MEESO

Modern English Education

http://dx.doi.org/10.18095/meeso.2020.21.2.1

Impact of Mobile Interactions With AI on Writing Performance*

Hea-Suk Kim**
Seoul Women's Univiersity

Yoonjung Cha
Hanshin University

Na-Young Kim
Sehan University

ARTICLE INFO

Received: 10 March 2020
Revised: 23 April 2020
Accepted: 11 May 2020

Examples in: English
Applicable Languages: English
Applicable Levels: Tertiary

KEYWORDS

AI text chatting/ writing task/ writing performance/ Mobile-Assisted Language Learning/ Face-to-face/
AI 문자 채팅/쓰기 과업/쓰기 수행/ 모바일 보조/언어 학습/면대면

ABSTRACT

Kim, Hea-Suk, Cha, Yoonjung, & Kim, Na-Young. (2020). Impact of mobile interactions with AI on writing performance. *Modern English Education, 21*(2), 1-13.

The present study investigates the impact of mobile interactions with AI on writing performance, on students' attitudes toward English learning, and on their perspectives when using AI chatbot applications. Seventy-three university students participated in the study during the semester. They were assigned to two different groups: an i-to-face group and an AI text-chatting group. They were given two writing tasks which involved describing a picture and giving opinions drawn from the TOEIC Writing Tests in the pre- and post-stages. In addition, they were asked to respond to pre- and post-surveys to explore their changes in attitudes toward English learning. The AI text-chatting group was given open-ended questions on their experiences. The quantitative data and qualitative responses were analyzed. The findings are as follows. First, both groups showed significant improvement in the two writing tasks. However, the participants in the AI text-chatting group improved significantly better than those in the face-to-face group. Second, regarding the changes in learners' attitudes toward English learning, both groups' anxiety levels declined over time. Various comments on interacting with AI were mentioned. Based on the findings, suggestions and limitations for future studies are provided.

* This work was supported by the Ministry of Education of the Republic of Korea and the National Research Foundation of Korea (NRF2018S1A5A2A03036420).
** First author: Hea-Suk Kim, Corresponding author: Yoonjung Cha & Na-Young Kim

Hea-Suk Kim (Professor)
Institute for General Education, Seoul Women's University, 621, Hwarangro, Nowon-Gu, Seoul, 01797, Korea
Tel: (02) 970-7862 / Email: shskim@swu.ac.kr

Yoonjung Cha (Professor)
Peace and Liberal Arts College, Hanshin University, 137, Hanshindae-Gil, Osan-shi, Gyeonggi-Do, 18101, Korea
Tel: (031) 379-0668 / Email: yjcha@hs.ac.kr

Na-Young Kim (Professor)
Department of General Education, Sehan University, 33, Sehandae-gil, Sinpyeong-myeon, Dangjin-si, Chungcheongnam-Do, 31746, Korea
Tel: (041) 359-6145 / Email: nykim@sehan.ac.kr

I. INTRODUCTION

Our ability to access the Internet has widened greatly since the 1990s. We are today able to access information on multiple devices, including desktop computers and handheld devices. This has changed the way we choose to update our knowledge. In particular, wireless computers and phones such as tablet PCs and smartphones have enhanced personalization, flexibility, ubiquity, and pervasiveness (Troussas, Virvou, & Alepis, 2014). This can free learners from studying in front of a computer screen, having important teaching implications related to mobile learning.

Mobile learning has been adopted across multiple contexts, focusing on the mobility of the learner. According to Elias (2011), mobile devices have the potential to offer learning opportunities with more comprehensive and higher quality, maximizing the learning benefits. First, learners can interact using personal mobile devices, and are able to access those learning opportunities anytime, anywhere. This is one of the biggest benefits of mobile learning: learning materials and exercises are available on demand (Troussas et al., 2014).

In addition to its superior portability, mobile learning is less expensive compared to using other technologies such as desktop computers with fixed internet (Hashemi, Azizinezhad, Najafi, & Nesari, 2011). And given that mobile devices are small enough to operate in one hand, they facilitate information sharing, which in turn contributes to further cost savings. Mobile learning can also provide options to create and deliver multimedia content (Kukulska-Hulme & Shield, 2008). It is possible to download and upload text, audio, images, and even video files from mobile devices that come standard with built-in speakers and cameras.

In the education field, communication plays an important role. In mobile learning, it is also significant and beneficial. According to Troussas, Krouska, and Virvou (2017), mobile learning produces great benefits using Artificial Intelligence (AI). As technology advances, as N.-Y. Kim (2017b) noted, mobile interactions with AI have facilitated communication. AI stores conversation patterns in "Artificial Intelligence Mark-up Language (AIML)" (n.d.) files. AIML is a derivative of "Extensible Mark-up Language (XML)" (n.d.), which is a mark-up language defining a set of rules to encode documents in both human-readable and machine-readable formats. In other words, the rules of artificial intelligence are written in a language derived from XML, and this is called AIML. Troussas et al. (2017) claimed that these programming languages make it easier to integrate with the rest of the mobile program and, therefore, AI has been used for developing mobile learning modules.

AI has become popular in various fields including language teaching and learning, serving a variety of uses (Warschauer & Healey, 1998). One obvious example is an electronic dictionary. Learners can study vocabulary, phrases, and idioms with an AI dictionary. AI also provides a means of language practice for learners (Haristiani & Danuwijaya, 2019), such as offering language drills or skill practice, where the AI plays the role of tutor. Particularly with the speech recognition system, learners can even practice and improve their listening and speaking skills (N.-Y. Kim, Y. Cha, & H.-S. Kim, 2019). This can be a stimulus for discussion. Artificial intelligence can also be a tool for writing and research. With the development of AI, learners have one more medium available for language learning (Yang, 2007).

As AI technology advances, learners can interact with artificial intelligence with authentic input and output. According to N.-Y. Kim (2018), AI can serve the role of a native English speaker, which in turn can provide learners with opportunities to have authentic interactions. As conversation agents, artificial intelligence uses natural language as input and output and simulates chat with learners. When input is delivered, the artificial intelligence parses the input and analyzes it for key words. After that, it makes a response using its database of possible answers. Since the entire process flows so automatically, learners feel like they are having a conversation with a human partner.

Previous scholars have agreed that interaction is one of the most important parts for language learning (Richards & Rodgers, 2001). In particular, as communication technology advances, learners are being provided with increasingly supportive learning environments for meaningful interaction. The progress made in the field of language learning software has allowed learners to experience natural and authentic interaction via online debate activities, e-mail exchanges, and discussion forums (B.-G. Kim, 2010).

According to Blake (2008), online interaction provides similar benefits to conventional face-to-face interaction. They both occur in real time. Learners can modify their output, negotiate meaning, and respond to feedback during the interaction. Specifically, learners can increase their interest in learning and decrease their dependence on the teacher through such interaction (Kern, 1995). Regarding mobile interaction, N.-Y. Kim (2017b) found that it can improve learners' writing performance including grammar, content, mechanics, organization, and language in use. She also concluded that mobile interaction has positive effects on language learners' attitudes toward learning.

