Abstract
This study introduced an anthropomorphized robot-assisted instructional tool that we developed for English as a foreign language (EFL) learning and assessed the effectiveness of robot-assisted English learning. An experimental design was adopted in this study and a total of 53 Taiwanese students in the third grade of elementary school participated in the experiment, including: one class consisting of 28 students, which was labeled as the experimental group, while another class of 25 students was labeled as the control group. There were two kinds of data collection that were used in this study: two tests (listening-and-acting as well as questioning-and-answering tests) and a questionnaire (learning material motivation scale). On the whole, the experimental group performed better than the control group on the listening-and-acting as well as on the questioning-and-answering tests. Additionally, the experimental group had higher learning material motivation than the control group, inclusive of attention, relevance, confidence, and satisfaction domains. The overall results suggest a new paradigm about our applications in teaching and learning English for Taiwanese EFL elementary school students.

Keywords: educational robot, English learning, learning motivation
Introduction

At present artificial intelligence is used in various fields, including speech understanding, computer vision, and robotic application. The earliest thinking about the integration of information into teaching and learning is the use of computer-assisted instruction helping students practice and repeat by means of computer simulations. Shortly after research on artificial intelligence began, some people began to think about whether they could make computers act like people with the ability to teach peers. Making computers wise can assist us in teaching and learning (Mubin et al., 2013). Artificial intelligence applied to study currently has two relatively large research areas. The first is Artificial Intelligence in Education (AI-ED), and the other is the Intelligent Tutoring System (ITS) (Benitti, 2012). Regardless of the area, it can be traced back to the earliest use of artificial intelligence in education, starting approximately in the 1970s, but only for some specific researchers engaged in such research. Until 1990, the continuous enhancement of network technology made it possible for many artificial intelligence applications to be used in technology and it began to flourish (Slangen et al., 2011).

In the past nine years, with the increasing development of network technology, robotics theory and application have been gradually incorporated into education in Taiwan. Researchers considered the related research on robots and education, and so applied their research on robotics development to the issue concerning the application of robots to education (Chang et al., 2010). Learning outcomes have become an extremely significant issue in the research on robot-assisted education. After analyzing robot-assisted education research conducted in recent years, it has been discovered that there has been a gradual increase in the amount of research in this, which shows that robot-assisted education has become gradually more valued over the last few years (Chen et al., 2011). In recent years, with the increasing popularity of technology products, many children have been exposed to mobile phones, tablet computers, and even the latest robot-related interactive products during their school years. As a result, some schools have gradually incorporated robotics technology into the education curriculum for schoolchildren. It is hoped that through the combination of science and technology, students can develop digital coding and other knowledge in the process of learning. Educational robots are an important application in the entire smart robot industry (Chang et al., 2010; Chen et al., 2011). This is a learning experience that cannot be achieved in the traditional way using paper and pencils as tools. Teaching robots have been widely used in the UK, the United States, Japan, and South Korea (Bers et al., 2014), whereas their application to English teaching is still in its infancy (Chen et al.,
The cross-domain combination of robot teaching assistants with elementary school English teaching is actually a trend of digital learning. It is expected that this combination can improve elementary school students’ English learning outcomes and increase their motivation for learning English.

In Taiwan, the goal of English teaching in the elementary school education stage gives first priority to both the skills of “listening” and “reading”. However, at present, there are about 20 to 30 students in an average elementary class in Taiwanese schools, and the learners have a large gap in their English proficiency. Thus, English teaching is difficult to carry out. In addition, students lose motivation and their interest in learning; it is difficult for teachers to take care of students’ individual learning status. Furthermore, considering not only the learning progress, but also providing learners with sufficient practice time with limited class time is often a thorny issue for English teachers. With the development of information technology, this study intends to integrate the researched and developed scheme of learning partners as a medium of instruction into the English teaching curriculum via the concept of learning partners maturely developed day by day. It is hoped that the idea of learning partners can be carried out in English practice and interactions to reduce learners’ fear and anxiety of English learning which is caused by their differences in ability. It is also hoped it that will increase the interest of learners who have different learning achievements. The purpose of this study is to explore the effectiveness of an anthropomorphized robot in improving elementary school children’s English ability and learning motivation.

