A MOBILE-DEVICE-SUPPORTED PEER-ASSISTED LEARNING SYSTEM FOR COLLABORATIVE EARLY EFL READING

Yu-Ju Lan
Yao-Ting Sung
Kuo-En Chang
National Taiwan Normal University

Collaborative learning methods which emphasize peer interaction have been widely applied to increase the intensity and effectiveness of EFL reading programs. However, simply grouping students heterogeneously and assigning them group goals does not guarantee that effective collaborative learning will ensue. The present research includes two studies. In Study One, the weaknesses of collaborative learning in a traditional EFL setting were observed. Then, in Study Two, a mobile-device-supported peer-assisted learning (MPAL) system was developed for the purpose of addressing the identified weaknesses. Two classes of twenty-six third grade students participated in the present research to examine the unique contribution of MPAL to collaborative EFL reading activities. The collaborative behavior of elementary EFL learners was videotaped and analyzed. Detailed analysis of the videotaped behavior indicated that MPAL helped improve collaboration in elementary school level EFL learners and promotes their reading motivation.

INTRODUCTION

Due to increased globalization and internationalization in recent decades, English has become the *lingua franca* of the world due to its widespread use in academia, business, commerce, and technology (Spolsky & Shohamy, 1999). As a result, study of the English language has increased worldwide. In Taiwan, formal English as a foreign language/English as a second language (henceforth referred to simply as EFL) instruction begins at the elementary school level. However, because of the limited opportunities for exposure to English, Hirvela (2004) highlighted the importance of providing reading materials to second language (L2) learners so that they can learn the rhetoric and writing styles of the language through reading. Moreover, there is a growing recognition that reading provides important opportunities for L2 development (Day & Bamford, 1998). Reading is especially important for learners of EFL in an educational setting with limited L2 resources (Gehard, 1996). Therefore, the teaching of English reading is receiving increasing attention from EFL teachers and researchers.

To achieve the reading goals set for elementary learners, intensive intervention programs have been viewed as an effective approach (Clay, 1993; Foorman & Torgesen, 2001; Hiebert, Colt, Catto, & Gury, 1992; Slavin, Madden, Karweit, Dolan, & Wasik, 1992; Taylor, Frye, Short, & Shearer, 1992). Further, collaborative learning that includes groups working together and peer assistants has been widely used in English reading programs to create the necessary intensity and strong support for learning. Numerous studies have confirmed the positive educational effects of collaborative learning on the instruction of English reading. Collaborative learning (or peer-assisted learning) can improve the cognitive activity of students (Hartup, 1992) and their reading outcomes (Greenwood, 1996; Ghaith, 2003; Slavin, 1988). Collaborative learning can also increase motivation and satisfaction (Ushioda, 1996), as well as the enthusiasm of students through the achievement of goals as a group (Nichols & Miller, 1994).

Although the effectiveness of collaborative learning in EFL reading has been clearly demonstrated, a collaborative learning environment in an EFL classroom in Asia may differ markedly from one in the West. Other pedagogical challenges (such as the diversity of students' reading ability, social and

economic differences, class size, time constraints, and available resources) become problematic when EFL teachers try to adopt collaborative methods for reading instruction in traditional EFL classes (Curtis, 1998; Lan, Chang, & Sung, 2004; Reed, 2002).

Mobile technology is currently a feasible approach to overcoming many of the obstacles in current methods of EFL reading instruction. Standing on the shoulders of the giant, CALL (Computer Assisted Language Learning, e.g., Barker & Torgesen, 1995; Mioduser, Tur-Kaspa, & Leitner, 2000; Speziale & La-France, 1992; Sung, Huang, & Chang, under review), mobile assisted language learning (MALL) has the capability of providing EFL learners with the same opportunities for independent and targeted reading practice and immediate corrective feedback as CALL. In recent years, many studies have explored new methods of language learning made possible by the unique features of MALL, including portability, social interactivity, context sensitivity, connectivity, individuality, and immediacy (Attewell & Webster, 2004; Chinnery, 2006; Klopfer, Squire, & Jenkins, 2002; Soloway et al., 2001).

Research suggests that MALL has excellent potential for providing students with rich, real time, collaborative and conversational experiences both in and outside the classroom. However, the focus of MALL is mostly on speaking (Kukulska-Hulme, 2005), vocabulary (Thornton & Houser, 2005), phrases (Thornton & Houser, 2005; Morita, 2003), and grammar (Sung, Huang, & Chang, 2006), rather than early reading skills. Furthermore, most subjects in recent studies of MALL have been college students. Few studies have investigated how mobile technology benefits the reading skills of elementary students. The subjects of studies by Zurita and Nussbaum (2004) (6- and 7-year old children) and Soloway and his colleagues (2001) (k-12 students) are exceptions, but the learning objective in these studies was not specifically English reading skills. Further, although the most widely used hand-held devices (e.g., cellular phones, personal digital assistants, and mp3 players such as iPods) have a good reputation in MALL research, their small screens have been frustrating (Carlson, 2002).

Considering the limited number of MALL studies focusing on early EFL reading skill training, and fewer studies using elementary EFL learners as participants, the purpose of this research was to investigate how mobile technology benefits collaboration in elementary EFL learners. Rather than measuring specific learning gains, this research focuses on the weaknesses of collaborative learning in traditional EFL reading activities and how these weaknesses could be overcome by using mobile technology. To achieve this objective, two studies were conducted. In the first study, collaborative learning behavior was observed in elementary EFL students to clarify deficiencies in traditional reading activities. In the second study, for the purpose of enhancing collaboration in elementary EFL learners, we first developed a mobile-device-supported peer-assisted learning (MPAL) system based on the results of Study One. In addition to the characteristic of mobility, the MPAL was implemented on Tablet PCs under the considerations of its bigger screen size, compared with the hand-held devices mentioned above, as well as the easy input equipment (stylus) that Tablet PCs could provide. The efficacy of MPAL in overcoming the perceived limitations of traditional collaborative learning was then assessed.

STUDY ONE: COLLABORATIVE EFL READING ACTIVITIES WITHOUT TECHNOLOGICAL SUPPORT

To develop a mobile-device-supported reading system that can enhance collaborative learning in EFL students, learners were first observed in class during traditional reading activities. All student activities were videotaped and analyzed by two observers. The analysis was intended to identify deficiencies in collaborative reading in traditional EFL settings, as well as the opportune moment to introduce mobile technology in EFL learners' collaborative reading activities.

