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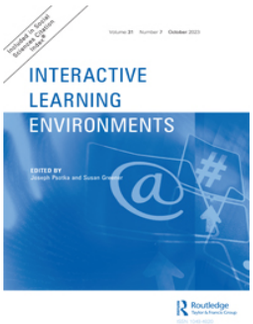

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Proposing a task-oriented chatbot system for EFL learners speaking practice

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ABSTRACT

Many learners of English as a foreign language often feel that learning spoken English is frustrating and quite difficult, especially when they have to talk to English-speaking foreigners. In general, because they are unfamiliar with the spoken mode of English and are worried about making grammatical errors, they often feel very scared to speak English. Furthermore, spoken language and reading differ in many ways. For instance, when seeing text containing new words, learners can stop and look up words in a dictionary. Additionally, a passage can be read multiple times by learners to understand it. Conversely, spoken language must be understood immediately in order to communicate effectively. The purpose of this study is to propose an interactive chatbot system named TPBOT which stands for "TOEIC Practice Chatbot" for EFL learners to eliminate their fear of speaking English and enable them to chat with online chatbots to practice spoken English at any time. This TPBOT would be very helpful to eliminate learners' anxiety about speaking a foreign language with foreigners.

Participants in this study are Taiwanese students whose oral scores on the TOEIC® test are below 100. They hope to improve their oral English ability after participating in the four-month experiment. The results have shown that students are satisfied with using this TPBOT and believe that it has indeed helped them improve their English speaking skills. Obviously, the TPBOT was very effective for the intended purpose. For educators, the TPBOT is very useful to build learning content in the TPBOT, provide learners with interactive exercises and improve learning effects.

KEYWORDS

Distance education and online learning; Human-computer interface; Improving classroom teaching; Informal learning; Mobile learning

1. Introduction

Learning English is usually divided into four parts: listening, speaking, reading, and writing. For non-native English speakers, when they communicate face-to-face with native English speakers, they need oral English skills at that moment. In general, Taiwanese students commonly feel shy and anxious when they are asked to speak English in class. This is the so-called foreign language phobia, also known as xenophobia, which is the feeling of panic, worry, tension, and anxiety experienced when using a second or foreign language. Young (1990) pointed out that speaking a foreign language is not the only source of student anxiety, but speaking a foreign language in front of the class. Therefore, Young (1991) tried to change the classroom environment to eliminate students' anxiety. Additionally, Minghe and Yuan (2013) also pointed out that the factor that causes anxiety

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is speaking in front of others. Fortunately, EFL learners can use computer-assisted methods to reduce oral anxiety (Tallon, 2009).

Now that smartphones are easy to carry around and can easily be used to customize courses for learners, mobile learning has become a common phenomenon. Therefore, learners can learn anytime and anywhere, and gaining knowledge is becoming increasingly convenient. In addition, Miangah and Nezarat (2012) stated that the oral function of mobile learning is very important. Therefore, if mobile learning can cover the function of interactive oral practice, this would be of great help to language learners. For these reasons, the AI chatbot designed in this study aims to be an effective learning tool for students to alleviate their anxiety about speaking foreign languages. In particular, using the AI chatbot as a speaking learning tool is one of the effective ways to improve oral English ability because it can minimize the problems encountered in language classes and reduce oral English anxiety.

Computer-based training is effective for learners to improve their English language skills. Wang and Munro (2004) proposed computer-based training for learning English vowel contrasts. Hsu (2008a, 2008b) proposed a personalized English learning recommender system for ESL students.

Since 2011, Facebook Inc. released Facebook Messenger (commonly known as Messenger) from pure messaging functionality to a multiple support platform to allow users to send messages and exchange photos, audio, and files. At that time, more than 40 standalone applications, including video editing and animation, were provided. The latest attempt is the Messenger robot program. Users can react to other users' messages and even interact with bots.

A chatbot, short for chat robot, is a software application designed to interact with users using text or text-to-speech functionality. Designed to make users feel like they are talking to a live human agent, most chatbots utilize artificial intelligence (AI) algorithms or natural language processors to generate the necessary response. Early chatbots simply created intelligent illusions by using simple techniques of pattern matching and string processing to interact with users based on rule-based and generation-based models. However, with the advent of new technologies, more intelligent systems have emerged using models based on complex knowledge.