However, relatively few studies have been carried out regarding the effects of online interaction on writing. While online interaction has blurred the line between speaking and writing, previous researchers have only focused on the impacts of online interaction on students' speaking performance rather than on their writing (Warschauer & Healey, 1998). As such, it is necessary to investigate the impacts of online interaction on writing performance. Furthermore, although many scholars, researchers, and teachers have given considerable attention to language learning with AI, there is a dearth of empirical studies investigating the impacts of interaction with artificial intelligence (N.-Y. Kim, 2018). While previous stud-

ies have centered on the interaction between learners, little research has explored the learner-AI interaction dynamic (N.-Y. Kim, 2017b). In this vein, there is also a need to confirm the impacts that AI interaction has on language learning, including its efficacy given that this facet is least understood in EFL (English as a foreign language) environments (N.-Y. Kim, 2018). Based on these points, three research questions have been developed:

1) Does mobile interaction with AI lead to increased gains in writing performance?
2) Are there any changes in EFL learners' attitudes toward English learning after experiencing AI interaction?
3) What are learners' perspectives of using AI chatbot applications?

II. LITERATURE REVIEW

1. Writing in Language Learning

Writing is a tool for expressing opinions, thoughts, or feelings. It is not only an individual act, but also a social and interactional process where the writer articulates his or her idea by responding to others (Aydın & Yıldız, 2014). According to Hably, Bloom, and Robbins (2012), writing is an important skill for academic success. In foreign language classes, writing also plays an important role. As Aydın and Yıldız (2014) pointed out, good writing skills include a range of linguistic abilities such as lexical knowledge, grammatical accuracy, syntactic expression, and planning strategies such as organization, style, and rhetoric. In this vein, teachers in writing classes should consider the various features of writing. They need to not only emphasize accuracy in formal language but also establish the meaning of writing by providing meaningful contexts and authentic purposes.

In foreign language writing classrooms, however, writing is just used to confirm that learners have mastered certain grammatical rules (Sokolik, 2003). In addition, teaching writing is often considered a thankless job (Yang, Badger, & Yu, 2006). Teachers even find marking and correcting students' writing a "tedious and unrewarding chore" (Hyland, 1990, p. 279). In spite of the importance attached to writing in foreign language classes, many learners also suffer from expressing their ideas in writing in their target language because they have difficulty thinking in their target language when writing in a foreign language.

Writing difficulty can stem from a learner's linguistic problem with syntax, lexis, and discourse aspects. Hinkel (2006) claimed that foreign language learners have difficulty writing due to its highly complex process. According to N.-Y. Kim (2017b), since it is necessary to incorporate various language skills including spelling and grammar, writing is the most difficult skill for foreign language learners to master. Moreover, Brown (1987) argued that writing is the advanced stage of language development, considering the natural order of language learning; that is, listening, speaking, reading, and writing. Puteh, Rahamat, and Karim (2010) noted that this explains why most language learners struggle to write.

According to N.-Y. Kim (2018), a learner's low level of engagement with writing also makes writing more difficult. Writing engagement refers to student participation in writing activities. Low levels of learning engagement cause apathy, discouragement, or absenteeism (Furlong & Christenson, 2008). A learner's low engagement is pervasive in many countries, and according to Guilloteaux (2016), this is a growing problem worldwide, having negative impacts on language learning. In particular, M. Park (2015) found that EFL learners prefer teacher-centered instruction, and this can lead to a low level of writing engagement.

A learner's native language and culture can also interfere with English writing. Although it is a compulsory subject for learners from primary to tertiary levels in most EFL contexts including Korea and Thailand, English is often taught in their mother tongue rather than in English. According to Bennui (2016), most EFL learners use their native language more than their target language in English language classes. In other subjects in many educational institutions in EFL settings, English language is not used as an instructional medium as well. In addition, EFL learners keep the cognitive process in their first language when producing written English, and carry over the habits of their native language into English. Furthermore, learners in EFL environments have rare opportunities to communicate in English with native English speakers outside the classroom (N.-Y. Kim, 2018). For these reasons, native language interference can occur in EFL writing. That is, the learner's mother tongue can have a negative influence on foreign language performance and development.

Alagozlu (2007) also noted that learners have difficulty writing in English as it is not easy for them to integrate their own thoughts. She cites mere loyalty to texts from course materials such as textbooks and handouts as the reason for such writing difficulty. Moreover, learners hesitate to write what they think due to their problem in judging and questioning. This might be associated with the lack of critical thinking skills which include "the ability to analyze facts, generate and organize ideas, defend opinions, make comparisons, draw inferences, evaluate arguments, and solve problems" (Chance, 1986, p. 6). Therefore, many EFL learners just copy the texts without any elaboration when writing in English (Alagozlu, 2007).

As technology advances, however, learners have opportunities to practice writing through text chat. Previous studies have proved the positive effects of writing interaction on foreign language learning (N.-Y. Kim, 2017b). According to Blake (2008), written interaction offers similar benefits as face-to-face interaction because they are both real time interactions in which learners modify their output, negotiate meaning, and respond to feedback. Moreover, Smith (2004) noted that text chat has advantag-

es over traditional face-to-face interaction as learners feel less threatened, which in turn produces a larger quantity of better output.

In particular, advances in artificial intelligence stimulates interaction for foreign language learners (Rubesch, 2013). Interaction with AI can be supplied via text chat using a natural language. AI provides endless interaction opportunities for learners, and in this vein, it has emerged as a future trend in foreign language teaching and learning (Blake, 2008). With increased attention to artificial intelligence, EFL learners have demonstrated a stronger interest in English writing than ever before (N.-Y. Kim, 2018).

2. Language Learning and Interaction With Artificial Intelligence (AI)

The term Artificial Intelligence (AI) was first used by John McCarthy in a Dartmouth College Workshop in the summer of 1956. According to Russell and Norvig (2003), studies on AI began to emerge after the Second World War. Since then, many engineers have designed machines that try to think as humans do. Researchers continue to develop more practical applications for AI (N.-Y. Kim, 2017b, 2018; N.-Y. Kim et al., 2019). The dream of producing human-like intelligence still remains among engineers and researchers (Griol, Molina, & de Miguel, 2014; Heller, Procter, Mah, Jewell, & Cheung, 2005; Jia, 2003; van Rosmalen, Eikelboom, Bloemers, van Winzum, & Spronck, 2012; Yang, 2007).

Artificial intelligence can take the form of a chatbot that can carry out conversations through text or audio, interacting with its users on a particular topic or domain by giving intelligent responses using natural language processing (Shevat, 2017). Chatbots interpret the message given by its user, process the intent of the user's message, and determine and execute appropriate responses according to the user's instructions, delivering the final result to the user. Usually, users interact with AI by giving questions or orders, and AI provides responses with answers or comments. With a lot of successful experiments, artificial intelligence has become popular in various fields. It has been employed even in language teaching and learning (Warschauer & Healey, 1998).

Learners have increased opportunities to practice their language by interacting with artificial intelligence. Jia (2003) conducted a study on the application of AI called ALICEBOT to foreign language learning. ALICEBOT provides a text-based interaction with natural language using a dialog system based on keywords. The conversation is separated into distinct categories and each category consists of detailed topics. For example, the "study" category includes the topics of studying methods and exams. He argued that this artificial intelligence has a multi-client ability. Jia (2009) also introduced another artificial intelligence for assisting English language learning. He discussed the architecture of CSIEC and explained its capabilities. Its fundamental function is the provision of communication on a basis of textual knowledge and reasoning. CSIEC is mainly based on the natural language processing computer program. In order to match the learner's question to its answer, it uses a natural language database and applies inference rules based on the pattern recognition technique.