Methods

Design

The first study was conducted during the first semester of the school year using a quasi-experimental design. Two classes of third grade students using identical materials participated in this study. One class (experimental group) learned reading using the collaborative learning approach, and the other class (control group) learned reading by individual learning and whole class activities led by the EFL instructor. All reading activities were videotaped for subsequent analysis by two observers who were instructed to record and analyze all collaborative behavior and interactive discourse observed in the experimental group.

Participants

The subjects in Study One included 52 third grade students (two classes of 26 students, 14 males and 12 females in each class) from an elementary school in Taipei, Taiwan. One class was randomly chosen as the experimental group and the other as the control group. All enrolled subjects were considered beginning-level learners, although they had received two years of EFL instruction in elementary school. According to the Taipei Municipal Education Department's standards for the elementary school English curriculum, all third-grade students must learn all letters in the English alphabet, 30 words, and 20 sentences of basic daily conversation and classroom English.

The students were divided into heterogeneous reading groups based on their level of English achievement in the second grade. Grade A students were classified as high reading ability, those at grade B or C were classified as medium reading ability, and those at grade D or Fail were classified as low reading ability. As a result, the experimental group had 6 high-ability, 11 medium-ability, and 9 low-ability students; the control group had 7 high-ability, 10 medium-ability, and 9 low-ability students. Students with more advanced English ability (referred to as "group leaders") were grouped with two or three students with lower ability (medium- and low-ability students) which resulted in both classes having seven reading groups (each consisted of five groups with four members and two groups with three members).

Instruments

Description of early EFL reading activities and teaching materials. Study One employed a program with five basic-level teaching packages. The lesson structure of the teaching materials was based on a balanced foundation of language skills: each teaching package included instructional material for basic linguistic-skills (phonemic awareness, phonics rules, and sight words) as well as text reading articles. This study package was similar to the one used in the second study (Appendix D). The basic linguistic skills training module for each teaching package included phonics rules and selected English words for instruction in sight identification. Based on the linguistic skill objectives in each teaching package, a carefully tailored written text was used as reading material to provide the students with opportunities to apply their skills to comprehending written text.

Each teaching package included two activities and lasted for two periods (40 minutes each period; 160 minutes for each teaching package). In general, elementary school students in Taiwan receive two periods of instruction on English each week; therefore, each teaching package was taught over a period of two weeks. Thus, the five teaching packages were applied for a total of 10 weeks. In the initial series of two-period reading activities, both groups used printed materials to practice basic linguistic skills together as a class or by working in pairs. In the second series of two-period activities, the two groups learned via different approaches. The experimental group engaged in collaborative group reading activities in which the students were permitted to assist each other when reading the assigned text. However, the students in the control group received instruction from the EFL teacher or were asked to practice individually.

Procedure

Before the experiment, the students in the experimental group were asked to agree on and follow their own collaborative reading rules (Appendix A). In the first two-lesson activities, the EFL teacher instructed the students in sight words, phoneme segmentation, and phonics rules. After direct modeling (in which the EFL teacher demonstrated the correct pronunciation of sight words and explicitly presented the phonics rules employed to decode and encode English words), the EFL teacher led entire-class activities and inter-group speed-reading contests. At the second of the two-lesson activities of each teaching package, the students in the experimental group participated in collaborative text reading activities while seated in groups around a desk. Each student read the text according to a step-by-step reading guide (Appendix B), after which they performed peer assessment. Whenever they encountered a problem reading a word or comprehending its meaning, the students were permitted to ask for instructed help from their group leader or groupmates.

In contrast with the experimental group, the students in the control group used identical reading materials but only received instruction from the teacher in the first two-lesson activity. In the second two-lesson activity, the students were then asked to read the articles individually following a simplified version of the step-by-step reading guide (Appendix C).

Data collection

During the experiment, video-cameras were installed in two corners of the room so that each camera could videotape four reading groups. Additionally, seven digital voice recorders were used to record oral discourse between group members. Upon completion of the reading activity, two observers reviewed all videotaped group reading sessions. The observers were instructed to record and classify all intra-group interactive behavior observed during the recorded group reading activity. The Pearson product-moment correlation of the frequencies of various behaviors from the two copies of the records was then computed. To identify the most opportune time to introduce mobile technology and associated scaffolding in EFL collaborative reading activities, the observation was also intended to identify deficiencies in any of the following aspects of group learning: (a) support provided by groupmates, (b) feedback provided by groupmates, and (c) collaborative processes.

Results

After the treatment finished the two observers repeatedly watched the videotapes and listened to the digital voice recordings until all the discourses and interactive behavior exhibited by the experimental group were coded. The observations focused on interactive behavior among groupmates and the problems that might have reduced the effectiveness of group collaboration. The Pearson product-moment correlation of the frequencies of various behaviors computed from the two copies of the records was 0.968.

The analytical results of the video data and discourse in the experimental group revealed frequent peer-assisted learning behavior in the collaborative reading groups. Examples 1 and 2 are two concrete positive examples of the components "support provided by groupmates" and "feedback provided by groupmates," in which group leaders helped group members read assigned tasks and provided feedback. Besides, in the following examples (Examples 1, 2, and 3) if students use Chinese (their native language) to communicate with each other, the particular discourse conducted in Chinese will be printed in italics, followed by its Chinese version in parentheses.

Example 1.

