.*

Table 8. *Main-Effect Analysis for the Prewriting Strategy Group and the English Composition Test (individual dimensions)*

Factor			*SS*	*df*	*MS*	*F*	*Sig.*
Content	Group	At pretest	2.81	2	1.41	1.10	.335
		At posttest	0.61	2	0.30	0.24	.788
	Test	MM	4.03	1	4.03	3.16	.078
		DR	3.13	1	3.13	2.45	.119
		BS	1.04		1.04	0.82	.368
Organization	Group	At pretest	2.33	2	1.16	0.88	.417
		At posttest	0.54	2	0.27	0.21	.814
	Test	MM	4.45	1	4.45	3.37	.068
		DR	3.89	1	3.89	2.95	.088
		BS	1.67	1	1.67	1.27	.262
Word Choice & Vocabulary							
	Group	At pretest	2.63	2	1.32	1.09	.340
		At posttest	0.01	2	0.00	0.00	.997
	Test	MM	8.17	1	8.17	6.75	.010*
		DR	3.63	1	3.63	3.00	.085
		BS	1.26	1	1.26	1.04	.309
Form	Group	At pretest	1.74	2	0.87	0.73	.483
		At posttest	0.05	2	0.02	0.02	.981
	Test	MM	5.51	1	5.51	4.64	.033*
		DR	3.01	1	3.01	2.54	.113
		BS	1.50	1	1.50	1.26	.263
Mechanics	Group	At pretest	3.34	2	1.67	1.52	.222
		At posttest	0.25	2	0.12	0.11	.894
	Test	MM	7.22	1	7.22	6.57	.011*
		DR	4.45	1	4.45	4.05	.016*
		BS	1.76	1	1.76	1.60	.208

*Note. df=degrees of freedom,*p < .05, **p < .01, ***p < .001.*

Comparison of EFL Writing Motivation (EWMS)

All of the students were asked to complete an EWMS questionnaire both before and after the treatment. The results are presented in the two columns on the right in Table 1. Additionally, Table 9 summarizes the results of the two-way ANCOVA of the EWMS.

The results revealed a non-significant test-by-group (F = .56, p = .572) interaction but significant main effects for group (F = 3.55, p = .032) and test (F = 12.25, p = .002). Post-hoc tests (the Scheffe test) showed (Table 10) that the main-effect of Group (three CSCL prewriting strategies) reached significant level (F = 4.89, p = .009) due to the fact that the MM group outperformed the BS group in the posttest (*Mean Difference = .739, p* = .003). In contrast, the main-effect of Test (EWMS pre- and pottest) did not reach any significant levels even if the DR group almost did (F = 3.86, p = .055).

Table 9. *Two-Way ANCOVA for the English Writing Motivation (EWMS)*

Factors	Type III *SS*	*df*	*MS*	*F*	*Sig.*
Group (three prewriting strategies)	5.93	2	2.97	3.55	.032*
Test (EWMS)	3.30	1	3.30	12.25	.002**
Group × Test	0.94	2	0.47	0.56	.572
Errors	7.00	26	0.27		

*Note. df=degrees of freedom, *p < .05, **p < .01, ***p < .001.*

Table 10. *Main-Effect Analysis of the Prewriting Strategies and the English Writing Motivation (df=degrees of freedom)*

Factor		*SS*	*df*	*MS*	*F*	*Sig.*
Group	EWMS at pretest	1.97	2	0.99	1.32	.270
	EWMS at posttest	7.70	2	3.85	4.89	.009**
Test	MM	1.42	1	1.42	2.20	.144
	DR	2.72	1	2.72	3.86	.055
	BS	0.09	1	0.09	0.09	.764

*Note. df=degrees of freedom, *p < .05, **p < .01, ***p < .001.*

DISCUSSION

Research studies have produced data supporting the effects of computer-supported cooperative writing and prewriting-strategy instruction on the English writing performance (e.g., Anderson-Inman & Horney, 1997; Liu, 2011; Saddler et al., 2004) and motivation (e.g., Hayes & Ge, 2008) of students. However, despite the abovementioned positive evidence, few studies investigated the effects of integrating CSCL and prewriting strategies on elementary-school EFL learners' writing performance or motivation. Furthermore, regarding the studies on the prewriting strategies, most of the literature mainly focused on the effects of explicit/implicit (Holmes, 2003) or with/without (Saddler et al., 2004) prewriting strategy instruction on language learners' writing performance, rather than the differences that might exist in how different prewriting strategies may benefit elementary-school EFL writers' performance and motivation. To fill in the gap, the authors based the current study on a pilot study conducted by the present authors (Lan et al., 2012). In the current research, the authors have provided empirical validations for the significant superiority of CSCL prewriting-strategy instruction over traditional cooperative paper-and-penciled based instruction. The results were obtained by further investigating the effects of using different CSCL prewriting strategies [mind mapping (a hierarchical diagram with text and image), drawing (a story-telling picture with images only), and text-based brainstorming (a list of idea or concepts with text only)] on elementary-school EFL writers' learning gains, including grammar knowledge, writing quality, and writing motivation.