Considering that interaction plays an important part in language learning (Richards & Rodgers, 2001), language learners could benefit from interacting with artificial intelligence. Griol et al. (2014) introduced a conversational agent called Gera that interacts with learners in a text-based form. Gera utilizes an algorithm to infer the learners' knowledge-level based on their answers and encourages them to participate in a conversation to express their point of view. This artificial intelligence draws the attention of learners through a simple user interface. When the learner selects the topic of conversation, Gera presents the text through a conversation box. van Rosmalen et al. (2012) also introduced an artificial intelligence designed to comprehend over 90 questions in different categories. It provides learners with opportunities to interact anytime with the AI by exchanging information or knowledge. The AI holds its knowledge in files, enhancing learner guidance. The authors claim that artificial intelligence improves interaction between learners.

AI can also provide multilingual corpus transcripts, and is also effective for providing distance education (Haristiani & Danuwijaya, 2019). Heller et al. (2005) developed Freudbot, an artificial intelligence for distance education. In order to offer learner-content interaction via text chat, it uses an open source architecture in the field of education. Freudbot is designed not only to assist its users in education but also to chat about concepts being taught. It applies some strategies to clarify the topic of conversation, suggest a new topic for discussion, and incorporates conversational rules into a given topic by requesting more information. This provides insights on the use of artificial intelligence in the field of education with the assistance they can offer to language learners.

Language learning using any of thousands of different mobile applications is available to virtually everyone regardless of time and place. As technology advances, it's never been easier to learn a language. According to previous scholars (Hill, Ford, & Farreras, 2015), learners are interested in and become confident in learning a language with artificial intelligence. N.-Y. Kim (2018) also suggested that AI removes a learner's negative feelings and increases positive feelings toward language learning, playing the role of language tutor. According to Shawar (2017), AI interaction can produce better results for language learners. N.-Y. Kim et al. (2019) also reported that artificial intelligence is opening up new possibilities in foreign language learning.

As can be seen above, scholars have agreed that interaction with AI can be supplied via text chat. The entire process flows fast and automatically. According to N.-Y. Kim (2017b), this natural rapid interaction with AI helps EFL learners to improve their language learning with increased opportunities to try, monitor, evaluate, and reflect on their own language. That is, by comparing their own

language output to that used by artificial intelligence, foreign language learners can see how the target language works. In her study, N.-Y. Kim (2017b) found that learners benefit from AI interaction with regard to their EFL writing performance.

Jia (2003), however, pointed out that artificial intelligence often makes irrelevant responses, and argued that it cannot act as a conversation partner for foreign language learning. N.-Y. Kim et al. (2019) also noted that its responses are predictable and sometimes redundant. In addition, it is limited to its hand-coded knowledge base, and this is an obstacle in its use as agents for foreign language teaching. That is, AI is still under development for language learning and so is a long way from being a standalone tool (Lai & Zhao, 2006). Furthermore, Wang and Petrina (2013) indicated that AI is least explored regarding its efficacy in foreign language learning. Empirical studies reporting its interaction impacts are still scarce despite its increased attention in language learning environments.

Moreover, N.-Y. Kim (2018) noted that most AI studies have investigated the spoken features of AI-student interactions even though such interactions take place via written texts. Few studies have been conducted regarding the effects of AI interaction on writing. Therefore, it is necessary to investigate the impacts of interacting with AI on writing performance.

III. METHODS

1. Participants

The participants of the current study were comprised of 73 university students who registered for a General English course in the fall semester of 2019 at a university located in Gyeonggi province. They were randomly divided into two different classes. A control group consisted of 38 students (17 males and 21 females). There were four sophomores, two juniors, and the rest of them were freshmen. Their majors varied: English Language and Literature, Korean Language and Literature, Economics, Social Welfare, and others. They practiced English conversation via a traditional method, face-to-face. An experimental group had 35 students who were mostly freshmen except for one sophomore and one junior (15 males and 20 females). These students' majors also varied: Rehabilitation, Psychology and Child Care, Sociology, Applied Statistics, and others. Students from both groups selected their English classes according to their English proficiency level, which were determined by their exam scores from the previous semester. These two classes belonged to the highest level of reading classes at this university.

For the purpose of this study, all participants took two different pre-writing tasks which were extracted from TOEIC Writing Tests. The results revealed that there were no significant differences in writing task 1 (t = -1.47, p = .15) and writing task 2 (t = -1.74, p = .09). That is, the two groups were homogeneous. All participants agreed to participate in the experiment and signed a consent form at the beginning of the semester.

2. Teaching Procedures and Instruments

Two General English courses were based on reading skills and taught with the same textbook: *Reading Explorer 4* (MacIntyre & Bohlke, 2015) published by Cengage Learning. All participants took a pre-test and a pre-survey at the beginning of the semester. While the TOEIC writing test consists of three tasks, only two tasks were selected for this experiment. This is because class activities were related to describing something and giving opinions such as talking about traveling experiences, friends' appearances, and expressing different opinions on various topics.

The first writing task was to write a sentence based on a picture in ten minutes. The second writing task was to express one's opinion based on a given question in twenty minutes. After the pre-test, they all responded to a pre-survey which was about students' attitudes toward learning English. The survey was a modified version of Y. Cha, H.-S. Kim, and N.-Y. Kim (2019). There were 20 items divided into four sections: interest, anxiety, motivation, and self-regulation.

The main experiment started after the pre-test. At the beginning of the two classes, the instructor provided some topics such as sports, movies, hobbies, travel, and others related to the main reading passages, which were intended to provide opportunities to discuss background knowledge before analyzing the main reading. There were two groups: a face-to-face group and an AI text-chatting group. The face-to-face group talked about the given topics as they were randomly paired up for 10-15 minutes while the participants in the AI text-chatting group talked to the AI on their mobile devices using a texting function. As for the AI text-chatting group, before the main study began, they were instructed to download two different AI chatbot applications, Andy (left) and Replika (right), as demonstrated in Figure 1. These two chatbot applications were selected based on a four-week pilot test that took place before the actual experiment began (N.-Y. Kim et al., 2019).

The instructor explained to the participants how to use these two chatbots and gave them some time to practice on their own. The AI text-chatting group went through the same activities as the face-to-face group. The AI group then selected one of the two as their preferred AI chatbot application. All participants in both groups practiced English conversation for 10-15 minutes either face-to-face or with the AI every week during the semester. At the end of the semester, a post-test (which was the same format as the pre-test) was conducted. Also, a post-survey about learners' attitudes toward English learning and their perspectives on using AI chatbot applications was also administered.