Group 1: Group members: Tracy, Pole, Joe and Faye Tracy: OK, now everyone read the text. Step two, mmm… *you read and circle the words you do not know.* (*你們自己讀，再把不會的字圈起來*)

(Students read and circle unknown words.)
Tracy: *Don't be afraid to circle too many unknown words*. (不要害怕圈太多字) *What I care is honest*. (我在意的是誠實) *Don't cheat*. (不要騙我) *Just let me know which word you don't know*. (盡管讓我知道你們什麼字不會念) *I will teach you*. (我會教你們)
Pole: Tracy, *how to say the word?* (這個字怎麼讀) (Pole points to the word 'Rat'.)
Tracy: r r /r/r/, a a /a/a/, /r/a/ /ra/, t t /t/t/, /rat/. Rat *is a big mouse, and* mouse *means a small one.* (Rat 是大老鼠，mouse是小老鼠) **Understand? (component: support provided by groupmates, positive**)
Pole: Understand. Thank you.
Tracy: Joe, Faye, any question?
Joe: Tracy, *how to say the word?* (怎麼讀這個字) (Joe points to the word 'Will'.)
Tracy: (Covers the last three letters, 'ill', shows letter *w* to Joe and supports scaffolding.) w w, *say what*? (怎麼念) **(component: support provided by groupmates, positive)**
Joe: w w /u/.
Tracy: i i…
Joe: /i/i/.
Tracy: l l …
Joe: (Kept silent.)
Tracy: (Models the sound of the letter "l") l l /l/l/. /u/i/ /ui/ /l/ /uil/. *Say it.* (念一遍)
Joe: /u/i/ /ui/ /l/ /uil/. (component: support provided by groupmates, positive)

Example 2.

Group 7:
Group members: Esther, Ann, Apple and Sandy

(Students read text.)
Esther: Hey, *read out loud, the guide says* 'read aloud'. (嘿，讀出聲音，這份guidance說read aloud) Ann, *listen and say* "Mr. and Mrs." (Ann，聽我讀跟著念Mr. and Mrs) (points to the words)
Ann: 'Mr.' and 'Mrs.'
Esther: **Good (component: feedback provided by groupmates, positive)**, *now how to say the word?* (這個字怎麼讀) (points to the word 'had')
Ann: (kept silent.)
(Apple and Sandy begin to read and discuss together.)
Esther: ***When you read a word, you cover the latter letters and sound the beginning sound, then the middle sound and say the two sounds together, and then add up the ending sound and say them together. Like this.*** (當你讀一個字時，先蓋住後面的字母，先讀開頭的字母，然後是中間的字母，然後把兩個字母拼起來，然後再把最後一個字母加近來一起讀，像這樣) **(covers letters a and d) h h /h/h/, a a /a/a/, /h/a/ /ha/, *then* (然後) d d /d/d/, *then say them together* (然後一起念), *it becomes* /had/. (就變成/had/) OK? (component: support provided by groupmates, positive)**
Now you try. Apple, Sandy, any question? Hey, *don't chat*. (不要聊天)
Apple and Sandy: *We don't*. (我們沒有)
Esther: Good, *let me know if you have questions*. (有問題要告訴我) Ann, *you say the word*. (你讀這個字)
Ann: /h/a/d/ /had/.
Esther: Good. **(component: feedback provided by groupmates, positive)**
(Esther was keeping busy in supervising and helping her groupmates to read.)

However, it was also found that simply placing students in groups heterogeneously and assigning them group goals (e.g., winning the inter-group reading contest and being rewarded) did not guarantee effective collaboration during the whole reading activity. Several weaknesses in the collaborative process were identified by the observers. First, the group leaders differed in their small-group collaborative reading activity in that some of them were constantly busy helping their groupmates whereas others spent most of their time reading individually. As a result, students in groups with busy leaders may have experienced

delays in assistance from their group leaders (classified as 'postponed support'), whereas leaders in other groups were constantly available for helping anyone (including those belong to a different group) in need of learning support (classified as 'invisible helper'). Furthermore, the medium-ability students were frequently asked to read by themselves because their group leaders were busy helping their low-ability groupmates. The lack of immediate feedback resulted in medium-ability students frequently demonstrating uncertainty or confusion during the reading activity (classified as 'absent feedback'). Other weaknesses in a small group included group leaders teasing or ignoring groupmates because of their slower rate of learning (classified as 'conflict-oriented collaborative process'), resulting in increased passivity in these students. In a specific example of the components of 'collaborative process', Example 3 shows a negative episode in which the group leader in Group 3 lost his temper and teased his group member.

Example 3.

Group 3:
Group members: Richard, Jasmine and Angel

(Students read step-by-step reading guide handout and the copy of the text.)
Jasmine: Richard (the group leader), *how to do step 1*? (第一個步驟怎麼做)
Richard: (Reads the guide statement.) Look at the Picture and think about its meaning. *See, look and think.* (看到沒，看一看，想一想)
(**Angel looks around. She is not sure how to do it.**) **(component: support provided by groupmates, negative)**
Richard: (to Angel) Hey, what are you doing? *Quickly, do it.* (趕快讀啦)
Angel: *But, but, …, I don't know how to read.* (可是…我不知道怎麼讀)
Richard: (Points to the handout of the reading instruction.) *Look at this and read.* (看這個步驟跟著讀)
(Richard sound angry and ignores Angel while reading the text.) **(component: collaborative process, negative)**
Angel: *How to say this*? (這個字怎麼讀) (Points to the word 'six' and asks Richard.)
Richard: Who knows?! *Oh, how terrible it is*! (喔！怎麼這麼慘啊) My God! **(component: collaborative process, negative)**
(Richard complains about the stupid question Angel asked him, and then he chatted with Jasmine.)
Angel: (**Sounding scared**) *Please teach me say the word.* (請…教我讀這個字) (Points to the word 'six'). **(component: collaborative process, negative)**
Richard: (Says the word 'six'.) /siks/ /siks/, don't forget.
Angel: *How to say this*? (這個怎麼念) (Points to the word 'kids'.)
Richard: Oh, /kidz/, /kidz/, oh, my God! Teacher, teacher, *she even doesn't know how to say the letter sound.* (她連字母發音都不會) *I don't know how to teach her*! (我不知道怎麼教她) **(component: collaborative process, negative)**
(The teacher comes to the group and shows the peer-assisted method to Richard then comforts and encourages Angel.)

STUDY TWO: SOLVING WEAKNESSES BY SUPPORT FROM MOBILE TECHNOLOGY

The findings of Study One appeared to show that collaborative learning and peer-assisted learning are feasible strategies for helping elementary EFL learners learn to read. In most of the small reading groups, the group leaders were willing to help their groupmates and provide their peers with necessary scaffoldings and feedback (see Examples 1 and 2). The study also found that elementary EFL learners require adequate support to address the above weaknesses and to enhance the teaching of EFL reading. The weaknesses identified in Study One were used to design a mobile-device-supported peer-assisted learning (MPAL) system implemented on the environment of Tablet PCs to support collaborative learning in elementary EFL learners. This study revealed how computer technology can be used to solve the shortcomings in traditional collaborative reading activities.