There are many successful computer applications for training on speaking languages. The development of chatbots has been undertaken to leverage learning and teaching in different disciplines. For instance, Freudbot was developed to understand the psychology of student interaction in distance education (Heller et al., 2005). The results indicated that a basic analysis of chat records shows a high proportion of task execution. The results also showed that chatbot technology is expected to become a teaching and learning tool in distance learning and online education (Heller et al., 2005). In science lectures, the use of chatbots was also compared with humanoid robots, and it was reported that visualization using chatbots helps students to understand lectures smoothly (Matsuura & Ishimura, 2017). However, research on the use and development of chatbots to enhance language learning is quite difficult.

Project LISTEN's virtual reading instructor (Mostow et al., 2013) uses speech recognition to monitor children's speech when reading aloud, thereby supporting elementary school students in improving their reading skills in their first language, English. Systems such as Robo-Sensei (Nagata, 2009) have implemented natural language processing algorithms to provide adult learners with semantic and syntactic feedback and improve foreign language grammar skills. Physical robots have also been shown to be effective in helping children to learn aryl compound vocabulary (Vogt et al., 2019). Hsu (2008a) proposed that robots can help young children to understand and create stories.

Without a doubt, the development of educational technology has combined innovative teaching methods and new technologies to enhance the learning experience of students. Virtual assistant or chatbot technology simplifies and enhances the learning process of students by integrating teaching methods and innovative technologies.

In addition, Hussain et al. (2019) noted the need to discuss the classification of chatbots, the design techniques used in early and modern chatbots, and the ways in which the two main categories of chatbots handle conversation contexts. Winkler and Soellner (2018) proposed that chatbots are in the early stages of use. Several studies have shown the potential of chatbots to improve

the learning process and learning outcomes. However, past research has shown that the effectiveness of chatbots in education is complex and depends on many factors.

Kozma (2001) pointed out that specific properties of computers are needed to provide learners with real models and simulations; therefore, the medium does affect learning. However, what students learn is not the computer itself, but the design of real models and simulations, and students interact with these models and simulations. In addition, the Auto Tutor is an intelligent tutoring system that can help students learn Newtonian physics, computer literacy, and critical thinking topics through natural language tutorial dialogues. In this study, the TPBOT system is a task-oriented learning system that focuses on TOEIC speaking training and its development was inspired by Kozma (2001) and Auto Tutor (Graesser et al., 2005) learning methods. The difference between TPBOT and Auto Tutor is that the TPBOT system was written in Python and aims to enable learners to easily engage in interactive conversations to encourage them to continuously improve. For instance, when the learner selects a topic and speaks to the TPBOT, the TPBOT employs a pronunciation recognition device, to determine the appropriate answer so that the learner can improve speaking via continuous imitation and practice.

The research questions of this study are 1. How to help non-native English speakers improve and eliminate their anxiety when talking to English-speaking foreigners?

(1) At present, many Taiwanese enterprises require their employees to submit TOEIC test scores to prove their English ability. Among them, many companies especially value the spoken English ability of their employees. Because of this phenomenon, how to help college students improve their spoken English ability and benefit their future employment?
(2) How to use the AI chatbot, called TPBOT, proposed in this study to help learners achieve these goals by using it for self-learning, eliminating foreign language phobia, and improving TOEIC speaking scores?

2. Method

2.1. Study design

This study used the experimental method to determine whether the use of TPBOT can improve students' TOEIC speaking scores. The experimental design was divided into an experimental group and a control group. Both groups of students took part in two TOEIC speaking simulation pretests and posttests. After taking the pretest, students in the experimental group were provided with the TPBOT as a self-learning tool and had to use it for a four-month oral training experiment at least one hour a week, part of the exercise content is shown in Figure 1, while the students in the control group did not use any experimental operations to compare the differences between the two groups and the experimental results.

2.2. Participants

The participants in this study were 100 students from a university in northern Taiwan. They participated in the TOEIC speaking simulation test. The results of the TOEIC speaking simulation test showed that 48 students achieved a score of less than 100 out of 200 points on the TOEIC speaking test.