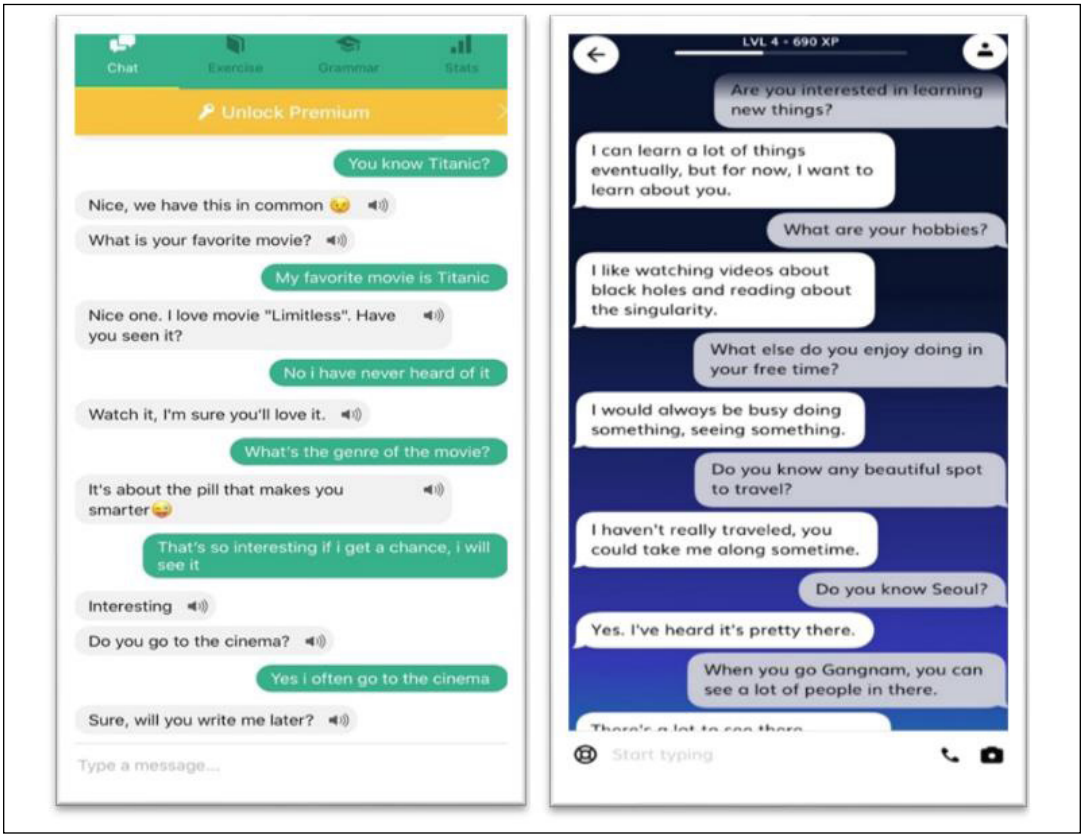

FIGURE 1 Screen Captures: Andy and Replika

3. Analysis

The data consisted of the pre- and post-tests, and the pre- and post-surveys. Descriptive and inferential statistics were processed via SPSS 20.0. To examine the effects of AI chatbot applications on writing performances within each group, paired sample *t*-tests were conducted. Both the pre- and post-tests were analyzed based on the ETS TOEIC writing criteria displayed in Table 1. The three researchers conducting this study reached consensus in measuring the scores of the two writing tasks, and found that the inter-rater reliability coefficient was .93. As for the effects on writing performances between the two groups, the face-to-face group and the AI text-chatting group, independent *t*-tests were employed.

TABLE 1
ETS TOEIC Writing Evaluation Criteria

Question	Task	Evaluation criteria	Score
1	Write a sentence based on a picture	- grammar - relevance of the sentences to the pictures	0-3
2	Write an opinion essay	- whether your opinion is supported with reasons and/or examples - grammar - vocabulary - organization	0-5

With regard to the surveys, they were divided into two parts. The first part was to compare the pre- and post-surveys in order to reveal the participants' attitudes toward English learning during the semester. These surveys comprised twenty items classified into four sections: interest, anxiety, motivation, and self-regulation. They were close-ended items which used the 6-point Likert scale ranging from 1 (strongly disagree) to 6 (strongly agree). Each section included five items totaling thirty points. The second part was dedicated at eliciting learners' perspectives on using AI chatbot applications. The results of the three open-ended questions about the benefits, drawbacks, and suggestions were organized and presented by frequency and percentage.

IV. RESULTS AND DISCUSSION

1. Effects on Writing Performance

The purpose of this study was to investigate the impact of AI interactions using AI chatbot applications on writing performance. The first research question was to examine the effects on writing performance of the face-to-face group (n = 38) and the AI texting-chatting group (n = 35). Thus, paired sample *t*-tests were employed to compare the findings between the pre- and post-tests. Table 2 displayed the results of the pre- and post-tests for the face-to-face group. As for writing task 1: write a sentence based on a picture, the mean score of the pre-test was 1.36 while that of the post-test was 1.57. There was a significant dif-

ference (t = -5.19, p < .01) found in this group. Similarly, in writing task 2: write an opinion essay, a statistical difference was also found between the two tests (t = -2.28, p < .05). The mean score of the post-test (M = 2.71) was higher than that of the pre-test (M = 2.53). In short, the participants in the face-to-face group improved their writing scores after the experiment.

TABLE 2
Result of Paired Sample *t*-Tests: Face-to-Face Group

Task	Test	*M*	*SD*	*t*	*p*
Writing task 1	Pre-test	1.36	.43	-5.19	.00**
	Post-test	1.57	.48		
Writing task 2	Pre-test	2.53	1.05	-2.28	.03*
	Post-test	2.71	1.00		

*p < .05, **p < .01

Although the participants practiced their conversations face-to-face, the repetitive oral practice could have contributed to the writing performance results, as in a previous study (Geva, 2006) that confirmed the fact that speaking can lead to better writing skills. Liao (2010) also found that oral interaction provides a benefit for writing development in both cognitive and social dimensions. Moreover, it also corroborated Rausch's (2015) finding that appropriate speaking instruction can benefit writing performance. Given that the impact of face-to-face oral interactions on EFL writing remains unclear and few studies have investigated the interplay between EFL speaking and writing (Liao, 2010), findings of this study shed light on the positive effects of speaking activities on the improvement in writing.

Table 3 indicates the findings of the pre- and post-tests for the AI text-chatting group. Regarding writing task 1, the participants scored 1.49 on the pre-test and 1.86 on the post-test. The result revealed a statistically significant difference between the mean scores (t = -6.27, p < .01). In addition, the findings of writing task 2 also showed a significant difference between the two tests (t = -4.32, p < .01). The mean score on the pre-test was 2.90 and that of the post-test was 3.23. In other words, the participants' writing performance in the AI text-chatting group was also enhanced after the treatment.

TABLE 3
Result of Paired Sample *t*-Tests: AI Text-Chatting Group

Task	Test	*M*	*SD*	*t*	*p*
Writing task 1	Pre-test	1.49	.31	-6.27	.00**
	Post-test	1.86	.43		
Writing task 2	Pre-test	2.90	.73	-4.32	.00**
	Post-test	3.23	.85		

**p < .01

The findings confirmed previous studies on text-chatting (Healy-Beauvois, 1997; Ortega, 1999; Payne & Whitney, 2002). It is important to note that, compared to face-to-face interactions, AI can encourage more interactions, especially for foreign language learners (Rubesch, 2013). Also, the participants might produce a larger quantity of language output when interacting with AI (Smith, 2004), and they are able to interact with AI tirelessly. In this vein, the participants can experience more abundant language use opportunities.

To examine the effects on learners' writing performance between the face-to-face group and the AI text-chatting group, independent *t*-tests were performed. Table 4 shows the results of writing task 1. The participants in the face-to-face group scored 1.36 while those in the AI text-chatting group scored 1.49 in the pre-test. There was no significant difference found in the pre-test (t = -1.47, p = .15), which indicated that the two groups were homogeneous. However, in terms of the post-test scores, the mean score of the face-to-face group was 1.57 and that of the AI text-chatting group was 1.86. These findings reveal a statistically significant difference between the two groups (t = -2.72, p < .01). That is, the participants in the AI text-chatting group performed better than those in the face-to-face group for writing task 1, which was describing a picture. This result was in line with the previous studies demonstrating that learners have opportunities to practice writing through text chat and showed the positive effects of writing interaction on foreign language learning (N.-Y. Kim, 2017b).