Methods

Design

The second study also adopted a quasi-experimental design but was executed in the second semester. In advance of the experiment, the control group received training in collaborative learning to minimize differences in the collaborative learning experience between the two groups (the experimental and the control groups). The video data were also collected but were analyzed quantitatively by coding the behaviors according to the defined categories and then calculating the frequency of each behavior for comparison of differences between the two groups.

Participants

Similarly to the evaluation of collaborative EFL reading activities, the mobile-device-supported activities were investigated over a 10-week period with the same subjects in the second semester of the same school year. All subjects were grouped into the same groups as described in Study One.

Instruments

Description of early EFL reading activities and teaching materials. Study Two employed five additional teaching packages at more advanced levels. The lesson structure of the materials used in the second study was identical to that of Study One. Appendix D is an example of a teaching package used in Study Two. The reading activities resembled that of Study One except that the collaborative learning approach was used in both groups.

Observation checklists. Study Two involved a more quantitative approach. In the observation checklists (see Appendix E), the EFL reading behaviors were categorized as learning-related and learning-unrelated behaviors according to whether the observed behaviors related to the specific learning activities. Additionally, the learning-related behaviors included three reading behaviors: individual, inter-group, and intra-group. The students were observed in four-minute segments. For each segment, observers coded the frequency of target behaviors at 15-second intervals. Finally, the relative frequency of each target behavior was calculated for comparison. In Study Two, observers focused on the weaknesses of collaborative learning activities observed in the two groups.

Hardware: Tablet PCs. Despite the usual limitations of mobile electronic devices (e.g., small screen), the tablet PC was a more appropriate device in this study because of its editing support. Tablet PCs allowed students to easily note and mark the learning materials; consequently the effect of different levels of typing skill was limited in this study. The hardware used in this study was TravelMate C110 Convertible Tablet PC. Appendix F lists the detailed specifications for the device.

Mobile-device-supported Peer-Assisted Learning (MPAL) System. The design purposes of MPAL were, first, to provide elementary EFL learners with necessary scaffolding during individual learning, especially when their group members are not available to provide them with feedback, and, second, to provide a simple method for EFL learners to assist each other, particularly when some group members are occupied. The MPAL model consists of two modules: (1) a phonological-skills training module and (2) a peer-assessment module. Figure 1 illustrates the learning flow for the MPAL and the function of each module.

The phonological-skills training module was comprised of two submodules: sight words and phonetic words. After students log into the MPAL system, MPAL first assesses their reading skills (sight and phonetic word identification skills) relative to a standard determined by EFL teachers. Upon passing the test, the students were allowed to access the peer-assessment module (Figure 1, left); students who failed the test were returned to the phonological-skills training module for additional practice with MPAL (Figure 1, right). With the coaching support provided by the system, students practiced sight and phonetic word identification for each unit until their ability reached specified testing standard. Throughout the

learning process (practice as well as testing), the MPAL system recorded the learning results, provided both real-time feedback and learning support, and assessed mastery of skills.

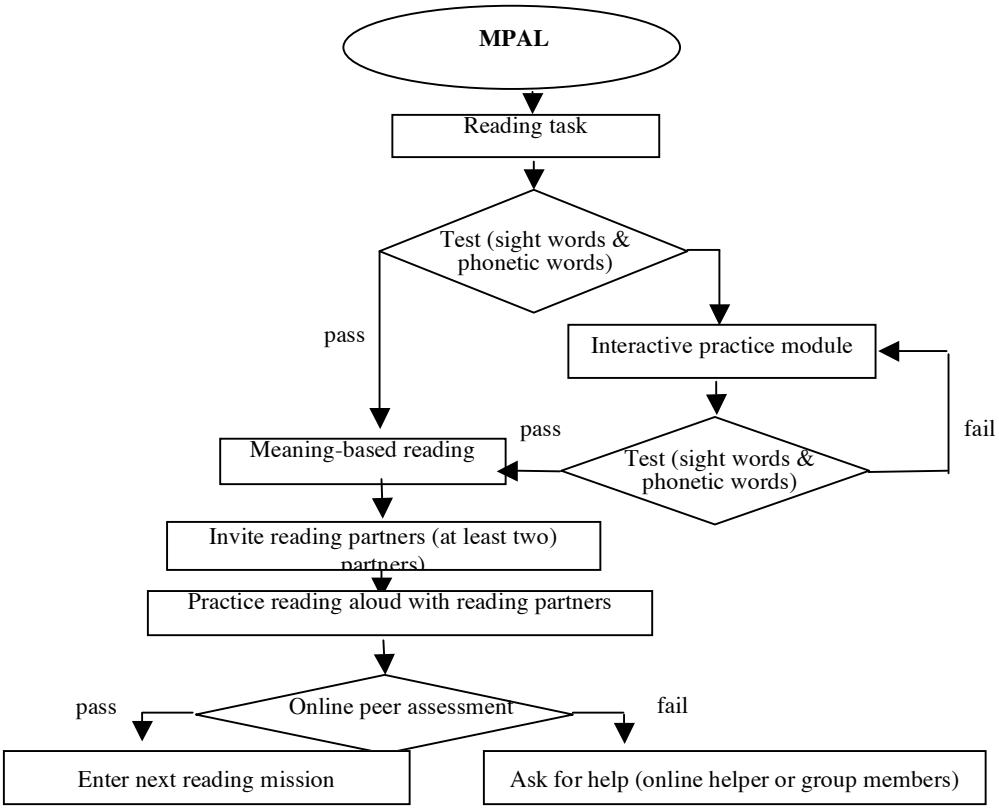


Figure 1. The learning flow in the MPAL system.

After the students mastered the target sight words and phonics rules for each unit, under the control of the MPAL system, they continued text reading (Figure 1, left). The MPAL system maintained a list of qualified online helpers including the names of all students that passed the peer-assessment process. The first five students who had passed the Test of sight words and phonetic words, as well as finished the step of meaning-based reading, read the text to their EFL teacher in an online assessment via Skype. After passing the test, their names were added to a list of those eligible to assist their peers in online peer assessments or in text reading.

