

The Game Embedded CALL System to Facilitate English Vocabulary Acquisition and Pronunciation

Shelley Shwu-Ching Young and Yi-Hsuan Wang*

Institute of Learning Sciences, National Tsing Hua University, Taiwan // Department of Information Technology and Management, Tzu Chi College of Technology, Taiwan // scy@mx.nthu.edu.tw // annywang12345@hotmail.com

* Corresponding author

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ABSTRACT

The aim of this study is to make a new attempt to explore the potential of integrating game strategies with automatic speech recognition technologies to provide learners with individual opportunities for English pronunciation learning. The study developed the Game Embedded CALL (GeCALL) system with two activities for on-line speaking practice. For the drill practice, learners get immediate scores with evaluation feedback on their utterances; in the game-based practice, they have to correctly choose and pronounce the English vocabulary from the candidate answers to pass the four-level barriers. To enable the study to confirm the factors that facilitate students' English learning, a total of 52 learners from Taiwan participated in this experiment, divided into an experimental group (E.G.) and a control group (C.G.). The learners in the E.G. learned English with both the drill and game-based practice, while the students in the C.G. learned only with the drill practice. The empirical evaluation reveals that those who learned with both drill and game-based activities performed better in terms of their English pronunciation than the learners who only participated in the drill practice, but the learners in the C.G. performed better in the delayed vocabulary retention test. Besides, the study indicates that the learners, especially the low-achievement ones, showed great involvement and were active in practicing speaking in the game-based scenario. The findings are in accordance with the previous research affirming that gameplay is the driving force that promotes learners' educative engagement, and that learners of different levels of learning achievement are active in learning together while practicing their oral speaking in the stress-free environment. In sum, the GeCALL system is an educative aid that could reduce learners' language speaking anxiety and to provide flexible chances for individual students to do self-speaking practice within the given limited teaching time. The findings of this study support the value of applying game strategies with ASR techniques for language learning purposes.

Keywords

CALL system design, Pronunciation learning, Game strategy

Introduction

English has become an international language and many Asian countries have established English learning policies to promote students' English ability. In Taiwan, the Ministry of Education has set up curriculum guidelines to enhance learners' oral communication and listening skills at the primary school stage. However, English instructors have indicated that coping with students' heterogeneity in classes with limited teaching time and arousing learners' speaking motivation are the main barriers when teaching (Su, 2006). In order to deal with teachers' difficulties, study have indicated that providing students with a one-on-one computer assisted learning system is a helpful method for encouraging learners of various language proficiency levels to learn in an enjoyable way (Dolati & Mikail, 2011). The concept of Computer Assisted Language Learning (CALL) to achieve learner-centered learning can be traced back to the early 1960s, and with the arrival of the World Wide Web, CALL systems were no longer limited to personal editions but enabled asynchronous and synchronous communication between instructors and students. Over the last decades, a variety of educational applications in the CALL research have been implemented, from web-based applications (Golonka et al., 2012; Hsu & Ou-Yang, 2013) to ubiquitous mobile-based learning environments (Wu et al., 2012), and from vocabulary acquisition to English writing skills. Within the topic of adoption of technology in language learning, there is strong support for the claim that integrating automatic speech recognition techniques (ASR) into computer-based learning systems had a measurable impact on pronunciation learning (Chiu, Liou, & Yeh, 2007; Chen, 2011). For example, Neri et al., (2008) used a story-based CALL system, PARLING, to encourage young beginner learners of Italian to memorize the words in a story. The PARLING system uses the word game to encourage children to pronounce the words in the story, and adopted an ASR component to analyze the learners' utterances. SPELL is another CALL system that created an interactive virtual world learning environment for secondary school students in French to have English conversations with virtual characters (Morton & Jack, 2010).

The above studies demonstrated that integrating an automatic speech recognition (ASR) component in a learning system benefits language learning, and especially facilitates an improvement in pronunciation. However, most of the CALL studies conducted comparison research regarding learners' performance of practicing speaking with and without an ASR-based environment (Neri et al., 2008; Morton & Jack, 2010), and little research explores the learning factors or interaction design in the ASR-based environment which may enhance the effectiveness of speaking. Many design variables such as self-learning approaches or pedagogy need and are worth investigating (Kim & Gilman, 2008; Neri et al., 2008). Neri et al. (2008), for instance, integrated game-like speaking practices into their system design; however, their results focus on analyzing whether the ASR system can help young learners improve their pronunciation comparable to that through traditional teacher-led scenarios, while the results related to students' perceptions of participating in the game-like speaking activities in the ASR-based learning environment or the effect of combining game strategy with ASR techniques for promoting the learning of speaking were less investigated.

On the other hand, some studies indicated that adopting educational games into language instruction has a positive impact on promoting students' learning motivation and performance (Tsai et al., 2012; Chiu, Kao, & Reynolds, 2012). For example, researchers have demonstrated that using scaffolding games helps students acquire targeted knowledge better; and the adoption of game strategies in instruction decreases frustration resulting from excessive numbers of learning retries (Sun, Wang, & Chan, 2011; Tsai et al., 2012). Moreover, the use of web-based games also facilitates language learning such as grammar or writing skills (Tsai et al., 2012). Despite the application of computer-based learning environments and game strategies in learning having separately received considerable attention for promoting learners' learning ability, research on using game scenarios for assisting English pronunciation training has been less studied.