To understand the above research purpose, this study addresses the following research questions:

1. Is there any significant difference in English listening-and-acting performances between elementary schoolchildren who use an anthropomorphized robot and those who do not?
2. Is there any significant difference in English questioning-and-answering performances between the elementary schoolchildren who use an anthropomorphized robot and those who do not?
3. What is the difference in attitude toward English learning material motivation (inclusive of attention, confidence, satisfaction, and relevance) between the elementary schoolchildren who use an anthropomorphized robot and those who do not?
Adapting an Anthropomorphized Robot for Enhancing EFL Learning

Literature Review

The Current Trend of Robot-Assisted Language Learning

Due to rapid development of technology, one of the cutting-edge technologies likely to be adopted is robotics. A variety of robots such as pet-robots, home-robots, and education-robots have been invented and used for various purposes (Han, 2012). Educational service robots refer to intelligent robots employed in the instructional and learning setting. When educational service robots are adopted for language learning, this is called robot-assisted language learning (RALL) (In & Han, 2015). Some studies stated that RALL not only triggered learning motivation, but also increased the effectiveness of learning outcomes, particularly in English learning (Han, 2012; Lee et al., 2011). In addition, some studies which examined students’ learning effectiveness and the roles of robots in various countries, such as the UK, the USA, Canada, Korea, and Japan, have found that children's learning outcomes with robots might be more successful in second and foreign language learning and effective (Han et al., 2008). Besides, Lee et al. (2011) employed robots in English classrooms to carry on conversation with learners during language learning. Papert (1993) confirmed that interaction between robots and humans not only improves teaching effectiveness, but also learning motivation because learners are less anxious and more cheerful.

People's learning is often not an individual learning process. It also refers to interactions with peers and teachers, because teaching is learning. Applying artificial intelligence to learning is a very important research topic, exploring whether students can process their learning with not only textbooks and teachers, but also with learning partners via computer simulations. The term, learning companion, was first proposed by Chan and Baskin (1988). With properly designed learning companions, students’ motivation and attention can be boosted. The concept, “Zone of Proximal Development” (ZPD) was developed by the Russian psychologist and social constructivist Lev Vygotsky. The ZPD refers to the difference between what a learner can do without help and what he or she can achieve with guidance and encouragement from a skilled partner (DeVries, 2000). The zone of proximal development (ZPD) has been defined as:

the distance between the actual developmental level as determined by independent problem solving and the level of potential development as determined through problem-solving under adult guidance, or in collaboration with more capable peers (Vygotsky, 1978, p. 86).
In Vygotsky’s theory, social interaction plays an important role in the learner’s cognitive process. Vygotsky’s zone of proximal development (ZPD) describes this phenomenon. The phenomenon of learning companions has existed for a long time. In the learning companion system, there are three roles, teacher, student, and learning companion respectively. The roles that the learning companions can play are competitors to the students, cooperators with the students, or problem solvers for the students (DeVries, 2000).

**The Influence of Robot-Assisted English Learning on Students’ Learning Motivation and Achievement**

In the study conducted by Chang et al. (2010), an anthropomorphized robot was adopted to teach English at an elementary school in Taiwan. Findings identified that robots could create interactive and positive learning experiences because the learners responded with high learning motivation. The anthropomorphized appearance of the robot attracted attention, even for lower level learners, and it might provide motivation for learners to practice more in the English class. In the study by Young et al. (2010), the researchers investigated children's perception of robots as learning companions in an elementary school in Taiwan. The findings showed that 95% have a positive attitude towards using tangible learning companions and the children were active in practicing English conversation with the robot. According to Chen et al. (2011), the researcher used the robot to teach English to five elementary school students. Through observations and interviews, the results showed that the use of the robot alongside computers and books increased learners’ concentration in their learning of English, together with their interest, and motivation. Wang et al. (2013) used ‘tangible companions’ for enhancing learning English conversation, and the results revealed that this had positive effects on participants’ learning motivation, confidence, and engagement, particularly for the lower-achieving learners. Both English teachers and students agreed that uses of the tangible learning companions effectively improved the class learning atmosphere, too.