Regarding the results of writing tests obtained from this study, although all the students among the three different CSCL prewriting strategy groups got higher scores in posttests, only students who used mind mapping and students who used drawing during the prewriting stage made significant improvement in

GJT. In addition, only the students who used the MM strategy improved significantly in ECT. The further investigations into different dimensions of English composition showed that MM strategy benefited students more than the other two strategies, especially in vocabulary choices, writing forms, and mechanics, although DR also benefited students in the dimension of writing mechanics. The findings obtained from the current study confirmed the results of the recent studies on prewriting strategies (e.g., Saddler et al., 2004; Whitney et al., 2008): explicit prewriting strategy instruction improves the writers' performance. Such findings are also consistent with those of Anderson-Inman and Horney (1997) and Lee (2013) that a computer-supported MM strategy can enhance students' writing by promoting visual thinking which is a process in which students generate and organize their ideas in preparation for writing via drawing a system (structure) of nodes (to represent concepts) and links (to represent the relationship between concepts) (Anderson-Inman & Horney, 1997). However, the results conflict with those of Lin, Strickland, Ray, and Denner (2004), who found that computer-based MM benefited the writing planning and idea collection of native English students but not their writing performance. It should be noted that those researchers did not apply cooperative learning in the prewriting and writing process. While considering CSCL, the study of Liu (2011) indicated that the quality of the mind maps was higher for those constructed cooperatively than for those constructed individually, and was also correlated with the writing performance of college students. However, the abovementioned effects of CSCL MM are only observed on mid- and low-level EFL college students' writing performances, while high-level ones preferred individually creating their own mind mapping for planning their writing. Whether the results of the current study were also affected by the elementary-school students' levels, as was identified for college EFL writers, is an issue which needs further investigation.

Furthermore, as to the results of English writing motivation test (EWMS), although all three prewriting strategy groups expressed more positive motivation at posttest (Table 1), the extent of improvement did not reach significant levels. However, in the MM group, the students' motivation was significantly higher than those of the text-based brainstorming group after the treatment (posttest). In brief, CSCL MM strategy appears to most benefit elementary-school EFL writers based on the overall results of the three tests: GJT, ECT, and EWMS. This result is consistent with the results obtained from the studies conducted by Lin et al. (2004): a computer-based MM strategy benefits all elements of writing by students; it is also effective at fostering students to write better.

Although the effects of using the mind mapping strategy on EFL writers' performance and motivation was confirmed, the less effective findings for the text-based brainstorming strategy on elementary-school EFL writers' performance is also worthy of researchers' attentions because the brainstorming list is a very commonly used prewriting strategy in writing classes (e.g. Kroll, 2001; Reid, 1987). Furthermore, based on Olson (1992), drawing (DR) is viewed as a very suitable prewriting strategy for young EFL writers when they needed to collect and organize their writing ideas in pressure-free situations. However, DR strategy did not bring its effects into full play in this study. Those students using the DR strategy for planning their composition made significant improvements only in the grammaticality judgement and the writing mechanics. In contrast, what Olson (1992) found was that the DR strategy benefited students' vocabulary use, which was not found in the current study.

Were the above-mentioned results due to the bad fit of the prewriting strategies to some elementary-school EFL writers' learning styles? Although all three prewriting strategies in the current study were visual-oriented, mostly preferred by the Chinese students, based on Reid's study (1987), some differences exist among the three strategies. The DR strategy includes the main organization of a composition, while the text-based brainstorming strategy mainly includes written words/concepts for later composition writing. In contrast, the MM strategy includes both written words/concepts and the organization of a composition. Thus, although all the three prewriting strategies used in this study were visual-oriented, the information possessed by the individual one was different. As suggested by Oxford (2003), when a given strategy fits the particular student's learning style preference, it will be helpful for a given learner. Thus,

the different pieces of information acquired by using different prewriting strategies may influence the results of the fitness between prewriting strategies and elementary-school EFL writers' learning styles. Furthermore, in addition to the issue of learning style fitness, is it possible that the differences in information possession among different prewriting strategies may influence elementary-school EFL writers' cognitive load while doing a composition? According to the arguments given by Chamot (2005), beginners struggle with finding the words they need and remembering grammatical conventions in writing. Kellogg (2008) also argued that reducing the working memory cost of planning, sentence generation, and reviewing process can release the executive attention which is devoted to managing article writing, the words/concepts and organization of a composition prepared in the prewriting stage can be beneficial to young EFL writers. The answers to the two questions above raised here will be valuable to the expansion of the knowledge of instruction in and research on writing strategies.