Research purpose and questions

To make up for this deficiency, this study integrates game strategies into developing an English speaking learning system to assist students' acquisition of English vocabulary as well as pronunciation. The researchers designed a four-level speaking game to help students learn English progressively through the game process. To enable the study to confirm the factors that facilitate students' English learning, the developed system supported learners with two learning scenarios: providing learners with speaking drill practice with and without game activities. In the drill practice, learners can practice speaking with the system repeatedly with a score and evaluation feedback; in the game activity, learners have to pronounce the English vocabulary from the candidate answers according to the given picture to pass each barrier and complete the game. This study aimed to explore whether or not applying game-like learning interactions for speaking practices in the ASR-based language learning system would bring various learning effects for learners, and also to observe if students would have diverse learning interactions through participating in different speaking activities. Thus, the following questions are investigated to understand the effectiveness of the developed GeCALL system:

- Which learning scenarios of the system would help the learners achieve better learning performance in acquiring English vocabulary and pronunciation?
- How did the learners perceive practicing pronunciation with the system?
- Were there different learning interactions or behaviors between the learners in the two learning scenarios?

Literature review

Related CALL studies

A variety of educational applications in the CALL research have been conducted, and the applications of CALL bring language learning a wealth of new possibilities (Chen, 2011; Golonka et al., 2012; Hsu & Ou-Yang, 2013). For example, Johnson and Heffernan (2006) conducted a reading CALL project in Japan in which high-beginner to intermediate students were provided with opportunities of exposure to target vocabulary through a series of online story readings. Ma and Kelly (2006) applied a web-based CALL system, WUFUN, to help Chinese students overcome their learning difficulties in reading English vocabulary (Ma & Kelly, 2006). Harbusch et al., (2008) developed a Sentence Fairy CALL system for elementary students to enhance their English writing in virtual writing conferences through the use of the Natural Language Processing technique. Lee et al. (2009) built a web-based

CALL system for adults to learn academic essay writing. The system used Latent Semantic Analysis to give learners immediate writing feedback including content sub-themes and organization. Fidaoui et al. (2010) proposed that fourth graders had more confidence and self-esteem in English writing through using a CALL system in their writing classes. The abovementioned CALL studies focus on enhancing learners' reading and writing abilities.

More recently, with the mature development of technology, more advanced techniques such as the ASR technology has been applied to CALL applications for immediate learning. For example, Chen and Chang (2011) integrated mobile devices, personal digital assistants, as learning tools to support listening comprehension activities for college students in Taiwan. Research conducted by Tsai and Young (2010) and Chwo (2012) all integrated the speech recognition technology or text-to-speech function to enhance students' multi-language, speaking and listening ability. The above studies all focused on adopting CALL applications to facilitate students' listening and speaking ability, and all revealed positive support for the claims that integrating learning technology into language learning systems offers learners extended opportunities and benefits students' language performance. We can conclude from the above studies that CALL programs offer learners self-directed learning environments and allow students to train at a self-paced speed.

The potential of game-based learning environments

The research on game-based computer assisted learning has increased rapidly since 2006 (Hwang & Wu, 2012) and has become a popular trend in the field of learning technology for promoting learners' educative engagement and motivation (Hong et al., 2009; Tsai, Yu, & Hsiao, 2012). Prensky (2001) mentions that teaching with game strategies could address some of the pitfalls found in traditional education, and most researchers believe that educational games could be learning aids to be used as reinforcement to support traditional learning (Tsai, Yu, & Hsiao, 2012) because such games can lower anxiety and make learning acquisition more likely. Furthermore, games have the power to get learners to learn enthusiastically, and the repetition of gameplay is the driving force that motivates learners to search for target knowledge through the chance of learning by playing (Coyne, 2003). Although many studies claim that educational games are beneficial for learning, there are still some researchers who deny the effectiveness of educational games because of the problems of students' distraction by gameplay and not paying attention to the targeted knowledge (Ke, 2008; Papastergiou, 2009). Therefore, finding ways to help students acquire learning content efficiently through playing educational games is a critical issue.

The principle of game-based activities design

To address the concern of how to appropriately design game-based learning activities, researchers of Behaviorism consider learning to be produced by stimulation and reinforcement, and the game-based learning environment is useful in autonomous learning. That is to say, learners in games have to know their learning goals and what actions help them to achieve those goals (Wu et al., 2012). During the processes of gameplay, frustration control should be designed to prevent learners from becoming stuck in the games (Sun, Wang, & Chan, 2011). On the other hand, the Constructivist perspective proposes that providing scaffolding processes in game-based design may be a possible way of directing learners to pay attention to learning contents during gameplay (Tsai et al., 2012). The scaffolding strategy could also be used for assisting learners to accomplish learning tasks at their own pace (Wu et al., 2012). Besides, the design of the game has to meet the target learners' prior knowledge level. If the provided games can achieve the balance between learners' skills and challenge, the possibility of experiencing learning through gaming is higher (Kiili, 2005). Meanwhile, multimedia learning materials in educational games are another factor impacting the effectiveness of game-based learning. There may be a risk of overloading learners' working memory due to inappropriate ways of presenting too many multimedia elements (Kiili, 2004). To appropriately balance the attractive factors of games and educational content in order to optimize the best learning effectiveness while designing educational games is a challenging task.