In this study, a simple random sampling (SRS) method was used to divide the experimental group and the control group. The way of using the SRS is to number each of the 48 students, and each student has only one number. Then use the RANDBETWEEN (1,24) function of the MS-Excel to generate random numbers to select 24 students. If a certain number is repeatedly selected, then abandon this number and re-execute to generate a new number until 24 different numbers are generated. After that, 24 students were assigned to the experimental group, and the remaining 24

A: What's the weather like in your country?

B: It's very hot and humid in the summer.

A: Do you have snow in winter?

B: No, we don't usually have snow. It snows only in the very high mountains.

A: What is autumn like in your country?

B: It's very colorful.

A: How often do you eat out?

B: I often eat out on weekends.

A: Are you running any business?

B: Yes, I'm running a small bookstore.

Figure 1. Part of the exercise content.

students were assigned to the control group. The students in the experimental group received the TPBOT to help them with speaking practice. On the contrary, the control group did not. They just used the TOEIC textbook with mp3 or audio CDs to practice English speaking and listening.

2.3. Study instruments

The TPBOT proposed in this study is an online chat robot system, which is a task-oriented chat robot system (Gao et al., 2019) that can be used on the LINE platform (https://line.me/zh-hant/). LINE is an instant messaging platform, such like Messenger, WhatsApp, Telegram … , developed by LINE Co., Ltd. Users can send messages and watch live broadcasts to other users via the Internet without additional costs, and can use functions such as shopping, mobile payment, and news and information through LINE. Users can access the TPBOT through mobile phones. The TPBOT is equipped with an automatic correction system that allows the user to repeatedly learn or imitate the robot's pronunciation, or to have a dialogue with the TPBOT, and the TPBOT will also detect the student's pronunciation in real-time and give the user an appropriate response. The purpose of this TPBOT is to help improve students' TOEIC speaking ability. During the TOEIC speaking test, questions must be answered continuously. This means that when the previous question is answered incorrectly, you still must continue to answer the next question. Therefore, in order to cultivate students' ability to continue answering questions, the TPBOT used in this study presets the error value at 70% (https://pypi.org/project/SpeechRecognition/). As long as the error of the student's answer is less than 30%, the TPBOT will continue to give answers and practice questions, and the user can continue to practice until the end of the session. Conversely, if the student's answer is more than 30% wrong, the TPBOT will record the student's answer for the question as an error and will display the correct answer for the student to answer, so as to continue the follow-up oral practice.

After finishing each exercise, the user can obtain the results produced by the TPBOT and find out the correct answer for each question.

2.4. The online chatbot system TPBOT

The TPBOT system on the sever side comprises two major modules: the database and the processing engine. Figure 2 shows the simplified architecture of the TPBOT system.

Users can access TPBOT via LINE on their mobile phones and devices and the mobile operating system is iOS or Android.

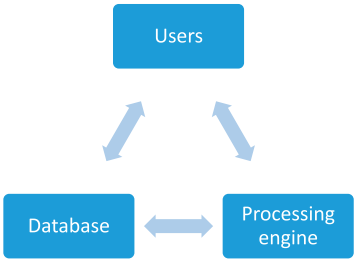

Figure 2. The simplified architecture of the system.

On the server side, the system requires Python version 3.7, Ngrok, and LINE Developers account. The other employed packages include line-bot-sdk version 1.8.0, *pydub* version 0.23.1, and speech_recognition version 3.8.1; *pydub* can quickly convert files into the required format, and speech_recognition allows the TPBOT to recognize all languages through Google.

2.4.1. The database

Since the TPBOT is task-oriented, all conversations are stored in the relational database named PostgreSQL (Drake & Worsley, 2002). PostgreSQL is a kind of open-source software and a relational database, just like MS-SQL and Oracle. However, PostgreSQL is a free relational database. Figure 3 is a diagram of the relationship.

The data sheet "Now_on" records the user's basic information and the user's current practice progress of each exercise, as well as the date and frequency of the exercise. The field "practice" records the user's current practice; "conversation" records the user's current dialogue practice; "practice data" records the user's feedback on the exercise.