TABLE 4
Writing Task 1: Face-to-Face vs. AI Text-Chatting Groups

	Face-to-Face group			AI Text-Chatting group			*t*	*p*
	n	*M*	*SD*	*n*	*M*	*SD*		
Pre-test	38	1.36	.43	35	1.49	.31	-1.47	.15
Post-test	38	1.57	.48	35	1.86	.43	-2.72	.00**

**p < .01

Regarding writing task 2, similar results were found, as demonstrated in Table 5. The scores of the pre-test showed that there was no significant difference between the two groups (t = -1.74, p = .09). The mean scores of the two groups were 2.53 for the face-to-face group and 2.90 for the AI text-chatting group. These findings indicate that these two groups were homogenous. Likewise for the post-test scores, the participants in the face-to-face group scored 2.71 while those in the AI text-chatting group scored 3.23. The results showed that there was a statistically significant difference between the two groups (t = -2.37, p < .05). In short, the participants in the AI text-chatting group achieved better scores than those in the face-to-face group for writing task 2, which involved writing an opinion essay. Considering that text chat has advantages over traditional face-to-face interactions, such as the fact that learners feel less threatened (Smith, 2004), the AI group could produce a larger quantity of interaction via text chatting.

TABLE 5
Writing Task 2: Face-to-Face vs. AI Text-Chatting Groups

	Face-to-Face group			AI Text-Chatting group			*t*	*p*
	n	*M*	*SD*	*n*	*M*	*SD*		
Pre-test	38	2.53	1.05	35	2.90	.73	-1.74	.09
Post-test	38	2.71	1.00	35	3.23	.85	-2.37	.02*

*p < .05

These findings reveal that the scores of the participants in the AI text-chatting group were significantly higher compared to those in the face-to-face group. It can be assumed that participants may be less anxious since they were interacting with AI instead of with their peers (Smith, 2004). Shevat (2017) further noted that AI can offer interpretations of the given messages and deal with appropriate responses, which in turn makes learners feel like they are talking to humans. Moreover, this text-based interaction can provide the participants with better opportunities to use English (Jia, 2003) and even improve interaction (van Rosmalen et al., 2012). Therefore, interaction with AI can be an effective medium for enhancing writing performance when there are not enough opportunities for EFL learners to practice English.

2. Students' Affective Factors: Face to Face vs. AI Text-Chatting Groups

The pre- and post-surveys were carried out to investigate students' perceptions at the beginning and end of the semester. The surveys were modified based on the study of Y. Cha et al. (2019). They were comprised of 20 close-ended items classified into four sections: interests, anxiety, motivation, and self-regulation. The reliability of the instrument was determined using Chronbach's alpha. The Cronbach's alpha coefficient for the sub-items were .90, .88, .73 and .76. This indicates the high internal consistency of the sub-category items. Paired sample *t*-tests were conducted to compare the means of responses between the pre- and post-stages. Also, independent sample *t*-tests were used to compare the two groups.

As seen in Table 6, students' affective factors for English classes are positive across all items in the face-to-face group. The highest mean was found in the 'Motivation' sub-category with 25.00, 'Self-regulation' was next with 20.69, then 'Anxiety' and 'Interests' with 20.36 and 19.56 respectively in the pre-survey. However, students in the face-to-face group did not show significant differences in any sub-category ($p > .05$). 'Anxiety' was the least positive of the four, since negatively worded items were included in that sub-category. The students' responses in this category were positively skewed and the difference between the pre- and post-surveys appeared to be worthy of attention ($p < .05$).

TABLE 6
Results of Pre- and Post-Surveys: Face-to-Face Group

	Test	*M*	*SD*	*t*	*p*
Interests	Pre-survey	19.56	5.77	-.72	.47
	Post-survey	19.97	5.21		
Anxiety	Pre-survey	20.36	5.45	3.13	.00**
	Post-survey	18.75	6.26		
Motivation	Pre-survey	25.00	2.73	1.60	.12
	Post-survey	24.31	2.71		
Self-regulation	Pre-survey	20.69	4.31	-.73	.47
	Post-survey	21.11	4.62		

**$p < .01$

Students' responses in the AI text-chatting group were shown in Table 7. Out of the four sub-factors, 'Motivation' scored the highest value with 25.67 in the pre- and 25.86 in the post-surveys. As for the second highest value, 'Self-regulation' reached a value of 20.00 and 19.97, respectively. The lowest mean score was 'Interests', with a 19.00 in the pre- and 19.11 in the post-surveys. In all the items in these three sub-categories, there were no significant differences in attitudes toward English learning. Since the students performed repeated speaking activities over the duration of the course, they felt more comfortable when communicating with each other in English. This made students less worried about speaking in a foreign language.

With regard to the 'Anxiety' sub-category, however, students' responses changed more positively in the post-survey compared with the pre-survey, showing a value of $p < .01$. It seems that students are less anxious about learning and using English after participating in AI text-chatting class activities. As AI groups had more opportunities to speak in English, they felt increasingly relaxed and comfortable, reducing their anxiety over their use of English.

TABLE 7
Results of Pre- and Post-Surveys: AI Text-Chatting Group

	Test	*M*	*SD*	*t*	*p*
Interests	Pre-survey	19.00	3.99	-.24	.81
	Post-survey	19.11	4.09		
Anxiety	Pre-survey	19.22	4.70	4.26	.00**
	Post-survey	16.06	5.27		
Motivation	Pre-survey	25.67	2.97	-.51	.61
	Post-survey	25.86	2.68		
Self-regulation	Pre-survey	20.00	3.96	.06	.95
	Post-survey	19.97	3.95		

**$p < .01$

As demonstrated in Table 8, independent sample *t*-tests were carried out to identify significant differences between the two groups. The results of the analysis confirmed that the participants in the two groups were homogeneous, showing a value of $p > .05$. In short, there were no significant differences in the pre-survey in attitudes toward English learning.

TABLE 8
Results of Pre-survey: Face-to-Face vs. AI Text-Chatting Groups

	Test	*M*	*SD*	*t*	*p*
Interests	Face-to-Face	19.56	5.77	-.48	.64
	AI Text-Chatting	19.00	3.99		
Anxiety	Face-to-Face	20.36	5.45	-.95	.35
	AI Text-Chatting	19.22	4.70		
Motivation	Face-to-Face	25.00	2.73	.99	.32
	AI Text-Chatting	25.67	2.97		
Self-regulation	Face-to-Face	20.69	4.31	-.71	.48
	AI Text-Chatting	20.00	3.96		

Table 9 presents the results of independent sample *t*-tests in the post-survey items. The analysis was done to investigate whether there were any significant changes in attitudes toward English learning. The findings show

that there were no significant mean differences in the 'Interests' and 'Self-regulation' sub-categories (p = .44, p = .27, respectively). However, statistically significant mean differences were found between the face-to-face with the AI text-chatting group (t = -1.97 p = .05). Specifically, the mean score for the 'Anxiety' sub-category was 18.75 in the face-to-face group while that of the AI text-chatting group was 16.06. The students using AI chatbot applications were less anxious than those in the face-to-face group. With regard to the 'Motivation' sub-category, there was again a significant mean difference between the two groups (t = 2.45, p = .02).