Generally, after entering the peer-assessment module, the students first read the text individually and asked for online help via Skype (a peer-to-peer internet-based telephony) whenever they encountered reading or comprehension difficulties. After they were able to read individually and comprehend the text (i.e., able to correctly answer the comprehension questions), they would invite two available online helpers and demonstrate their ability to read the text. The text was continuously displayed on their screens when performing peer assessment, and the online helpers noted mispronounced words by clicking on the word with a stylus. Immediately after completing the assessment, MPAL automatically evaluated the performance of the student by calculating the accuracy ratio and assessing the result as a ‘fail’ or ‘pass’. The reader could then become eligible as an online assistant after receiving a 'pass' from two different online helpers. If one of the two online helpers assessed the reader as ‘fail’, the readers were required to continue reading the text. Figure 2 shows examples of the learning activities involved in online peer assessment.

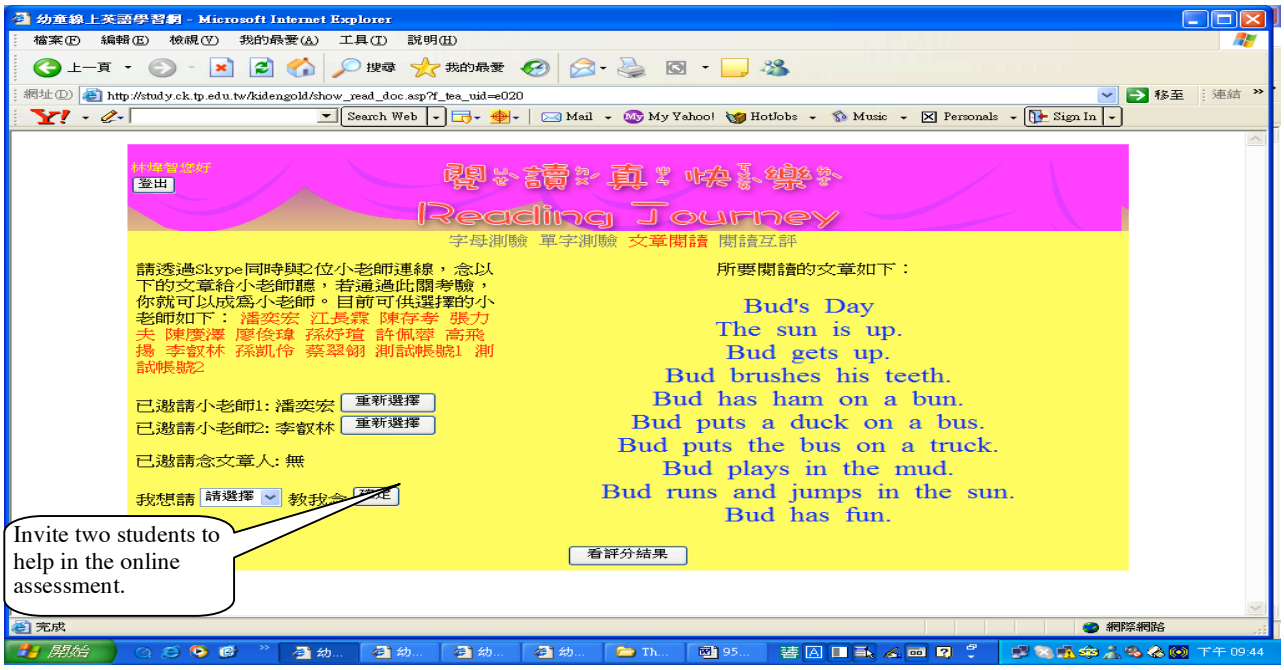


Figure 2. An example of online peer assessment.

Procedure

Before the treatment, the control group was trained in collaborative learning and was also asked to formulate collaborative reading rules by entire-class discussion. The group was also asked to agree to follow all rules during the study. Conversely, the experimental group was simply asked to review the collaborative reading rules and follow them.

Shortly after the training session for collaborative learning skills, five advanced level teaching packages (see Appendix D) were taught during the treatment period (10 weeks). Each package was taught in two two-lesson activities. In the first two-lesson activity, the teaching activities were similar to those described in Study One. However, in the second two-lesson activity, the activities were conducted differently. In the control group, students first reviewed the materials (sight words and phonetic words) through direct instruction and tests administered by the EFL teacher. They were then asked to collaboratively read a printed text with their peers in groups following the step-by-step reading guide (Appendix G). Finally, each student was asked to read the text to two of their peers (peer-assessment). Students who passed the peer-assessment were instructed to wear paper crowns and print their names on the blackboard to signify that they were qualified helpers available for reading assistance or assessment.

In contrast to the control group, each student in the experimental group received a Tablet PC with a stylus and a headset which the students used for collaborative reading activities with the support of the MPAL system.

The main differences between the collaborative EFL reading activities without technological support (the control group) and those with support (the experimental group) were the following: First, during text reading activities, the MPAL allowed the students to find available helpers easily and receive help not only from their groupmates but also from the online helpers (any student who had passed peer-assessment). Additionally, two or three students spontaneously formed a learning group by making an online call (using Skype) when performing online peer-assessment activities or peer-assisted learning. Moreover, the results of peer-assessment were available from MPAL immediately upon completion of assessment. Thus, both the EFL teacher and the students were able to precisely monitor the learning process and outcome. Second, during phonological-skills training activities, the experimental group

received real-time learning support and feedback from MPAL during individual reading activities when no other help was available.

Data collection

During the treatments, all activities were recorded by three digital video cameras. Two were focused on two small reading groups (one on each group), and one was focused on the entire class. After completion of the experiment, the same observers reviewed the video data. However, in contrast to Study One, the purpose of observation was to determine the frequency of target behaviors listed in the observation checklists (Appendix E). The Pearson product-moment correlation of the observation results of the records was then computed. To document the efficacy of MPAL, the observation focused on the following aspects of collaborative behavior: (a) support provided by groupmates, (b) visible or invisible helper, (c) feedback provided by groupmates, and (d) collaborative processes.

Results

The observations of learning behavior recorded in this study had two objectives. One was comparison of weaknesses due to postponed support, invisible assistance, lack of immediate feedback, and conflict-oriented collaboration in the two groups. Another objective was identifying differences in collaborative behavior (learning-related and learning-unrelated) between the two groups.