**Research Methods**

**Participants**

The experiment was conducted at an elementary school in Taiwan. The participants were two classes of third-grade students and one school teacher. The English proficiencies of the students in both classes were basically similar. These
participants were divided into two groups: an experimental group and a control group. One class consisting of 28 students was labeled as the experimental group, while another class of 25 students was labeled as the control group. The teacher did not inform participants of the special experimental nature of the instruction that was used because the learning material was just like the regular classes on the campus. A total of 53 elementary students were enrolled in English lessons two hours per week, and this activity lasted for one month during the regular semester. Prior to the experiment, the teacher was asked to take three-hours of training to learn how to control and display the robot system.

**Teaching Activity Design**

In terms of teaching activities, both groups of participants learned the same contents from their English textbooks. In the experimental group, the learning contents were presented by a display system with a robot, while in the control group the contents were presented by the teacher without a robot. The Shinbobo robot was adopted as a learning companion (Figure 1 and Figure 2)

![Shinbobo robot](image1.jpg)

**Figure 1.** Shinbobo robot

![Shinbobo robot interacting with students](image2.jpg)

**Figure 2.** Shinbobo robot interacting with students
Shinbobo's specifications are as follows: A Wi-Fi controlled security robot with two-way communication functionality. The robot can remotely record 720p security video in low light environments and provide total access to every corner with video streaming solutions that enable monitoring anywhere in the world through a mobile phone or tablet.

Due to the imperfect development of technical voices and sounds, we are still far away from high quality robotic human-like interaction and communication. Generally speaking, the sound of human voices are the most natural method of interaction and communication input and output. Therefore, two English teachers participated in the teaching experiment. One teacher observed the students to assess their responses and actions in the classroom, and the other teacher used a cellular phone to control the movement of the robot as well as speak out commands from another classroom. Basically, two kinds of teaching activities were applied in the both classrooms, including a listening/acting activity, and a questioning/answering activity. The listening and acting activity was based on Total Physical Response theory (TPR) which is a teaching method used in teaching various languages. Based on the human language learning model, the TPR method adopts physical movements similar to those used in games, enabling children to listen more and do more, so that they can precisely comprehend words and phrases and then speak out after becoming familiar with them. In this experiment, the teacher in the control group asked students in English to respond with physical movements to commands such as “stand up,” “sit down,” “turn right,” “turn left,” and so forth. The same activity was also conducted for the experimental group, but these commands were given by the robot. Then, the teacher could observe the students’ physical movements and try to give corrective feedback to help the students understand the robot’s commands if they responded with incorrect actions. By using this method, not only is the stress and anxiety existing in language learning reduced, but also young children’s mental health is taken into account. Owing to its friendly operation and its clearly visible outcome, teachers and learners can easily obtain a sense of accomplishment.

The questioning-and-answering activity was based on the communicative approach. The communicative approach is based on the idea that language learning becomes successful through having to communicate real meaning. When learners are involved in real communication, their natural strategies for language acquisition will be used, and this will allow them to learn to use the language. The communicative approach emphasizes interaction as the major goal of increasing speaking ability. For instance, the robot in the experimental group was designed to ask questions or to greet, with questions like “How are you?”, “How’s the weather?”
“What time do you get up”, and so on. In the control group, the teacher asked the same questions herself to the students.