Game-based language learning study

Several studies have applied game strategies to language acquisition for enhancing English grammar or vocabulary acquisition (Chiu, Kao, & Reynolds, 2012; Tsai et al., 2012). For many language learners, the traditional way of

learning a new language is to "look and remember" repeatedly without internalization, and sometimes students even write down the translation of new words but cannot pronounce them. Research has shown that the cramming method of language learning is not an effective way and that after a short period of time, many learners may slowly forget the learned vocabulary (Decarrico, 2001). However, language learning could be facilitated by educational games and much research has indicated that game-based teaching strategies have positive effects on language acquisition (Barendregt & Bekker, 2011). For example, Decarrico (2001) applied a web-based game to facilitate learners' English vocabulary acquisition and found that the learners had the opportunities to be in control of the lessons during games and were able to move at their own pace to complete the learning. Besides, both advanced students and less advanced ones worked together to finish the learning task. On the contrary, learners who learned without using games as aids were passive and depended on teachers totally for the input of new materials without involvement for self-development. Meanwhile, another study pointed out that the use of games had positive impacts on supporting teachers to engage learners of various language proficiency levels in a more enjoyable way of learning English compared to traditional teaching methods such as mechanical drilling (Chiu, Kao, & Reynolds, 2012).

In summary, the advantages of adopting game strategies for language learning shed light on the potential for 1) learning and retaining knowledge more easily, 2) keeping learners' interested and getting involved actively, and 3) repeated practice in a game-based manner. However, most of the reviewed studies adopt game strategies for language reading or writing skills; using game-based scenarios for speaking training has been less studied. Besides, in the application of CALL, there is a lack of a systematic approach to investigating the key factors in ASR-based CALL systems that may enhance the effectiveness of speaking learning, and further research is suggested to explore the effectiveness of using games for teaching speaking (Dolati & Mikail, 2011). Hence, this study aims to develop an interactive speaking system from the perspective of learning-theory foundations invoked to underpin educational computer game design. Meanwhile, the study examines whether the developed system adopting the game-based activities could facilitate students' vocabulary acquisition and pronunciation and also to identify the potentiality of using games for pronunciation learning.

The Game embedded CALL (GeCALL) system

The goal of developing the GeCALL system is to provide learners with self-learning opportunities to achieve vocabulary acquisition and pronunciation ability. The researchers adopted a self-developed ASR application for evaluating speakers' English pronunciation based on the factors of tone, speed, volume and timbre (Chen, Lo, & Jang, 2004).

Learning materials and activities design

The learning materials in the GeCALL system were selected from the required elementary school level vocabulary from school textbooks to balance the learners' language skills and game challenge so as to promote the possibility of learning through gaming (Kiili, 2005). The elementary English teachers further differentiated the vocabulary into four categories based on the frequency of their appearance in the textbooks, with Category One containing the most common vocabulary while Category Four includes the least common vocabulary. Then the researchers designed the learning activities according to the vocabulary in the four categories. Two types of activities were designed in the system, drill practice and game-based practice. The drill practice includes four parts with each containing the vocabulary from one category. For example, Part 1 contains the vocabulary from Category One and Part 4 contains the vocabulary from Category Four (Figure 1-1).

The researchers designed the game-based practice as a four-level challenging barrier game for scaffolding learners while acquiring the vocabulary and accomplishing learning tasks at their own pace. The scaffolding strategy is adopted to design the question of each level, and the vocabulary from each category is selected according to different proportion as learning questions to assist the students in learning the vocabulary of each category gradually (Wu et al., 2012). For example, Level 1 contains the vocabulary from Category One; in Level 2, 40% of the vocabulary is from Category One and 60% is from Category Two; in Level 3, 20% is from Category One, 20% is from Category Two and 60% is from Category Three. If the students get stuck in Level 2, then they have to practice the vocabulary of Category One and Two again to pass the Level 2 barrier in the game. The structure of the game-based practice is presented as Figure 1-2.