After the treatment finished, two observers tallied the frequency of each target behavior. Pearson product-moment coefficient of concordance was then computed from the decoded results obtained from the two copies of the records. The Pearson correlation was 0.78 ($p < .01$).

Comparison with weaknesses identified in Study One

Table 1. The Frequencies of the Four Target Behaviors and the Chi-Square Analysis Results

Behaviors		**Groups**		**Chi-square**
		Experimental	Control	$\chi^2_{(1,1)}$
support	Real-time	33	7	11.46*
	Postponed	11	15	
helper	Visible	35	25	.06
	Invisible	1	1	
feedback	Real-time	37	18	35.21*
	Absent	13	65	
collaborative process	collaboration-oriented	79	72	8.17*
	conflict-oriented	4	17	

*$p < .05$.

Table 1 displays the frequencies of the four target behaviors related to support, helper, feedback and collaborative process. Each target behavior was confirmed by chi-square analysis to identify significant differences between the two groups. Results of chi-square analysis revealed that the two groups significantly differed in behaviors related to support ($\chi^2_{(1,1)} = 11.46$, $p < .05$), feedback ($\chi^2_{(1,1)} = 35.21$, $p < .05$) and collaborative process ($\chi^2_{(1,1)} = 8.17$, $p < .05$). These statistical findings revealed that the incidence of postponed support, absent feedback, and conflict-oriented collaboration was significantly lower in the

experimental group than in the control group. However, the result of chi-square analysis related to helper type showed that there was no significant difference between the two groups.

Comparison of collaborative learning behaviors

All the reading activities were videotaped during the treatments. Two observers watched the video data and recorded the results based on the observation checklists. The EFL reading behaviors were categorized as learning-related and learning-unrelated behaviors. The learning-related behaviors included three reading behaviors: individual, inter-group, and intra-group. Table 2 displays the frequency of each category of behaviors. Results of chi-square analysis revealed that the frequency of learning-related (the sum of individual, inter-group, and intra-group items) and learning-unrelated behaviors in the experimental group significantly differed from that of the control group ($\chi^2_{(1,1)} = 90.61$, $p < .05$).

Table 2. The Frequency of Group Reading Behaviors and the Chi-Square Analysis Results

Group reading behaviors	**Groups**	
	Experimental	Control
Learning-related		
Individual	142	97
Inter-group	157	35
Intra-group	201	121
Sum	500	253
Learning-unrelated	78	167
Chi-square ($\chi^2_{(1,1)}$)	90.61*	

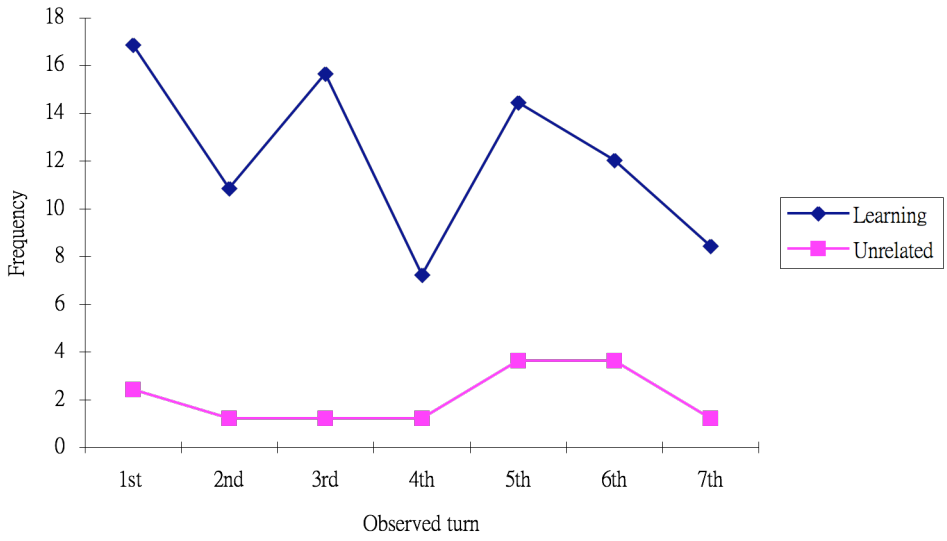
*$p < .05$.

According to Table 2, the students in the experimental group concentrated on EFL reading activities (fewer learning-unrelated behaviors) with the support of MPAL. Table 2 also reveals that MPAL benefited collaborative reading behavior (both inter- and intra-group), especially inter-group behavior because of the use of peer-to-peer internet-based telephony.

In addition to the above comparison, the frequency of each behavior category in each observed turn (4-minute interval) was compared between the two groups to identify different trends in student behavior during collaborative reading activities (see Figure 3). As illustrated in Figure 3, students in the experimental group were more focused than the students in the control group. The students consistently paid attention during reading activities with the support of MPAL. Conversely, the students in the control group tended to pay attention to learning activities during the first half of the two-lesson reading activities only. Subsequently, they were easily distracted, and their attention decreased as the activities progressed.

Similar differences also appeared on learners' anxiety, motivation, and oral reading confidence. Those students' attitudes were identified by video data observation. It was found that students in the experimental group, especially the lower-ability students, were eager to practice what was instructed and ask for online help without hesitation or fear of being teased by the helper. Furthermore, the desire of becoming a qualified online helper also motivated them to be willing to read to their peers over and over again until they passed the online peer-assessment.

a.



b.