Data Collection

There were two kinds of data collection used in this study: two tests and a questionnaire. The tests adopted were an oral examination designed by the teacher. The listening-and-acting and questioning-and-answering tests were each made up of 10 questions, and the total score of the overall test was 100 points. Students needed to listen to a command from the teacher and do the correct action in the listening-and-acting test. The students were also required to answer short questions from the teacher. Then the teacher scored students’ responses based on their use of the vocabulary, pronunciation, grammar and sentence structure in the questioning-and-answering test.

The questionnaire used in this project was based on the Instructional Materials Motivation Survey proposed by Keller (1987). The instrument used for measuring learning motivation was IMMS which includes four scales: attention, relevance, confidence, and satisfaction, followed by a total of 29 questions, shown in Appendix A. The answer options are: Strongly Agree (5 points), Agree (4 points), Neutral (3 points), Disagree (2 points), and Strongly Disagree (1 point).

The teacher administered the survey in the classroom. The teacher first briefly explained to the participants the main purpose of this study and provided instructions on how to answer the questionnaire. Then the participants were informed that there were no right or wrong answers to the questions. They just answered the questionnaire according to their learning motivation. They were given thirty minutes to fill in the questionnaire. When the participants completed the survey, their answers were collected for statistical analysis. Both groups of students responded to the questionnaire, and the final response rate was 100%.

Data Analysis

The researcher used the SPSS 11.0 statistical package to compute the collected data. Internal consistency reliability (Cronbach alpha) was analyzed to show how well a group of items measured the same concept, and the overall Cronbach alpha reliability was 0.86. An independent-samples t-test was conducted to determine whether there was a significant difference in the listening-and-acting and ques-
tioning-and-answering tests, between the experimental and control groups. An independent-samples t-test was also performed to examine the experimental and control groups in view of their learning material motivation (attention, relevance, confidence, and satisfaction).

**Results**

According to the independent-samples t-test analysis, the result showed significant differences between the experimental and the control group in the listening-and-acting tests, \( t(52) = 5.97, p < 0.0001 \). That is, there were mean differences between the experimental and the control group in terms of listening-and-acting tests. On the whole, the experimental group (\( M = 86.07, SD = 11.97 \)) performed better than the control group (\( M = 66.80, SD = 11.45 \)) (See Table 1). By contrast, according to the independent-samples t-test analysis, the result showed significant differences between the experimental and the control group in the questioning-and-answering tests, \( t(52) = 9.04, p < 0.0001 \). That is, there were mean differences between the experimental and the control group in terms of the questioning-and-answering tests. On the whole, the experimental group (\( M = 87.14, SD = 10.49 \)) performed better than the control group (\( M = 60.40, SD = 10.98 \)) (See Table 2).

**Table 1. A comparison between the listening-and-acting test using an independent t-test in the control and experimental groups**

<table>
<thead>
<tr>
<th>Group</th>
<th>N</th>
<th>Mean</th>
<th>Standard Deviation</th>
<th>95% Confidence Interval</th>
<th>p-value</th>
<th>t-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>LAC</td>
<td>25</td>
<td>66.80</td>
<td>11.45</td>
<td>(62.08, 71.52)</td>
<td>&lt;0.0001</td>
<td>5.97</td>
</tr>
<tr>
<td>LAE</td>
<td>28</td>
<td>86.07</td>
<td>11.97</td>
<td>(81.43, 90.71)</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Note: LAC refers to the listening-and-acting test in the control group.
LAE refers to the listening-and-acting test in the experimental group.

**Table 2. A comparison between the questioning-and-answering test for an independent t-test in the control and experimental groups**