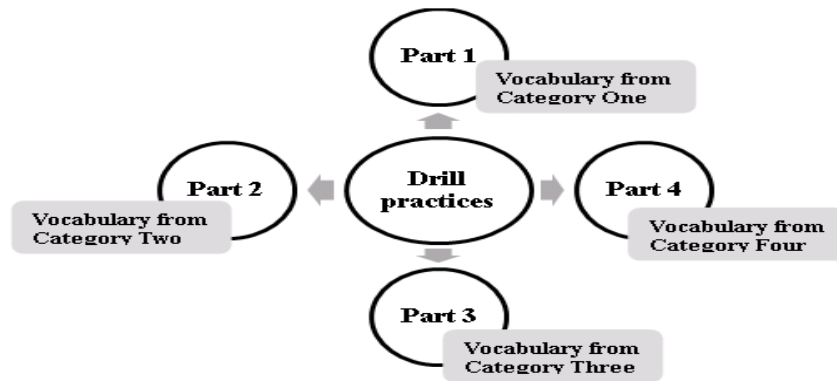


Figure 1-1. The structure of the drill practice: 4 parts

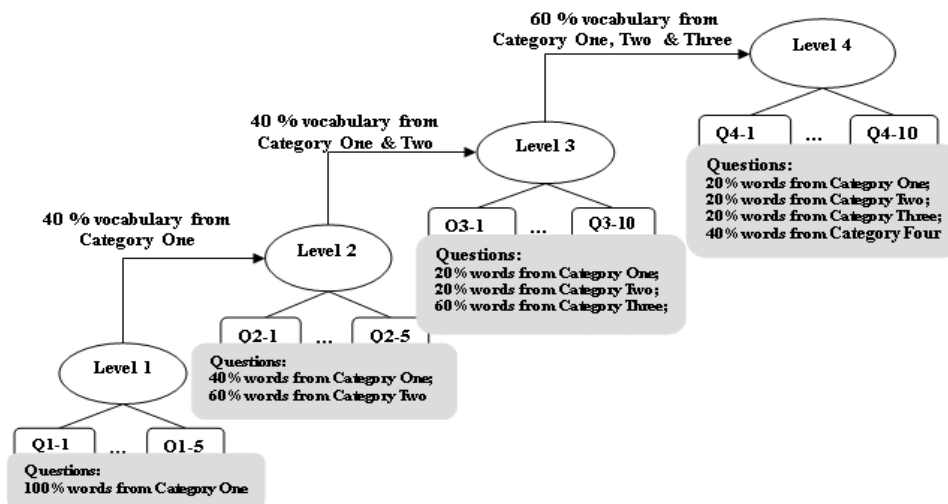


Figure 1-2. The structure of the game-based practice: 4-level barrier game

Rules of the two activities: drill practice and game-based practice

In the drill practice, students can listen to sounds produced by a native speaker and then record themselves repeating the sounds. Their pronunciation accuracy is displayed with a score and evaluation feedback on the screen, and then they can have repeated practice with the system (Figure 2).

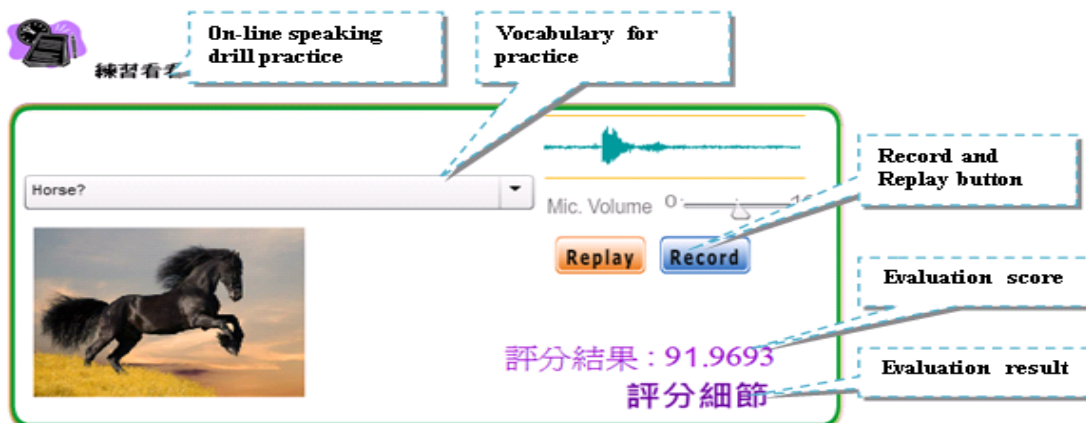


Figure 2. Sample screen of the drill practice

In the game-based practice, the learners have to select and pronounce the English vocabulary from three candidate answers on the screen according to the given picture (Figure 4-a). If they choose the correct answer and pronounce it correctly, the system will give them positive feedback and then they can go on to the next question (Figure 4-b). When learners complete one level of barrier game, they will get one color of virtual medal as reward. After they collect the four colors of medals, they complete the barrier game. Meanwhile, the system also offers a frustration control tool that gives the learners textual hints to prevent them from becoming stuck (Sun, Wang, & Chan, 2011) (Figure 4-c). The flow diagram of the game-based practice is shown as Figure 3. Through the gaming process, the learners are asked to pronounce the vocabulary, and the motivation to practice speaking comes from the desire to pass the different-level barriers in the game, thus empowering and enriching their self-speaking opportunities.