The data sheet "Questions" is used to store the questions, and it contains all exercise questions for the system to retrieve and compare with the sentences read by the user. The field "practice" records the practice code of the question; "conversation" records the conversation code of the question; "text" records the content of the question. Additionally, "AB" is a flag used to determine whether the user or the system speaks out.

2.4.2. Processing engine

The design of TPBOT follows the idea of (Graesser et al., 2005). Its design feature is that TPBOT allows users to install on their mobile phones, which is very convenient to use. The flowchart is shown in Figure 4.

While the TPBOTs server is running, the system will monitor all incoming messages including text messages, voice messages, etc. to the server. If a user sends a voice message to the corresponding account, the system will perform the following steps:

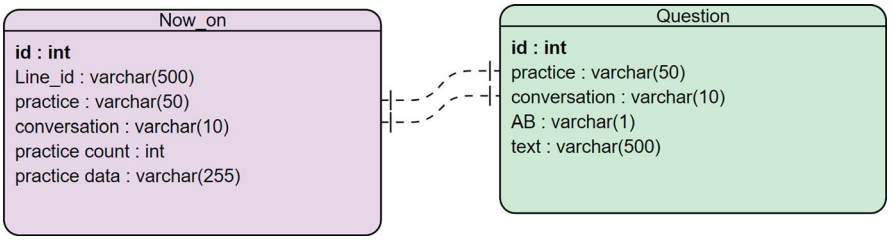

Figure 3. The diagram of the relationship.