<table>
<thead>
<tr>
<th>Group</th>
<th>N</th>
<th>Mean</th>
<th>Standard Deviation</th>
<th>95% Confidence Interval</th>
<th>p-value</th>
<th>t-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>QAC</td>
<td>25</td>
<td>60.40</td>
<td>10.98</td>
<td>(55.87, 64.93)</td>
<td>&lt;0.0001</td>
<td>9.04</td>
</tr>
<tr>
<td>QAE</td>
<td>28</td>
<td>87.14</td>
<td>10.49</td>
<td>(83.08, 91.21)</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Note: QAC refers to the questioning-and-answering test in the control group.
QAE refers to the questioning-and-answering test in the experimental group.
Based on the independent-samples t-test analysis, there were significant differences in the overall learning material motivation in the experimental and the control groups. The results show that the experimental group (M=3.92, SD=0.15) had higher learning material motivation than the control group (M=1.81, SD=0.17), (t(52)=45.6, p<0.0001) (See Table 3). To be specific, the independent-samples t-test analysis also showed that the experimental group had higher learning material motivation than the control group inclusive of the attention, relevance, confidence, and satisfaction domains. The t-value for each sub-dimension was 29.77, 23.28, 14.54, and 16.03, respectively, at p<0.0001 (See Tables 4–7).

**Table 3.** A comparison between the control and experimental groups in overall learning material motivation for an independent t-test

<table>
<thead>
<tr>
<th>Group</th>
<th>N</th>
<th>Mean</th>
<th>Standard Deviation</th>
<th>95% Confidence Interval</th>
<th>p-value</th>
<th>t-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>C</td>
<td>25</td>
<td>1.81</td>
<td>0.17</td>
<td>(1.73, 1.88)</td>
<td>&lt;0.0001</td>
<td>45.6</td>
</tr>
<tr>
<td>E</td>
<td>28</td>
<td>3.92</td>
<td>0.15</td>
<td>(3.86, 3.98)</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Note: C refers to the control group.
E refers to the experimental group.

**Table 4.** A comparison between the control and experimental groups in learning material motivation of attention domain for an independent t-test

<table>
<thead>
<tr>
<th>Group</th>
<th>N</th>
<th>Mean</th>
<th>Standard Deviation</th>
<th>95% Confidence Interval</th>
<th>p-value</th>
<th>t-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>C</td>
<td>25</td>
<td>1.80</td>
<td>0.26</td>
<td>(1.69, 1.90)</td>
<td>&lt;0.0001</td>
<td>29.77</td>
</tr>
<tr>
<td>E</td>
<td>28</td>
<td>3.87</td>
<td>0.24</td>
<td>(3.77, 3.97)</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Note: C refers to the control group.
E refers to the experimental group.

**Table 5.** A comparison between the control and experimental groups in learning material motivation of confidence domain for an independent t-test

<table>
<thead>
<tr>
<th>Group</th>
<th>N</th>
<th>Mean</th>
<th>Standard Deviation</th>
<th>95% Confidence Interval</th>
<th>p-value</th>
<th>t-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>C</td>
<td>25</td>
<td>1.66</td>
<td>0.36</td>
<td>(1.51, 1.81)</td>
<td>&lt;0.0001</td>
<td>23.28</td>
</tr>
<tr>
<td>E</td>
<td>28</td>
<td>3.95</td>
<td>0.34</td>
<td>(3.81, 4.08)</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Note: C refers to the control group.
E refers to the experimental group.
Table 6. A comparison between the control and experimental groups in learning material motivation of satisfaction domain for an independent t-test

<table>
<thead>
<tr>
<th>Group</th>
<th>N</th>
<th>Mean</th>
<th>Standard Deviation</th>
<th>95% Confidence Interval</th>
<th>p-value</th>
<th>t-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>C</td>
<td>25</td>
<td>1.97</td>
<td>0.53</td>
<td>(1.75,2.19)</td>
<td>&lt;0.0001</td>
<td>14.54</td>
</tr>
<tr>
<td>E</td>
<td>28</td>
<td>3.83</td>
<td>0.39</td>
<td>(3.68,3.98)</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Note: C refers to the control group.
E refers to the experimental group.