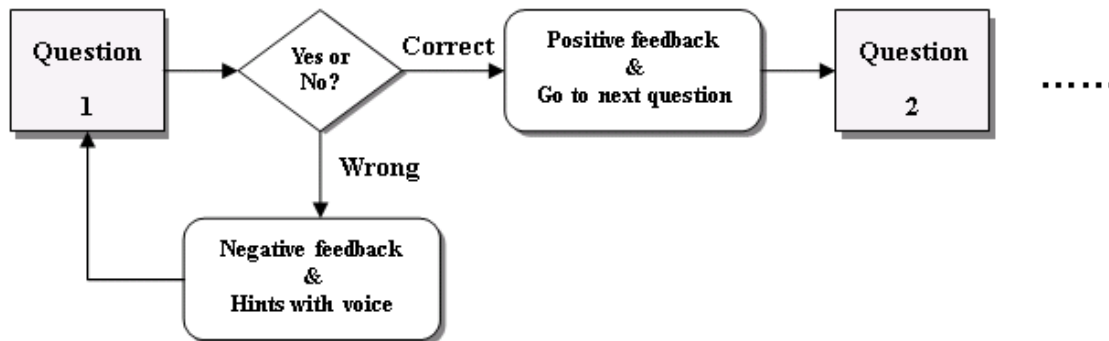


Figure 3. Flow diagram

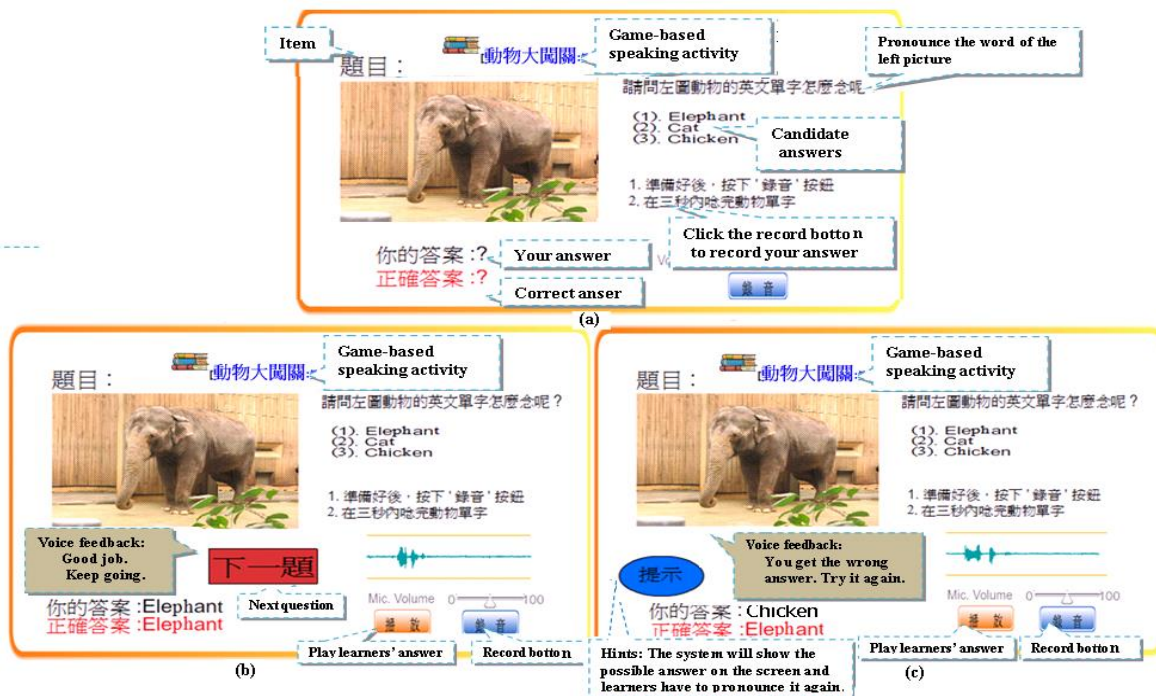


Figure 4. Sample screens of the game-based practice

Methodology

The study used comparative test data to report on the performance of learning English in the GeCALL system with two learning scenarios, and both qualitative and quantitative approaches were employed. The learners in the experimental group (E.G.) learned English with both the vocabulary drill practice and the game-based practice, while the students in the control group (C.G.) learned only with the vocabulary drill practice. In order to explore how the

GeCALL system facilitated the learners' English learning and what conditions contributed to their English vocabulary acquisition and pronunciation learning, the researchers conducted a paper-based test and speaking test before and after the experiment as the learning pre-test and post-test. In the speaking test, the learners had to pronounce five words learned in the GeCALL system, while the paper-based test consisted of ten multiple-choice questions that required the learners to select the corresponding English vocabulary according to Chinese items. The total scores of the paper-based test and speaking test were 100 each. Moreover, the questionnaire developed by the researchers of the present study was administered to the learners. The items included two parts, learning feedback and system operational feedback. The perceived learning scales were modified based on the Motivation-and-Attitudes-toward-Learning-English-Scale-for-Children (MALESC) questionnaire used to measure the English motivation and attitudes of elementary students (Carreira, 2006). The reliability coefficient of the questionnaires was 0.92 as measured by Cronbach's α . To increase the validity, the wording of the survey items were reviewed by one learning technology expert and one English teacher. Meanwhile, in order to understand the participants' experiences of participating in the speaking activities, a total of 15 students were chosen for interviews. The semi-structured interview included the questions: (1) How did you feel when participating in the speaking activities in the system? and (2) Did you enjoy the speaking activities? Finally, a delayed vocabulary retention test was administered to understand whether the learners in the two groups had remembered the learned words because the purpose of the delayed test was to measure learning outcomes not only before and immediately after the experiment, but also several days later (Draper et al., 1996). A one-week delay period was used in this study (Iwashita, 1999; Mohammad et al., 2011).