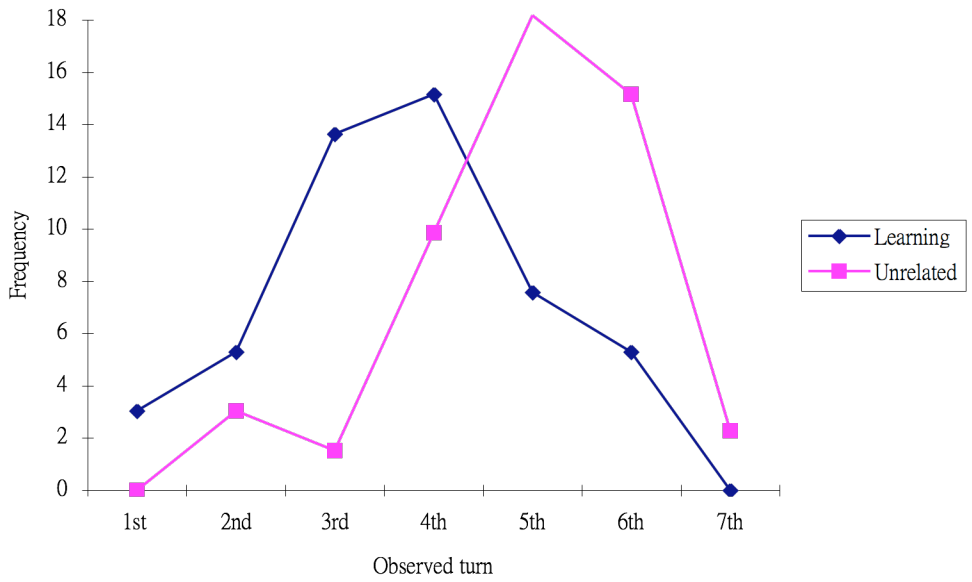


Figure 3. The frequencies of each behavior category happened in each observed turn: (a) the experimental group and (b) the control group.

DISCUSSION AND CONCLUSION

The goal of this study was to explore the potential application of mobile technology for elementary EFL reading instruction. Due to limited reference studies found in this area and to avoid careless use of mobile technology in education, a two-study research was conducted to explore the reasonable moments and methods for introducing mobile technology in the teaching and learning of elementary EFL reading. In

Study One, by observing twenty-six third grade students (experimental group) learning to read in a small group, the weaknesses which might hinder students' collaborative learning were identified. This in turn laid the groundwork for designing a mobile learning system. The data analyzed in the first study indicated that simply grouping students into heterogeneous small groups does not guarantee effective collaboration even with collaborative and peer-assisted learning behavior.

Careful analysis of the video data revealed the limitations of traditional group learning, including delayed support, invisible helpers, lack of feedback, and conflict-oriented collaborative processes. This finding challenges traditional collaborative learning approaches in which students are heterogeneously grouped to work together and to reach a common goal (Johnson & Johnson, 1994; Ravenscroft, Buckless, & Hassall, 1999; Slavin, 1986). The findings also demonstrate that if the students are grouped heterogeneously with different levels of critical skills needed for reading tasks, additional learning support (scaffolding) is necessary for an effective collaborative and peer-assisted learning process.

Based on the findings of Study One, the use of mobile technology for elementary EFL reading activities was evaluated in Study Two. In Study Two, a mobile-device-supported peer-assisted learning (MPAL) model was used to support the collaborative reading activities of elementary EFL learners.

According to the results of Study Two, it is our distinct impression that MPAL seemed to reduce anxiety in elementary EFL learners, promote motivation to learn, and enhance oral reading confidence. These findings are consistent with recent studies evaluating the application of CALL in EFL such as instruction for early reading skills by Mioduser, Tur-Kaspa, and Leitner (2000) and the study of individualization of instructional sequence by Speziale and La-France (1992). The present study also bears similarities to previous studies of MALL which explored the possibility of learning vocabulary via cell phone (Kukulska-Hulme, 2005; Thornton & Houser, 2005) or Personal Digital Assistant (PDA) (Zurita & Nussbaum, 2004).

Furthermore, with the scaffoldings provided by MPAL, students could read on their own or receive online help without their group leaders. Thus they demonstrated a higher level of concentration on reading tasks, particularly the low- and medium-ability students. This finding underscores the value of technology for EFL students with lower reading ability as suggested by Foster, Erickson, Foster, Brinkman, and Torgesen (1994). The experimental results of the current study are also consistent with the findings of Attewell and Webster (2004) that mobile learning inspires enthusiasm in young adults and increases their motivation to improve their reading skills. In addition to the positive effect on collaborative learning, the weaknesses identified in Study One were effectively addressed by the support of MPAL.

In summary, it appears that the use of mobile devices in collaborative EFL reading activities reduces the stress experienced by students and facilitates student collaboration. Use of these devices also opens a new world of possibilities where students can individually engage in EFL reading activities anywhere and at any time with the assistance of learning support and real-time feedback. Immediate responses to requests for help or feedback allow students to learn reading according to their individual needs and individual pace. Furthermore, it seems likely that the availability of online helpers not only enhances the usability of the help resource but also encourages students to pass the peer-assessment process and thereby achieve the status of online helper. This study provides further evidence that a mobile-device-supported EFL reading program is an emerging portable and potential solution that can provide students with adaptable and ubiquitous support for collaborative EFL reading activities at virtually any place and time.

APPENDICES

Appendix A. Collaborative Reading Rules

I will:

1. take good care of the learning materials and equipment.
2. concentrate.
3. be willing to learning with others.
4. follow the reading guide.
5. work hard.
6. ask for help when I need it.
7. be nice in discussions with others.
8. answer the requests of others for learning help.
9. be a responsible peer.
10 tidy up the material when I have finished reading.

I will not
1. tease others.
2. chat or play with others when learning.
3. fight with others.
4. make noise.
5. discuss in a loud voice.
6. wander around.

Appendix B. Step-By-Step Reading Guide Used in Experimental Group in Study One

Story Title: _____
Group: _____ Name: _____ Date: _____

📖 Do and check.
( ) 1. Look at the picture and think about its meaning:
who, what, where, and when?
( ) 2. Read aloud the story.
If there are some words that you cannot read:
① Circle the words you do not know.
② Try to read them using phonics rules.
③ Are they sight words?
④ Ask **your groupmates** to help you.

( ) 3. Read aloud again.
( ) 4. Read the story to **your group**.
Peer assessment:

Performance	☺	😐	☹
Signature			
Signature			

Appendix C. Step-By-Step Reading Guide Used in Control Group in Study One

Story Title: _____
Group: _____ Name: _____ Date: _____

📖 Do and check.
( ) 1. Look at the picture and think about its meaning:
who, what, where, and when?
( ) 2. Read aloud the story.
If there are some words that you cannot read:
① Circle the words you do not know.
② Try to read them using phonics rules.
③ Are they sight words?
④ Ask **your teacher** to help you.