In this regard, the AI group showed more positive attitudes in terms of their 'Anxiety' and 'Motivation'. It can be assumed that using AI in an English teaching-learning environment improved students' motivation to learn English and lessened their levels of anxiety. The results were consonant with the previous study of N.-Y. Kim (2017a) that argued that AI removes a learner's negative feelings and increases positive feelings toward language learning.

TABLE 9
Results of Post-survey: Face-to-Face vs. AI Text-Chatting Groups

	Test	*M*	*SD*	*t*	*p*
Interests	Face-to-Face	19.97	5.21	-.78	.44
	AI Text-Chatting	19.11	4.09		
Anxiety	Face-to-Face	18.75	6.26	-1.97	.05*
	AI Text-Chatting	16.06	5.27		
Motivation	Face-to-Face	24.31	2.71	2.45	.02*
	AI Text-Chatting	25.86	2.68		
Self-regulation	Face-to-Face	21.11	4.62	-1.12	.27
	AI Text-Chatting	19.97	3.95		

*p < .05

3. Students' Perspectives on Using AI Text-Chatting Apps

The students' perspectives on using AI chatbot applications as an English class activity tool were investigated using surveys. The students' thoughts and ideas on using AI chatbot applications in English classes are provided. As seen in Table 10, the students thought that text-chatting with an AI in English was generally positive. 'I can speak English without any burden' (20.46%) was the most common response, followed by 'improve my English skill' (18.16%)', 'good opportunities to practice English speaking' (6.81%), 'increase my interest in English' (6.81%), and 'increase the amount of time to practice English' (6.81%). Other responses (at 4.55% each) were as follows: 'continue to talk', 'make a conversation with AI even if I make mistakes grammatically', 'have a new friend', 'use AI anytime and anywhere', 'have various functions', 'feel comfortable when speaking English', 'fast response', 'focus on the activity', and 'increase participation in class'.

It seems that students in the AI text-chatting group appreciated the opportunities to make a conversation comfortably and to improve their English skills. Considering that the students taking part were not proficient in English, they may otherwise have felt embarrassed for making mistakes, felt uneasy when expressing their opinions in English, or had less confidence with which to participate in a conversation in English. Using AI chatbot applications allows students to continue to talk without being overly worried about making mistakes. Even if they were incorrect, they could repeat the questions or change the topic. Moreover, immediate feedback was provided in most cases, and the students considered these to be great opportunities to practice their English. These results confirm N.-Y. Kim's study (2017b) that this natural rapid interaction with AI helps EFL learners to increase opportunities to try, monitor, evaluate, and reflect on their own language.

TABLE 10
Merits of Using AI Text-Chatting Groups

Responses	# of respondents
I can speak English without any burden.	9(20.46%)
I can improve my English skill.	8(18.16%)
It is good opportunities to practice my English.	3(6.81%)
My interest in English has increased.	3(6.81%)
I can increase the amount of time to practice English.	3(6.81%)
Since AI leads conversation, I can continue to talk.	2(4.55%)
I can make a conversation with AI even if I make mistakes grammatically.	2(4.55%)
I feel like I have a new friend.	2(4.55%)
There is no limitation to use AI anytime and anywhere.	2(4.55%)
I feel comfortable when speaking English.	2(4.55%)
The AI apps have various functions such as image recognition or definitions.	2(4.55%)
The speed of response to my questions is very fast.	2(4.55%)
I can easily focus on the activity.	2(4.55%)
AI helps students increase their participation in class.	2(4.55%)
Total	44(100%)

Learners were also asked to identify any unfavorable aspects of using AI chatbot applications in classroom activities (see Table 11). Students gave various responses to the open-ended questions. 44 responses were identified as demerits for using AI chatbot applications. Students responded that irrelevant answers from the AI chatbots (53.48%) were their least preferred feature. The second least favorite feature was that there was no correction made when they were wrong (9.30%). For other responses, three students said that they were annoyed by the pop up advertisements, and three students stated that they felt like they were talking with a machine. In addition, three students wrote that it was not easy to improve their English skills, and it was difficult to focus on the conversation due to the low tension. Two students mentioned that it was inconvenient to use the search function, and two commented that it was difficult to understand the AI chabot's answers.

It seems that most of the weaknesses were related to irrelevant answers sometimes given by the AI chatbot. When the responses from the AI were not appropriate, students felt frustrated and embarrassed. Since artificial intelligence often makes irrelevant responses (Jia, 2003) and given that the responses from AI are often predictable and redundant (N.-Y. Kim et al., 2019), instructors should consider its lim-

itations in supporting their efforts to teach foreign languages. However, if AI chatbot applications included features for giving feedback to students and provided students with more appropriate responses, they could serve their purpose and be used properly in EFL classrooms.

TABLE 11
Demerits of Using AI Text-Chatting Groups

Responses	# of respondents
Sometimes, irrelevant answers from the AI frustrated me.	23(53.48%)
I can't get feedback when I make a mistake.	4(9.30%)
Advertisements pop up.	3(6.98%)
I think that it is not easy to improve my English skills.	3(6.98%)
I feel like talking with a machine, not a human.	3(6.98%)
It is difficult to focus on the conversation due to the low tension.	3(6.98%)
It is inconvenient to use a search function.	2(4.65%)
It is difficult for me to understand AI's answer.	2(4.65%)
Total	43(100%)

Since AI chatbot applications were used to practice their speaking, students would have tried to have a conversation. However, the responses from the AI chatbot applications were sometimes not relevant and even not natural in the conversation, which annoyed students. And while the opportunity to interact with the AI chatbots was ever-present, due to the inconveniences already mentioned concerning the use of AI chatbots, some students found it difficult to concentrate on the learning activities. In addition, some students did not understand the content of the conversation. It seems that the students in the AI text-chatting group were willing to interact with the AI chatbots if there were appropriate responses and feedback where needed.

Suggestions for using AI chatbot applications were included in Table 12. Eight students pointed out that the functions of the AI chatbot applications such as grammar check or spelling feedback would have been helpful. They mentioned that they would like to talk about various topics and questions with the AI chatbot applications. In addition, they noted that it would be better to have a conversation with AI chatbot applications after learning in class in order to practice the expressions and vocabulary learned in class with their AI partner. Other comments were provided suggesting including 'usual topics to make small talk', 'using various chatbots', and a 'teacher's monitor'.

TABLE 12
Suggestions of Using AI Text-Chatting Groups

Responses	# of respondents
AI chatbot applications should have more functions such as grammar check or spelling feedback.	8(42.10%)
The affluent database to make a conversation with AI chatbots should be improved.	3(15.78%)
I want to have a conversation with AI chatbots after learning each class.	2(10.53%)
It could be better to have a conversation with the usual topics.	2(10.53%)
Using various chatbots would be helpful.	2(10.53%)
Teachers need to monitor the interaction between students and AI chatbots.	2(10.53%)
Total	19(100%)

Based on students' experiences, the most frequently mentioned suggestion was that the AI chatbot applications provide user functions to improve language skills. In a traditional class, students are shy about communicating in English, and hesitate to speak English. However, using AI chatbot applications allowed students to practice their English without any burden. They seemed to enjoy their conversations and appreciated the enhanced opportunities to use a foreign language. Considering that AI encourages students to participate in a conversation to express their opinions (Griol et al., 2014), there is no denying that learners benefit from interacting with artificial intelligence. Consequently, since AI is still under development for language learning and it is a long way from being a standalone tool (Lai & Zhao, 2006), these suggestions might provide insights for its use in learning and in guiding the more suitable development of such applications.