Table 7. A comparison between the control and experimental groups in learning material motivation of relevance domain for an independent t-test

<table>
<thead>
<tr>
<th>Group</th>
<th>N</th>
<th>Mean</th>
<th>Standard Deviation</th>
<th>95% Confidence Interval</th>
<th>p-value</th>
<th>t-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>C</td>
<td>25</td>
<td>1.84</td>
<td>0.59</td>
<td>(1.59,2.09)</td>
<td>&lt;0.0001</td>
<td>16.03</td>
</tr>
<tr>
<td>E</td>
<td>28</td>
<td>4.11</td>
<td>0.43</td>
<td>(3.95,4.28)</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Note: C refers to the control group.
E refers to the experimental group.

Conclusions and Discussions

The results of these findings are consistent with the findings of Hong et al. (2016). The results revealed that the experimental group outperformed the control group in the listening-and-acting tests and questioning-and-answering tests. In addition, the results also identified that the experimental group yielded significantly higher mean scores than the control group in their learning material motivation scale (including attention, relevance, confidence, and satisfaction domains).

There is no denying that the AI robot is a trend that will overwhelmingly change our future lives. Soon we will coexist with robots. In various workplaces, robotic colleagues and assistants will gradually appear in different fields, such as medical treatment, disaster relief, and greeting and reception. At present, robot-assisted education has entered the university curriculum and has been integrated into artificial intelligence, automation, and other related professional courses. Besides, it has gradually moved from curriculum theory to instructional practice. In the future, the popularity of robot-assisted education in elementary school will become a general trend. People have been constantly learning since they were born; children are constantly exploring the unknown world while playing. Toys can directly influence their learning motivation as well as interest and preference.
Educational robots are used as toys which enhance children’s learning motivation and interest.

Motivation is not only the basis of all learning behaviors but also a requirement which enables students to effectively engage in meaningful learning (Molaee & Dortaj, 2015). The theory of ARCS (Attention, Relevance, Confidence, Satisfaction) contains four elements - attention, relevance, confidence, and satisfaction, often used in the student-centered instructional design and learning activity design (Molaee & Dortaj, 2015). In robotic foreign language learning, motivation is also an important factor affecting learning. To enable students to effectively carry out meaningful learning, the trigger of motivation is the primary condition. If we can apply the ARCS motivation theory to arouse students’ motivation and interest through the elements of attention, relevance and confidence and make students satisfied with robotic foreign language learning; it is believed that the effect of robot foreign language learning will be greatly improved.

References
In, J., & Han, J (2015). The prosodic conditions in robot's TTS for children as beginners in English Learning. *Indian Journal of Science and Technology, 8* (S5), 48–51.

**Appendix A**

The Instructional Materials Motivation Survey
1. The learning materials can draw my attention.
2. The materials used in class are more difficult than I originally imagined.
3. After learning from the materials, I have sense of achievement.
4. I know very well that the learning materials are quite relevant to the English lessons I have learned.
5. I do not know or remember what I have learned in class.
6. The learning materials used in class make me engaged.
7. I think that the contents in the learning materials are worthwhile learning for students.
8. The learning materials are very important to me when I learn English.
9. It is very difficult for me to keep focusing on the learning materials because they are abstract.
10. I am confident because I feel that I can learn the lessons taught in class.
11. I look forward to learning the forthcoming materials.
12. The learning materials are quite boring and cannot draw my attention.
13. The learning materials used in class match my interest.
14. The learning materials help me pay attention in class.
15. The learning materials are too difficult for me.
16. I am very curious about the learning materials.
17. I really enjoy learning the materials in this class.
18. Sometimes the learning materials bore me.
19. Sometimes I am amazed at what I have learned from the learning materials; I learn more than I can imagine.
20. After attending the class for a period of time, I find myself more confident.
21. In class, I feel I was motivated and I can have more sense of achievement.
22. The ways the materials were taught in class help keep me focused.
23. The ways the materials were taught make me bored.
24. The learning materials and the teaching make me feel fun and interesting.
25. I feel good about the learning materials.
26. The learning materials are useful for me.
27. There are many places in the learning materials I do not understand.
28. The learning materials help me learn in class and develop more confidence.
29. I enjoy the materials chosen by my teacher so much.