Participants

A total of 52 fourth graders (aged from 7 to 9) from an elementary school in Taiwan participated in this study and were divided into two groups. The E.G. consisted of 27 learners practicing English with the system using both drill practice and game-based practice, while the C.G. consisted of 25 students only given drill practice. Learners in both groups were further divided into three subgroups based on their English grades during the previous semester for further qualitative analysis. The high-achievement learners were those students whose grades were in the top one third of the class. The grades of the low-achievement learners were in the bottom third of the class, and the rest of the students were categorized as medium-achievement learners.

Data collection

The duration of the data collection was 8 weeks. In the first class, the English instructor gave the students a detailed demonstration of the system operation and its functions. Then the learners had to take the pre-test. During the experiment period, the learners in the E.C. and the C.G. learned English with the system in the drill practice, while only the learners in the E.G. participated in the game-based speaking practice. Besides, observation forms detailing the students' learning performance and processes in the classes were recorded by the trained observers. The observational scales were documented in the observation forms. The content of the evaluation criteria included: Did the students show motivation and involvement during the practice session with the system? How did the learners interact with the system and their classmates while practicing speaking? After 8 weeks of practice, the learners were asked to take the post-test. Moreover, the delayed vocabulary retention test was administered to the students one week later.

Data analysis and results

Data from the pre-test, post-test, delayed test, questionnaires and interviews were analyzed according to the research questions. Descriptive statistics were calculated to describe the means and standard deviations, and analysis of covariance (ANCOVA) was adopted to compare the final learning results (post-tests) of the two groups with pre-test scores as covariates to eliminate the effect of any existing pretest difference on the results. The homogeneity of variances was assessed by the Levene's test, and the results confirmed that the data met the equality of variance assumption.

Learning performance of the two groups

The pre-test, post-test and delayed test data were analyzed to answer the first research question. Table 1-a shows the descriptive statistics, including the means and standard deviations of the pre-test and post-test scores of the two groups. Both groups showed improvement on the post-test, but, noticeably, the ANCOVA results show a significant difference only in the pronunciation post-test scores of the C.G. and E.G. (Table 1-b; $p = 0.03^*$). However, it is noticed that the learners in the E.G. lagged behind the learners in the C.G. a little in the delayed vocabulary retention test. This indicates that the learners with game-based practice achieved better speaking improvement than those with only drill practice during the experiment, but the learners with only drill practice memorized the vocabulary better than the learners with game-based practice from a long-term perspective.

Table 1-a. Descriptive statistics

	E.G.				C.G.			
	Pre-test		Post-test		Pre-test		Post-test	
	M	S.D.	M	S.D.	M	S.D.	M	S.D.
Pronunciation Test	51.36	12.4	66.19	10.55	51.61	11.52	57.55	13.66
Paper-based Test	60.63	27.99	88.66	22.82	71.54	27.34	88.82	27.26

Table 1-b. ANCOVA table

	SS	MS	F	p		SS	MS	F	p
Pretest_	618.77	618.77	4.75	.04	Pretest_ Paper-based	1036.80	1036.8	1.87	.19
Pronunciation Test					Test				
Between(Group)	685.80	685.80	5.52	.03	Between(Group)	37.57	37.57	.08	.83
Within(Error)	3536.74	132.84			Within(Error)	14378.77	557.47		
Total	124889.96				Total	234398.0			
Corrected total	4745.34				Corrected total	15398.79			

Evaluation of learners' learning reflection

The questionnaires regarding the learners' reflections on using the GeCALL system were analyzed in order to answer the second research question. In all, the general evaluation by the learners was positive and they reflected that the GeCALL system helped them to memorize and pronounce the English words (Table 2, Q4 & Q5). Besides, the participants claimed that using the system promoted their opportunities of English speaking and most of them expressed the expectation to practice speaking with the aid of the GeCALL system for further learning (Table 2, Q1 & Q3). Furthermore, learners from the E.G. gave affirmative feedback on participating in the speaking game. They acquired the English vocabulary by completing the different levels of the speaking activity and showed strong motivation to practice speaking in order to experience achievement in the speaking barrier game (Table 3, Q1~Q4.).

Table 2. Learners' feedback on the system

Items	Total Avg	Group	Avg for groups	S.D. for groups
Using the system enhances the opportunities of English speaking.	4.12	E.G. C.G.	4.15 4.08	1.28 1.04
I like to practice English speaking and I am not afraid of making mistakes.	3.92	E.G. C.G.	3.92 3.92	1.55 1.19
I would like to use the system for further learning.	4.65	E.G. C.G.	4.92 4.38	0.28 1.04
I can pronounce the words clearly with the aid of the system.	4.37	E.G. C.G.	4.47 4.22	0.83 1.09
I can memorize the words with the aid of the system.	4.12	E.G. C.G.	4.40 3.67	0.83 1.41

Table 3. The E.G. learners' feedback on the system

Items	Avg	S.D.
Participating in the speaking game enhanced my speaking motivation.	4.47	0.83
Learning speaking through speaking games is quite interesting	4.55	0.76
I learned lots of new vocabulary through playing the speaking barrier game.	4.82	0.57
I would like to practice speaking repeatedly for experiencing achievement in the speaking activities.	4.52	0.73

Evaluation of learners' learning interaction and behavior when using the system

The observational data and interviews regarding the learners' learning processes and interaction while using the GeCALL system for speaking practice were analyzed in order to answer the third research question. The classroom observation indicated that the learners in the two groups all engaged in participating in on-line speaking learning. The learners in the C.G. had little learning interaction except comparing speaking scores with each during the drill practice, while, some of the high-achievement learners in the E.G. shared their experience of completing the game-based activity with the low-achievement ones, and some of the high-achievement learners in E.G. even accompanied the others especially the low-achievement learners to practice speaking in the game-based activity.