In addition to the three possible factors discussed above that affected the effects of different prewriting strategies on young EFL writers' performance and motivation, the process of CSCL prewriting might also need to be taken into account. According to the report of Whitney et al. (2008), although prewriting instruction was delivered in two classes, the differences identified in the prewriting processes in the two classes (one class was student-centered while the other was teacher-centered) had achieved different writing outcomes. Even though CSCL were applied in all of the three prewriting strategy groups, the cooperation presses might be different among the three groups. Thus, the qualitative information of CSCL prewriting behaviors should be also collected and analyzed in the future study to clarify the concerned issue.

CONCLUSION

The current study has preliminarily confirmed that different CSCL prewriting strategies benefit different aspects of the writing performance of young EFL beginning learners as well as their English grammar forms and motivation. The findings of this study indicated that (a) the CSCL MM strategy has significantly benefited young EFL writers' grammar knowledge, and learners using this strategy outperformed those using the other two strategies in word choice and forms in the English composition and writing motivation; (b) the CSCL DR strategy also significantly benefited young EFL writers' grammar knowledge, and improved young EFL writers in writing mechanics; and (c) the CSCL BS strategy seems less beneficial to young EFL writers' performances and motivation. Owing to BS showing the smallest learning effect on almost all of the items, it does not seem to be an appropriate strategy for elementary-school young EFL writers in Taiwan. However, this is only a temporary argument; further investigation should be conducted in future studies. In contrast, the MM and DR strategies are feasible in EFL beginning writing classes, and teachers can choose either of them when assisting students according to their different learning needs. In other words, EFL teachers can adopt different strategies according to different types of instruction or learning goals, and the different learning needs of students, as suggested by Chamot (2005), who claimed that tasks should be carefully chosen for providing students with the opportunities of practicing strategies. Furthermore, in addition to individual student differences, including learning styles and English ability, and prewriting strategies, the CSCL prewriting process should also be further investigated in future research.

In addition to the examination of the prewriting strategies used in different groups, the students in this study were all found to have more positive motivation with the application of the CSCL prewriting strategies in their English writing courses. Therefore, it is suggested that technology should be incorporated as part of writing instruction for young learners so as to promote writing cooperation and motivation, as well as increasing interaction, sharing, and feedback among peers, writers, and readers, and also between teachers and students.

However, some limitations of this study should be dealt with in future research. In addition to the issues described in the Discussion section which mentions the lack of the foci on EFL ability levels, young EFL

learners' learning styles, and qualitative observation of CSCL process, the fact that this research focuses only on English riddles and stories is also a limitation. Although the young EFL writers are familiar with the two writing styles, effectively reducing their demands on working memory while writing (Kellogg, 2008), whether the two prewriting strategies, drawing and text-based brainstorming, benefit other styles of writing tasks performed by elementary-school EFL beginning writers needs further investigation. Additionally, each of the participating class was randomly assigned a prewriting strategy for the writing plan, the differences in the learning styles and their English proficiency levels not considered. Although the effects of such individual differences might have been canceled out due to the average performance being considered, how different prewriting strategies could be beneficial to the writing performance of individual students requires further investigation.

In summary, the results of the present indicate that different CSCL prewriting strategies exert different effects on the English writing performance and motivation of young EFL students. The study findings add to the knowledge of research on CSCL prewriting for young EFL learners, thereby complementing the previous literature about college students as well as native English speakers. For practical application, it is suggested that EFL teachers should consider the different effects of using different strategies on young EFL beginning writers from different aspects so as to maximize the learning effects on their students. Additionally, the relationship between prewriting strategies and individual differences of young beginning writers should receive greater attention from L2 researchers and educators.

ACKNOWLEDGEMENTS

The authors would like to thank the Ministry of Science and Technology, Taiwan, R.O.C., for financially supporting this research under Grant Nos. NSC 101-2511-S-003-031-MY3, MOST 104-2911-I-003-301, and MOST 103-2628-S-003-002-MY3. They are also thankful that this research is partially supported by the Aim for the Top University Project and Center of Learning Technology for Chinese of National Taiwan Normal University (NTNU), sponsored by the Ministry of Education, Taiwan, R.O.C., and the International Research-Intensive Center of Excellence Program of NTNU.

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