( ) 3. Read aloud again and **assess your reading**.
Self-assessment: ☺ 😐 ☹

Appendix D. An Example of Teaching Packages Used in Study Two

Group: _____ Class: _____ Name: _____ Number:_____ Date: _____

Today's mission:

1. Practice the sight words (Sight words_a.ppt)
2. Practice the phonetic words (Phonetic words_a.ppt)
3. Read the article "What is it in the box?" & answer the questions
4. Peer-assessment: Read the article to two of your classmates.

Sight words:

by, asked, guess, said, isn't, can, does, doesn't, baby, sing, know, will, who, so, no, look, like, her

Phonetic words:

o	ob	cob hob job mob rob
	ock	chock cock dock hock lock nock rock shock sock
	op	chop cop hop lop pop shop top
	ot	cot dot got hot jot lot pot rot shot
	ox	box pox fox
	ob	cob hob job mob rob
	ock	chock cock dock hock lock nock rock shock sock

Peer-Assessment

Signature: _____ Date: _____

What is it in the box?

Doctor Dodd sits on a log by the pond.
Doctor Dodd has a big box.
"What is it in the box?" asked Tom.
"Guess," said Doctor Dodd.
"Is it a doll?" "No, it isn't."
"Is it a fox?" "No, it isn't."
"It has spots. It can hop.
It does not look like her baby.
It likes to sing in the pond."
"What is it in the box?" asked Doctor Dodd.
"I know it. It is a …," said Tom.

What is it in the box?

Doctor Dodd sits on a log by the pond.
Doctor Dodd has a big box.
"What is it in the box?" asked Tom.
"Guess," said Doctor Dodd.
"Is it a doll?" "No, it isn't."
"Is it a fox?" "No, it isn't."
"It has spots. It can hop.
It does not look like her baby.
It likes to sing in the pond."
"What is it in the box?" asked Doctor Dodd.
"I know it. It is a …," said Tom.

Answer the questions:

( ) 1. What is it in the box?
(1) A rabbit. (2) A bug. (3) A frog.

( ) 2. Which animal doesn't look like her baby?
(1) Butterfly. (2) Cat. (3) Pig.

( ) 3. What is the baby of a frog?
(1) Kitten. (2) Tadpole. (3) Puppy.

( ) 4. Draw a line to match the baby animals and their moms.

Piggy	Sheep
Lamb	Bear
Duckling	Pig
Cub	Hen
Chick	Duck

Appendix E. Observation Checklists Used in Study Two

Date: Unit: Observed group:

Observed behaviors		Observe intervals	1st				2d					9th			
		Time													
		Students' numbers	1	2	3	4	1	2	3	4		1	2	3	4
Learning-related behaviors	individual	Set up or operate the TabPCs													
		Do practice													
		Do test													
		Use Skype													
		Idle helper (ignore help request)													
	inter-group	Peer-assessment													
		Teach another to learn materials													
		Teach another to use TabPC													
		Be taught to use TabPC													
		Be taught to learn materials													
		Waiting for peer-assessment													
		Ask for help													
		negotiation									…				
		communication													
		discussion													
	intra-group	Peer-assessment													
		Teach another to learn materials													
		Teach another to use TabPC													
		Be taught to use TabPC													
		Be taught to learn materials													
		Waiting for peer-assessment													
		Ask for help													
		negotiation													
		communication													
		discussion													
		Sharing with group mates													
		Encouraging group mates													
		Watching group mates													

	Students' numbers	1	2	3	4	1	2	3	4		1	2	3	4
Learning-unrelated behaviors	Chatting with others													
	Playing with others													
	Moving around													
	Catnapping									…				
	Playing alone													
	Abstracted													
	Leaving seat													
	Looking around													
	Other behaviors													

Appendix F. The Specification of TravelMate C110 Convertible Tablet PC

Operation system: Microsoft® Windows XP Tablet PC Edition

Platform: Intel® Centrino™ mobile technology

Processor: Low Voltage Intel® Pentium® M processor at 800 MHz; 512KB L2 cache memory

Chipset: Intel® 855GM chipset with 400 MHz front-side bus

Wireless technology: Integrated, coexistent, Intel® PRO/Wireless 2100 network connection 802.11b

Memory: 256MB of DDR memory and a Flash BIOS can be upgraded to 2GB, 512KB; support shadow RAM

Screen: 512 Flash BIOS; support shadow RAM; The notebook screen can be swiveled up to 180°

Storage: 30 GB of DASP (Disk Anti-Shock Protection) hard disc storage

External drive: IEEE1394 DVD

Size/weight: 257 by 216 by 25.4 mm/ 1.45 Kg

Appendix G. Step-By-Step Reading Guide Used in Study Two

Story Title: _____
Group: _____ Name: _____ Date: _____

📖 Do and check.

( ) 1. Look at the picture and think about its meaning:
who, what, where, and when?

( ) 2. Read aloud the story.
If there are some words that you cannot read:
① Circle the words you do not know.
② Try to read them using phonics rules.
③ Are they sight words?
④ Ask your groupmates to help you.

( ) 3. Read aloud again.

( ) 4. Answer the questions by yourself.

( ) 5. Discuss the answers with your group members.

Self-assessment: ☺ 😐 ☹

( ) 6. Read the story to two of your classmates.
Peer assessment:

Performance	☺	😐	☹
Signature			
Signature			

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ABOUT THE AUTHORS

Yu-Ju Lan received the B.S. degree in Computer Science from Chinese Culture University, Taipei, Taiwan, R.O.C., in 1990 and M.S. and Ph.D. degrees in Information and Computer Education from National Taiwan Normal University, Taiwan, in 1995 and 2006, respectively. Her research interests include EFL instruction and research, ICT in education, and mobile learning.

Email: yujulan@gmail.com

Yao-Ting Sung received the M.S. and Ph. D. degrees in Education and Psychology and Counseling from National Taiwan Normal University, Taiwan, R.O.C., in 1992 and 2000, respectively. He is a professor of Department of Education and Psychology and Counseling at National Taiwan Normal University, Taipei. His research interests include the psychology of learning and computer-assisted instruction.

Email: sungtc@ntnu.edu.tw

Kuo-En Chang is currently vice president and a professor in the Department of Information and Computer Education at National Taiwan Normal University, Taipei. He is also a co-chair of the National Project of e-Learning. His research interests include intelligent tutoring systems, web-based learning, and learning technology. His main research work is the design of web-based systems with applications to education.

Email: chang@ice.ntnu.edu.tw

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