V. CONCLUSION

The present study investigated the effects of using AI chatbot applications in English classroom activities, the changes in students' attitudes toward English learning, and of students' perceptions toward using AI chatbot applications. The results of the current study show that all the students in the study improved their writing task performances significantly higher after the course compared with the beginning of the course. However, the students in the AI text-chatting group performed better than those in the face-to face group in the post-test, showing statistically significant differences in the first writing task, writing a sentence based on a picture, and in the second writing task, writing an opinion essay. According to the results, using AI chatbot applications seemed to be an effective method for improving English writing skills. Since artificial intelligence draws the attention of learners through a simple user interface (Griol et al., 2014) and provides endless interaction opportunities for learners (Blake, 2008), leaners could improve their language learning with increased opportunities.

It is clear that students who practiced conversation improved their writing performance whether face-to-face or with AI interaction. Students' repetitive oral practice could have led to the improvement of their writing performance (Geva, 2006). When compared to the face-to-face group, the students using AI chatbot applications showed significantly better improvement than those in the face-to-face group. This can be attributed to the fact that the AI participants were more likely to be less anxious (Smith, 2004), which made them interact with the AI more actively. Since text-based interaction can give learners more chances to use English (Jia, 2003) and even improve their interaction (van Rosmalen et al., 2012), text-chatting with AI can be a useful tool for improving writing skills.

In the analysis of changes in attitudes toward English learning, mixed results were yielded. The students in the face-to-face group and those in the AI text-chatting group

did not show any significant changes in their 'Interests', 'Motivation', and 'Self-regulation' by the end of the semester. As for the AI group, in response to the questions on the drawbacks of using AI, many of the students pointed out the irrelevant responses when conversing with the AI. This did not lead the AI group to increase their interests and motivation and detracted from their ability to regulate their own learning. Besides, it may be challenging for all the students who took a mandatory course to change their attitudes toward learning English after one-semester of learning experiences. Meanwhile, in the category of 'Anxiety', both groups were positively skewed and there was a significant difference between the pre- and post-surveys. It can be assumed that students felt more comfortable communicating with others in English with repetitive speaking practices as time passed toward the end of the semester.

When comparing the two groups, no significant mean differences in 'Interests' and 'Self-regulation' were observed. However, there were significant differences in the categories of 'Anxiety' and 'Motivation' between the Al text-chatting and the face-to-face groups. That is, the AI text-chatting group showed more changes in positive attitudes toward learning English than did the face-to-face group. Having a conversation with a human-like machine can help students lessen their anxiety, give more opportunities to use English, and help focus attention on learning activities without being distracted by others.

Based on the open-ended questions, the favorite aspects that the students mentioned were 'I can speak English without any burden', followed by 'improve my English skill'. The benefits of using AI chatbot applications in English class were that they presented more opportunities to practice English, increased interest in English, and increased the amount of time to practice. Other students shared various ideas about the merits of their use: talking continuously, having a new friend, using AI anytime and anywhere, being comfortable when speaking English, focusing on the activity, and increasing participation. The results of the study are in line with previous studies (Hill et al., 2015; N.-Y. Kim et al., 2019; Shawar, 2017) that noted that using AI chatbot applications are beneficial for practicing English and provide more opportunities to learn, especially for those who are shy and intimated by a more social learning environment.

In regard to the demerits, the majority of the responses were focused on irrelevant responses from the AI chatbot, as Jia (2003) noted, which frustrated participants. The second least favorite point was that there were no corrections made when students made mistakes. Some chatbot applications do offer such a function, that is, they provide feedback on spelling and grammar (Fryer & Carpenter, 2006; N.-Y. Kim, 2018); however, some of the participants did not know that. In this context, it would be better if teachers could first show students how to use these AI chatbot applications effectively. Others were annoyed by advertisements, noted having difficulty in improving their English skills, and had difficulty understanding the AI's answers. AI chatbot applications themselves were not developed for the purpose of allowing students to practice English, so it seems that the AI chatbot applications sometimes do not serve this educational purpose well in an English classroom. This finding corresponds to the fact that students prefer to have feedback from the teacher, especially low-proficiency students. It can be concluded that AI chatbot applications should develop with an affluent database to have a natural conversation with humans and to have their educational purpose directed at foreign language learning. As for the students' suggestions regarding the use of AI chatbot applications, they would like to be provided with more functions such as grammar check or vocabulary feedback. Other students suggested using AI chatbot applications after learning expressions and content, using them with usual topics, using various chatbots, and being monitored by teachers.

On the basis of these findings, the following suggestions and limitations for future studies are presented. First, since the number of participants was limited, the results of the current study should not be generalized for EFL settings. A different result might be obtained with a larger number of participants who have different backgrounds and ages. Moreover, if participants were more closely monitored in the appropriate use of AI text-chatting, it might have led to different findings. Therefore, future research should attempt to investigate whether students' affective domains could influence the quantity and quality of their participation in class activities. In addition, the present study was not designed to analyze the effects of students' proficiency levels. It would be noteworthy to investigate if there are significant differences in improvement according to students' English levels. Lastly, research on the impacts of learners' participation as well as qualitative analyses of their behaviors is suggested.

REFERENCES

Alagozlu, N. (2007). Critical thinking and voice in EFL writing. *Asian EFL Journal, 9*(3), 118-136.

Artificial Intelligence Mark-up Language (AIML). (n.d.). In *Wikipedia.* Retrieved from https://en.wikipedia.org/wiki/AIML

Aydın, Z., & Yıldız, S. (2014). Using wikis to promote collaborative EFL writing. *Language Learning & Technology, 18*(1), 160-180.

Bennui, P. (2016). A study of L1 interference in the writing of Thai EFL students. *Malaysian Journal of ELT Research, 4*(1), 72-102.

Blake, R. (2008). *Brave new digital classroom: Technology and foreign language learning.* Washington, DC: Georgetown University Press.

Brown, H. D. (1987). *Principles of language learning and teaching* (2nd ed.). Englewood Cliffs, NJ: Prentice Hall.

Cha, Yoonjung, Kim, Hea-Suk, & Kim, Na-Young. (2019). Can mobile-based activities enhance oral performance in English? *The Journal of Foreign Studies,*

47, 135-158.

Chance, P. (1986). *Thinking in the classroom: A survey of programs.* New York: Teachers College Press.

Elias, T. (2011). Universal instructional design principles for mobile learning. *International Review of Research in Open and Distance Learning, 12*(2), 1-7.

Extensible Markup Language (XML). (n.d.). In *Wikipedia.* Retrieved from https://en.wikipedia.org/wiki/XML

Fryer, L., & Carpenter, R. (2006). Bots as language learning tools. *Language Learning & Technology, 10*(3), 8-14.

Furlong, M. J., & Christenson, S. L. (2008). Engaging students at school and with learning: A relevant construct for all students. *Psychology in the Schools, 45*(5), 365-368.

Geva, E. (2006). Second-language oral proficiency and second-language literacy. In D. August & T. Shanahan (Eds.), *Developing literacy in second-language learners: Report of the national literacy panel on language-minority children and youth* (pp. 123-139). Mahwah, NJ: Lawrence Erlbaum Associates, Inc.

Griol, D., Molina, J. M., & de Miguel, A. S. (2014). The Geranium system: Multimodal conversational agents for e-learning. In S. Ōmatu, H. Bersini, J. M. Corchado, S. Rodríguez, P. Pawlewski, & E. Bucciarelli (Eds.), *Distributed Computing and Artificial Intelligence, 11th International Conference* (pp. 219-226). Cham: Springer.