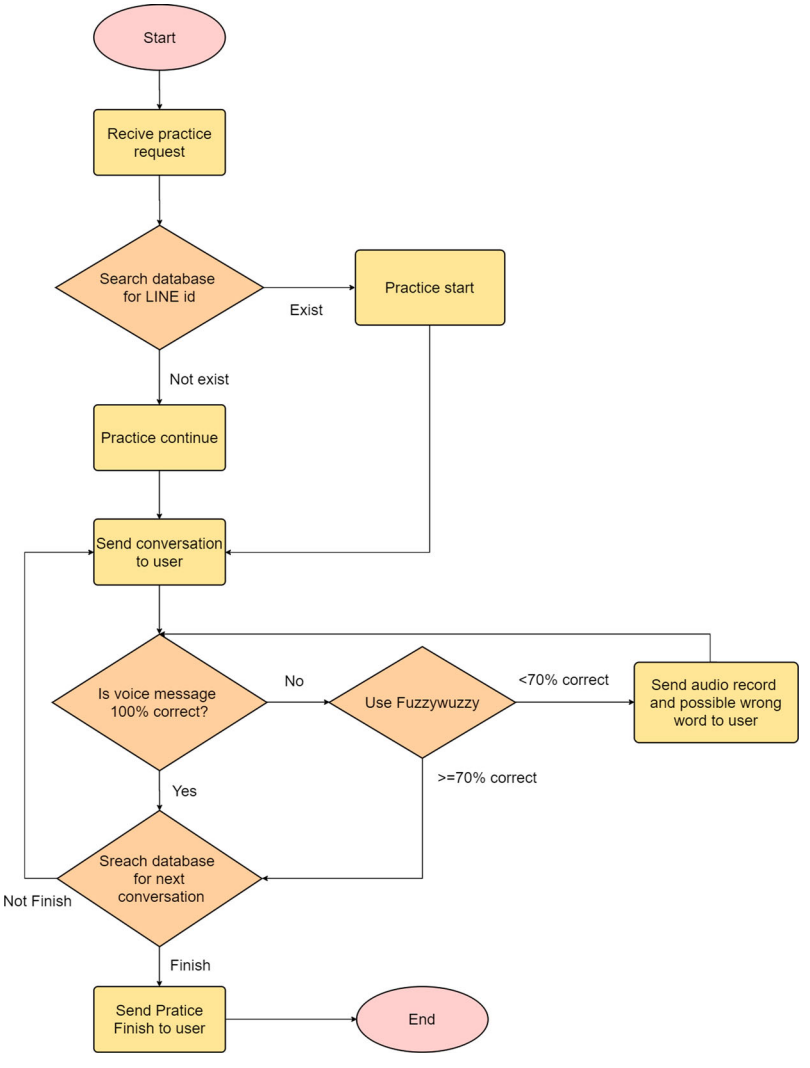

Figure 4. The processing of TPBOT engine

(1) When the user logs in to the dialogue window with the TPBOT, a practice menu will appear to allow the user to choose the type of exercise she/he wants. In Figure 5, listening exercises, speaking exercises, and reading exercises are shown in sequence.
(2) When receiving the exercise request from a user, the system will first query the database whether the user is a new user or an old user. If it is a new user, the system will store the new user's data on the User's Data Sheet of the database and record the exercise currently selected by the user and then send it to the user's first exercise dialogue, as shown in Figure 6.
(3) After the user returns the voice message of the dialogue prompted by the system, the system will convert the voice message with the pydub package through FFmpeg software (.m4a to .wav) and save it.
(4) Then use the Speech_recognition package to read the converted voice message and send it to Google for voice recognition.
(5) Searching the current user's exercises and the code of the dialogue from the database, and then use the code to search for the dialogue text of the code in the Questions data table, and temporarily store it in the system.

Figure 5. The TPBOT menu on the mobile phone.

Figure 6. The user's practicing.

(6) Comparing the returned Google voice-recognized text with the user's current conversation text temporarily stored in step (5).
(7) Determining whether the sentence spoken by the user completely matches the standard answer in the database. If there is no complete match, use the fuzzywuzzy package to compare whether the similarity between the interpreted text and the sentence that the user is guided to say is acceptable. The Fuzzywuzzy package calculates the difference between sequences using the method of Levenshtein (1966). That is, with Google text-to-speech service, the message to be responded to the user is converted into a voice response to the user, and a sentence to be guided to the user next time is added to complete this conversation. If the system does not accept the user's speech, it means that the user has a very low understanding of the sentence. The system will send a voice message to inform the user of the correct pronunciation of the sentence, and a text message to inform the user of the words that the user needs to pay attention to after the comparison.
(8) When the system fails to interpret the user's answer, the reason may be that the user is silent, or the environment is too noisy to be recognized, or the network connection is unstable. The system will display a message, asking the user to say it again, and reply to the user "Sorry, I didn't quite catch that." The user is prompted to send the voice message again to facilitate system identification, as shown in Figure 7.
(9) If the server is disconnected during the exercise or the exercise is interrupted, the server will record the dialogue position of the user's last exercise (for example, the third sentence of exercise 2). When entering the system again to practice, the user can choose to continue the previous exercise or start a new exercise.

3. Pre- and post-experimental statistical analysis

Before and after the experiment, 48 students took the in-class TOEIC speaking simulated test as a basis for comparison.

3.1. Pre-experimental statistical analysis

In this study, an independent-sample t test was used to compare the difference in the means between the control group and experimental group. The control group sampled 24 individuals with an average test score of 75.42; the experimental group sampled 24 individuals with an average test score of 76.79, as shown in Table 1.

In Table 2. in the independent-sample *t* test, the test statistic *t* value is -.332, and the probability value *p* value is .742, which does not reach the significance level of α=0.05, so the null hypothesis cannot be rejected. The results of the analysis indicate that there is no significant difference between the control group and experimental group.

3.2. Post-experimental statistical analysis

Four months later, the 48 students took the TOEIC speaking simulation posttest. The control group sampled 24 individuals with an average test score of 73.21; the experimental group sampled 24 individuals with an average test score of 141.25, as shown in Table 3.

In Table 4, in the independent-sample t test, the test statistic t value is -14.035, and the probability value p value is .000, reaching the significance level of α=0.05. Therefore, the null hypothesis is rejected, and the opposite hypothesis is accepted.

The results of the analysis indicate that there is a significant difference between the means of the control group and the experimental group. Among them, the experimental group had a significantly larger mean than the control group.