Noticeably, learners of various learning achievement levels in the E.G. had different learning behaviors during the activities. The low-achievement learners in the E.G. tended to firstly participate in the game-based speaking activity and went to the drill practice only if they got stuck in the speaking game (Figure 6a); however, the higher learning achievement learners in the E.G. usually practiced the vocabulary and read the results of the speaking evaluation through the drill practice first before challenging themselves in the game-based activity (Figure 6b). It is worth mentioning that originally some students were shy and afraid of being mocked by their classmates when they spoke in front of students with better performance. But it was observed that by using the speaking game, the students had more interaction with each other and practiced the target language together comfortably. Although the students were moving around the classroom, the environment was controllable because they needed to pay attention to the learning contents to complete the challenging barrier game.

Meanwhile, qualitative feedback from the interviews was also collected. The learners pointed out that speaking English with the computers was easier than practicing with a real person. In addition, most of the students agreed that the levels of the game were moderate, while a few low-achievement learners revealed that the game was challenging but they were not frightened to keep practicing speaking because it was just a game. Their comments included: "Yes, I did play the game and I think it was a little hard. But I am not afraid of it because I was just playing a game" (EL9) and "It was hard and I had to try lots of times to complete the game. I was nervous but I think it was still quite interesting" (EL10). In contrast, the researchers also found that very few (only two) of the high achievement learners showed any anxiety about playing the game because they were afraid of making mistakes in the speaking practice which might affect their score. They commented that, "The game was not hard and I had learned some of the words before. But I had to be careful so that I wouldn't make any mistakes in the game" (EH22). For a better understanding, a summary of the observational results of the two groups is provided in Table 4.

Table 4. Summary of the observational results

	C.G.: Drill practice	E.G.: Drill practice and Game-based practice
Learning interactions	<ul style="list-style-type: none"> Learners only compared speaking scores with each other Learners had little learning interaction except for comparing the speaking scores 	<ul style="list-style-type: none"> Learners of different learning achievement had good learning interaction: <ul style="list-style-type: none"> ✓ High-achievement learners shared the learning experience with the low-achievement learners ✓ High-achievement learners accompanied the others to practice speaking during the game-based activity
Learning behavior	<ul style="list-style-type: none"> Learners were pleased with practicing speaking with the system Learners all sat in their own seats and were well 	<ul style="list-style-type: none"> Learners were moving around the classroom Learners of different learning achievement had different learning paths: <ul style="list-style-type: none"> ✓ Low-achievement learners firstly participated in the game-based speaking activity and then

	<ul style="list-style-type: none"> behaved Learners were engaged in the activities 	<ul style="list-style-type: none"> went to the drill practice ✓ Higher-achievement learners practiced the drill activities first before challenging themselves in the game-based activity A few low-achievement learners revealed that the game was challenging A few high-achievement learners showed anxiety about playing the games
Learning feedback	<ul style="list-style-type: none"> <i>I am more willing to practice speaking with the activities. (CH1)</i> <i>Practicing with the computer is better. It is difficult to speak with classmates. (CH9)</i> <i>I see the classmates get good scores and I like to practice more. (CL12)</i> 	<ul style="list-style-type: none"> <i>The game is easy. I am not afraid. (EH1)</i> <i>Yes, I did play the game and I think it was a little hard. But I am not afraid of it because I was just playing a game (EL9)</i> <i>Practicing speaking with games makes me want to learn English. (EL12)</i> <i>It was hard. I had to try lots of times to complete the game. I was nervous but I think it was still quite interesting. (EL10).</i> <i>The game was not hard and I had learned some of the words before. But I had to be careful so that I wouldn't make any mistakes in the game. (EH22).</i>

Discussion

Different impacts of the game-based practice and drill practice on English learning

The evaluation results from the pre-test and post-test indicated that the use of the GeCALL system enhanced the learners' vocabulary acquisition as well as their pronunciation ability, especially for the learners in the E.G. who achieved significant improvement in their speaking performance from the results of ANCOVA analysis. Those who learned with the game-based activity compared their speaking performance with each other during the speaking activity and "the desire to complete the barrier game" became a trigger that motivated them to speak out. The process of completing the game helped the learners acquire the target vocabulary level-by-level, and it was observed that the learners went back to the drill practice to practice pronunciation again if they got stuck in one particular level. This finding echoes the research affirming that games have the power to get learners to learn enthusiastically, and the repeated gameplay was the driving force that motivated the learners to internalize the target knowledge gradually by playing (Coyne, 2003). On the other hand, the learners in the C.G. who learned only with the drill practice performed better in the delayed vocabulary retention test one week later. The reason can be explained and inferred from the qualitative observation that the learners in the E.G. put more focus on speaking the words rather than memorizing them during the barrier game; however, those students who learned with drill practice read the English vocabulary and the content description carefully, but sometimes they did not or forgot to pronounce the words. Accordingly, those who learned with the game-based activity performed better in terms of their pronunciation performance, but their vocabulary retention regressed compared with that of the learners who just used the drill practice. We conclude from the results that the game-based speaking activity enhanced the students' speaking motivation as well as their speaking performance; yet, the adoption of traditional teaching instruction, the drill-and-practice method, may facilitate learners' vocabulary retention more than that of the game-based activity.