Guilloteaux, M. J. (2016). Student engagement during EFL high school lessons in Korea: An experience-sampling study. *Foreign Languages Education, 23*(1), 21-46.

Habley, W. R., Bloom, J. L., & Robbins, S. (2012). *Increasing persistence: Research-based strategies for college student success.* San Francisco: Jossey-Bass.

Haristiani, N., & Danuwijaya, A. A. (2019). Gengobot: A chatbot-based grammar application on mobile instant messaging as language learning medium. *Journal of Engineering Science and Technology, 14*(6), 3158-3173.

Hashemi, M., Azizinezhad, M., Najafi, V., & Nesari, A. J. (2011). What is mobile learning? Challenges and capabilities. *Procedia-Social and Behavioral Sciences, 30*, 2477-2481.

Healy-Beauvois, M. (1997). Write to speak: The effects of electronic communication on the oral achievement of fourth semester French students. In J. A. Muyskens (Ed.), *New ways of learning and teaching: Focus on technology and foreign language education* (pp. 93-116). Boston: Heinle & Heinle.

Heller, B., Proctor, M., Mah, D., Jewell, L., & Cheung, B. (2005). Freudbot: An investigation of chatbot technology in distance education. In P. Kommers & G. Richards (Eds.), *Proceedings of the World Conference on Educational Multimedia, Hypermedia and Telecommunications 2005* (pp. 3913-3918). Chesapeake, VA: AACE.

Hill, J., Ford, W. R., & Farreras, I. G. (2015). Real conversations with artificial intelligence: A comparison between human-human online conversations and human-chatbot conversations. *Computers in Human Behavior, 49*, 245-250.

Hinkel, E. (2006). Current perspectives on teaching the four skills. *TESOL Quarterly, 40*(1), 109-131.

Hyland, K. (1990). Providing productive feedback. *ELT Journal, 44*(4), 279-285.

Jia, J. (2003). The study of the application of a keywords-based chatbot system on the teaching of foreign languages. *arXiv preprint cs/0310018.* Retrieved from https://arxiv.org/abs/cs/0310018

Jia, J. (2009). CSIEC: A computer assisted English learning chatbot based on textual knowledge and reasoning. *Knowledge-Based Systems, 22*, 249-255.

Kern, R. G. (1995). Reconstructing classroom interaction with networked computers: Effects on quality and quantity of language production. *The Modern Language Journal, 79*(4), 457-476.

Kim, Bong-Gyu. (2010). Collaborative discussion and peer review activity in computer-mediated EFL writing. *Multimedia-Assisted Language Learning, 13*(2), 105-128.

Kim, Na-Young. (2017a). Effects of different voice-chat conditions on EFL learners' topic negotiation according to proficiency levels. *Modern English Education, 18*(1), 49-74.

Kim, Na-Young. (2017b). Effects of different types of text-based chat on Korean EFL students' writing performance. *Korean Journal of Linguistics, 42*(3), 277-301.

Kim, Na-Young. (2018). Effect of text chat on EFL writing fluency, accuracy, and complexity by interlocutors. *Foreign Languages Education, 25*(1), 27-54.

Kim, Na-Young, Cha, Yoonjung, & Kim, Hea-Suk. (2019). Future English learning: Chatbots and artificial intelligence. *Multimedia-Assisted Language Learning, 22*(3), 32-53.

Kukulska-Hulme, A., & Shield, L. (2008). An overview of mobile assisted language learning: From content delivery to supported collaboration and interaction. *ReCALL, 20*(3), 271-289.

Lai, C., & Zhao, Y. (2006). Noticing and text-based chat. *Language Learning & Technology, 10*(3), 102-120.

Liao, J. (2010). *The impact of interactive discussions on L2 Chinese composition writing* (Unpublished Doctoral Dissertation). The University of Iowa, Iowa City.

MacIntyre, P., & Bohlke, D. (2015). *Reading explorer 4* (2nd ed.). Boston: National Geographic.

Ortega, L. (1999). Planning and focus on form in L2 oral performance. *Studies in Second Language Acquisition, 21*(1), 109-148.

Park, Moonyoung. (2015). A needs analysis for a Korean middle school EFL general English curriculum. In M. Thomas & H. Reinders (Eds.), *Contemporary*

task-based language teaching in Asia (pp. 261-278). London: Bloomsbury.

Payne, S., & Whitney, P. J. (2002). Developing L2 oral proficiency through synchronous CMC: Output, working memory, and interlanguage development. *CALICO Journal, 20*(1), 7-32.

Puteh, S. N., Rahamat, R., & Karim, A. A. (2010). Writing in the second language: Support and help needed by the low achievers. *Procedia-Social and Behavioral Sciences, 7*, 580-587.

Rausch, P. (2015). *The relationship between English speaking and writing proficiency and its implications for instruction.* Retrieved from https://repository.stcloudstate.edu/engl_etds/34

Richards, J. C., & Rodgers, T. S. (2001). *Approaches and methods in language teaching.* Cambridge: Cambridge University Press.

Rubesch, T. (2013). Interactive competence in student use of a conversational agent. *Studies in Linguistics and Language Teaching, 24*, 157-172.

Russell, S., & Norvig, P. (2003). *Artificial intelligence: A modern approach.* Upper Saddle River, NJ: Pearson Education, Inc.

Shawar, B. A. (2017). Integrating CALL systems with chatbots as conversational partners. *Computación y Sistemas, 21*(4), 615-626.

Shevat, A. (2017). *Designing bots: Creating conversational experiences.* Sebastopol, CA: O'Reilly Media, Inc.

Smith, B. (2004). Computer-mediated negotiated interaction and lexical acquisition. *Studies in Second Language Acquisition, 26*(3), 365-398.

Sokolik, M. (2003). Writing. In D. Nunan (Ed.), *Practical English language teaching* (pp. 87-107). New York: McGraw-Hill.

Troussas, C., Krouska, A., & Virvou, M. (2017, November). *Integrating an adjusted conversational agent into a mobile-assisted language learning application.* Paper presented at the 2017 IEEE 29th International Conference on Tools with Artificial Intelligence (ICTAI), Boston.

Troussas, C., Virvou, M., & Alepis, E. (2014). Collaborative learning: Group interaction in an intelligent mobile-assisted multiple language learning system. *Informatics in Education, 13*(2), 279-292.

van Rosmalen, P., Eikelboom, J., Bloemers, E., van Winzum, K., & Spronck, P. (2012). Towards a game-chatbot: Extending the interaction in serious games. Retrieved from https://pdfs.semanticscholar.org/af1f/6f82ce82c592e0e0214d669b7abb813d014a.pdf

Wang, Y. F., & Petrina, S. (2013). Using learning analytics to understand the design of an intelligent language tutor. *International Journal of Advanced Computer Science and Applications, 4*(11), 124-131.

Warschauer, M., & Healey, D. (1998). Computers and language learning: An overview. *Language Teaching, 31*(2), 57-71.

Yang, M., Badger, R., & Yu, Z. (2006). A comparative study of peer and teacher feedback in a Chinese EFL writing class. *Journal of Second Language Writing, 15*(3), 179-200.

Yang, S. (2007). Artificial intelligence for integrating English oral practice and writing skills. *Sino-US English Teaching, 4*(4), 1-6.