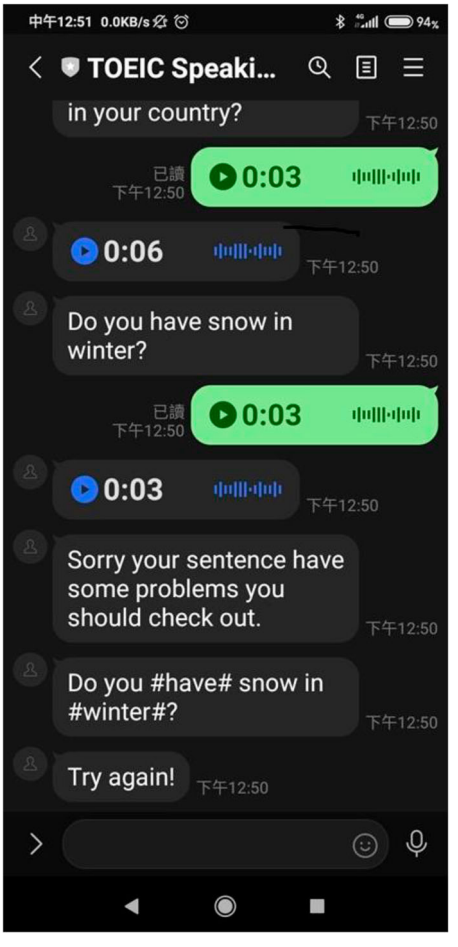

Figure 7. Response when the system cannot recognize the user's answer

Table 1. Sample descriptive statistics

Group	Number	Average	Standard deviation
Control Group	24	75.42	16.21
Experimental Group	24	76.79	12.25

Table 2. Independent-sample t-test for experimental group and control group.

Group	Number	Average	Standard deviation	*t*	*p*
Control Group	24	75.42	16.21	-.332	.742
Experimental Group	24	76.79	12.25		

The test results showed that the students in the experimental group made significant progress. In contrast, the students in the control group did not.

Table 3. Sample descriptive statistics

Grouping Variable	Number	Average	Standard deviation
Control Group	24	73.21	16.10
Experimental Group	24	141.25	17.46

Table 4. Independent-sample t-test for experimental group and control group.

Grouping Variable	Number	Average	Standard deviation	*t*	*p*
Control Group	24	73.21	16.10	-14.035	.000***
Experimental Group	24	141.25	17.46		

3.3. Result

In this study, the experimental results showed that students who took part in oral training on the TPBOT made significant improvements in their oral English ability. In contrast, students who did not use the TPBOT had limited or no progress at all. Without a doubt, TPBOT that provide interactive functions are very useful tools for helping learners improve their spoken English.

The experimental results of this study showed that in the experimental group, the students had an average improvement of 65 points, but the standard deviation was 17.46, which means that the degree of improvement varied substantially among students. An explanation can be found in the results of the questionnaire survey. Most students found it very interesting to learn spoken English by using an interactive online chatbot; in particular, online practice on a smart phone is very convenient. However, as shown in Figure 8, there were still a small number of students whose practice frequency was relatively low, and their learning progress was relatively low. Therefore, the average score of the students in the control group dropped by 2 points, and there was no difference in the standard deviation, indicating that their degree of progress did not change much. The results of this study and the report of Ruan et al. (2019) both confirm that chatbots play an important role in users' learning.

In addition, a satisfaction survey was conducted at the end of the training. The scale ranges from 1 (not helpful) to 5 (very helpful). According to the results of the satisfaction questionnaire survey, the average scores answered by the experimental group students all exceeded 4.0. Most students find TPBOT helpful and their performance in learning TOEIC has improved (see Table 5).