Various achievements resulting from the game-based speaking scenario

According to the qualitative data, learners in the English class were all engaged in speaking practice with the GeCALL system. A previous study had indicated that sometimes noisy and disorganized learning happens while adopting game activities for teaching (Evans, 1979). However, even though we found the same situation, the atmosphere in the class was full of joy while the students were moving around the classroom during the game-based activity. One observation worth noting is the different learning behaviors of the learners in the C.G. and E.G. during the practice sessions. In the C.G., the learners were willing to practice speaking with the system and most of them

worked on their own in the drill practice. They liked to compare their speaking scores with each other, but little learning interaction happened while they were practicing speaking.

On the contrary, learners in the E.G. who participated in the game-based speaking activities tended to help each other to complete the game. The desire to try and the willingness to make mistakes among the learners were the factors which led to the students in the E.G. having learning interaction with classmates without stress. This observation was particularly obvious for the low-achievement learners who showed great involvement and were active in practicing speaking. Similar results were found in a previous study (Decarrico, 2001) in which the research mentioned that adopting game-based activities motivated advanced and less advanced students to work together to finish the learning tasks. The flexible and comfortable learning atmosphere during games made the students feel more relaxed and promoted their educative engagement so as to facilitate language acquisition (Barendregt & Bekker, 2011; Dolati & Mikaili, 2011; Chiu, Kao, & Reynolds, 2012). In addition, another noticeable observation is that (very) few advanced learners were afraid of making mistakes in the games due to their high self-expectations, and they showed little pressure while participating in the activities.

Conclusions

This study is a new attempt to explore the potential of integrating game strategies with state-of-the-art ASR technologies to provide learners with individual opportunities of immediate English pronunciation learning. The research concludes that, firstly, the learners' pronunciation performance improved significantly through practicing with the game process in comparison with the students who used the drill practice only, while the learners with only drill practice performed better in a delayed vocabulary retention test. Secondly, the low-achievement learners tended to participate in the barrier game first, only trying the drill practice if they got stuck pronouncing words. However, the high-achievement learners progressed the other way. This implies that the GeCALL system with both drill and game-based practices fulfilled learners' diverse needs. Thirdly, the results of the study indicate that the learners were not afraid of speaking English in front of peers even though they might make mistakes; meanwhile, the high-achievement learners were willing to share their speaking experiences with the low-achievement ones. The study affirms that the learners of various achievement levels had friendly learning interaction with each other while practicing speaking with the GeCALL system, and the lively interaction and great involvement during the game scenarios helped the learners overcome their anxiety about speaking and hence has positive potential for speaking acquisition. Despite the drill practice in the GeCALL system seeming to have better affirmation for vocabulary retention that benefits learners in passing traditional paper-based exams which are a feature of Taiwan's education system, the game-based activity in the GeCALL system obviously provides learners with a stress-free environment in which they are stimulated to actively practice their oral speaking, an important communicative skill required in the authentic world, comfortably.

Currently, most learners in Taiwan attend English classes in which they have to share their teacher's attention with each other, and this may reduce the amount of time that each student spends producing language output. However, the adoption of the GeCALL system provides students with an immediate one-on-one on-line speaking scenario, which could be an educative aid that school teachers could use to provide flexible chances for individual learners to do self-speaking practice within the given limited teaching time. Meanwhile, it is suggested that English instructors apply the GeCALL system in their formal English courses or for after-school learning, for example, once a week, as a remedial strategy for speaking practice. The learning contents could be modified according to the curriculum, and English instructors could assign the learners with diverse levels of proficiency to different kinds of speaking activities. For the high-achievement learners, they learn through advanced drill practices to further memorize the spelling of the vocabulary and internalize the knowledge; for the low-achievement students, the game-based activities can arouse their speaking motivation and, as long as the learners have interest in learning English, they could start engaging in the language learning scenario. The role of the English teachers could be as facilitators who could move around the classroom to monitor the students' learning processes and to provide help when needed. It could reduce teachers' teaching burden in coping with students' heterogeneity in one class; meanwhile, it can increase learners' speaking opportunities compared with learning in a traditional practice environment. Besides, for informal learning, teachers could hold on-line speaking competitions in the GeCALL system to encourage learners to keep practicing speaking after school. The game-like and relaxed learning scenarios of GeCALL may be a trigger that fosters learners, both at the advanced and low-achievement levels, to join together practicing speaking in a pleasurable learning environment. The findings of this study support the value of applying game research with ASR techniques for language learning. Other related studies on integrating game speaking training with ASR applications will be further explored in the near future.

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