3.4. Disscusion

The results of the satisfaction survey of experimental group students were considered advantageous, as shown in Table 5. It is obvious from this result, the TPBOT is indeed a good self-learning tool, which satisfies the research questions. More importantly, when EFL learners practice oral English through TPBOT, it can help them eliminate their deep-rooted fear of speaking English. Because of the convenience of mobile phones, they can practice oral English with TPBOT at any time. It can be seen that TPBOT is a great assisted self-learning tool to help eliminate learners' anxiety about speaking foreign languages with foreigners. This result is the same as the web-based language learning and speaking anxiety proposed by Bashori et al. (2020). As pointed out by Minghe and Yuan (2013), "effective learning and practicing out of class is also important, which not only contributes to improving students' oral proficiency, but also helps them keep strong motivation and reduce the anxiety of learning oral English." The results of the analysis indicate that there is a significant

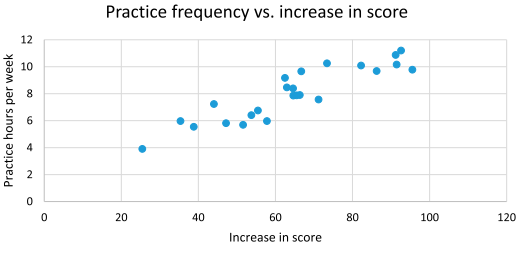

Figure 8. The relationship of practice frequency and increase in score

Table 5. The results of the satisfaction survey of experimental group students

	Questions	Mean(S.D.)
1	The TPBOT prompted me to explore new challenges.	4.5 (0.88)
2	Compared to talking directly with foreigners, using TPBOT to practice speaking makes me more confident.	4.7 (0.79)
3	I think my process of TOEIC speak learning on TPBOT is very interesting.	4.6 (0.89)
4	TPBOT can stimulate my thinking ability.	4.5 (0.81)
5	TPBOT is easy to use.	4.3 (0.85)
6	The mobile TPBOT allows me to learn anytime, anywhere.	4.2 (0.82)
7	I think using TPBOT can improve my speaking ability.	4.8 (0.81)
8	Compared to studying alone, I prefer to use TPBOT to learn.	4.8 (0.82)
9	I think to learn will help me get good grades in TOEIC.	4.7 (0.83)

difference between the means of the control group and the experimental group. Among them, the experimental group had a significantly larger mean than the control group.

The test results showed that the students in the experimental group made significant progress. In contrast, the students in the control group did not. After the students in the control group learned that the students in the experimental group had greatly improved their oral English after using TPBOT, they also increased their motivation and expected to use TPBOT for oral practice.

4. Conclusion and future research

The purpose of this study is to help non-native English speakers eliminate their anxiety when talking to English-speaking foreigners, help improve their spoken English ability and offer them an interactive spoken language self-learning tool. The TPBOT was designed to achieve this goal and it is a task-oriented interactive spoken language self-learning tool and can be installed on smartphones or tablets. In this study, the experimental design is divided into the experimental group and the control group. Both groups of students took the pre-test and post-test of the TOEIC Speaking simulated test. After taking the pre-test, students in the experimental group were provided with TPBOT as a self-learning tool, while students in the control group did not use any experimental tools, but used the TOEIC speaking textbook with CDs or mp3 for speaking practice.

The results of this study have shown that the students in the experimental group have effectively improved their English speaking ability through interactive learning with TPBOT. In addition, their post-simulated test scores have also been significantly improved. Particularly, through interacting with the TPBOT, the learners received help from its system and speak English more correctly. Moreover, it can immediately provide a corrective response, enabling students to participate in comprehensive spoken language drills through continuous simulation. The TPBOT absolutely is very helpful for learners to avoid experiencing anxiety when speaking in a foreign language to foreigners. In the design of this study, various considerations have been taken to avoid research errors. The limitation of this study is that the frequency and length of time that students use the TPBOT is difficult to control. Overall, it is certain that the TPBOT proposed in this study can also be used for self-learning in other spoken languages. In future research, TPBOT can be combined with Hsu's recommendation system, which is an assisted language learning system for EFL learners (2008a, 2008b), providing more powerful language learning assistance for foreign language learners.

Notes on contributor

Mei-Hua Hsu received the Ed.D. degree in Instructional Technology from Nova Southeastern University, FL, USA. She is now an associate professor at the Center of General Education of Chang Gung University of Science and Technology, responsible for teaching English for Nursing students. From 2014 to 2019, she signed the industry-academia cooperation contract with Chang Gung Memorial Hospital, one of Taiwan's largest and most well-known hospitals, and was responsible for training the hospital's staff in English courses. Her recent research interest is applying Chatbot in education and helping EFL students learn English.

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