

Enhancing EFL Learning of Elementary School Students through Human-Robot Interaction

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Abstract: This study explored the potential for using in-house built teaching assistant robots in elementary school classrooms for the instruction of English as a Foreign Language (EFL). Both hardware and software design for such an innovative English program via interactions with the robot was included in this study. This Human-Robot Interaction (HRI), based on the results, led to better pedagogical effects on learning. This paper provides not only new directions for EFL instructors but also instructional design guidelines that other researchers can follow to create an innovative and enjoyable English classroom that employs an interactive robot as an assistant for enhancing English acquisition while simultaneously reducing the pressure and teaching load of the English instructors.

Keywords: teaching assistant robot, HRI, EFL, r-learning

1. Introduction

The robot industry is recognized as one of the most promising future industries throughout the world (Han, Jo, Jones & Jo, 2008). While a significant number of studies have revealed that r-Learning (Robot Learning) can bring new affordances to education, i.e. new capabilities, experimentation in r-Learning has mainly occurred in the fields of mathematics and science, the disciplines that actually develop the robots. The literature addressing the value of using educational robots to support second/foreign language learning is still skimpy. Chang, et al, (2010) echoed this observation by stating that only a few researchers have focused their attention on implementations of robotics for language teaching in elementary schools, and most have been located outside the cultural context of Taiwan. In recent years, there have been studies integrating applied robotics with education (Ryuey et al., 2008); however, research into robot assisted teaching and learning is still in its infant stages; therefore, more and more researchers are joining in the exploration of this field. The experimental results have shown that a communication robot can support human activity with its communication abilities, that proper programming can motivate children to desire additional interactions with the robot, and that robots have the potential to exhibit certain beneficial social skills when interacting with young children, the target population of the current study.

2. Hardware and Software Design of Teaching Assistant Robots

In view the obstacles to optimal English learning environments and the merits of using teaching assistant robots to facilitate language acquisition in the classroom, an intelligent teaching assistant robot named Powerful English Tutor (PET) was designed and created by the researchers to combine r-Learning functionality with a unique 3D visual experience. PET had the capability to exhibit various forms of communication and interaction with the student learners, such as facial expression, gestures, and motions on wheels. The main purposes of the creation of PET included (1) first to capture the students' attention as a result of PET's novel appearance, (2) then to motivate students to learn and to sustain their learning by engaging them with PET, and (3) eventually to ensure the students' mastery of the learning materials by interacting repeatedly with PET. The first author of this paper had been

involved in designing and producing robots successfully for several years and therefore brought significant expertise to this project.

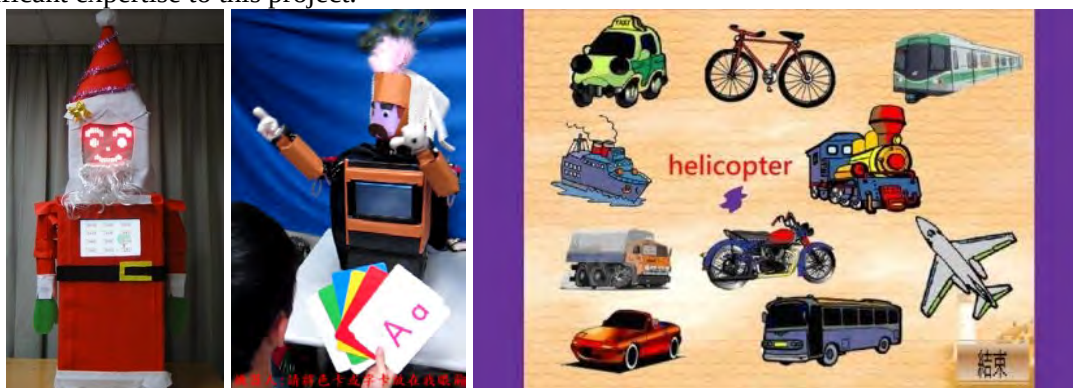


Figure 1.

In order to fully support the instructional design of the class and achieve desired learning outcomes, the researchers employed a conceptual framework for this study based on three major theory-based teaching approaches to create an interactive learning environment for students including Communicative Language Teaching (CLT), Total Physical Response (TPR), and Storytelling, each incorporated into the databases that governed and managed PET's moment-by-moment actions. The CLT approach was used in the construction of databases for the teaching of self-introduction, conversation teaching, and teaching via storytelling. The TPR approach was applied in developing databases covering English character teaching, making use of entertaining body movements, singing, and dancing in order to help students internalize their lessons. The Storytelling approach was used in preparation of the databases for story teaching and learning.

The theory-based creation of PET's physical appearance was an important factor in the study. The upper part of PET was android in nature, with a head, face, ears, and arms, appearing similar to the cartoon characters familiar to the elementary school children. In particular, PET's face appeared on an LED display of 20x20 centimeters that could show smiles and a variety of other expressions (see figure 1). The lower body of PET was wheeled, to make it easily mobile. The android part of the body was able to imitate many kinds of human actions as well as perform a variety of teaching activities.

This physical design of PET was based on the need described in the introduction for an external appearance that was human-like or cartoon-like, with the following specific criteria: (1) The appearance of the robot must be appealing and interesting in order to attract the attention of young children; therefore, the researchers chose a humanoid structure with various cartoon-like elements appropriate to the needs of the curriculum (see Figure 1); (2) A 10.1" Tablet computer needed to be embedded in the robot's chest to show multimedia teaching content and to interact with students such as to increase the students' attention and motivation; (3) The upper part of the robot needed to imitate many kinds of human actions as well as perform a variety of teaching activities; (4) The robotic hands needed to easily hold teaching materials and English character cards to keep the attention of the students; and (5) The price of this robot, should it reach commercial production, needed to be reasonable for general classroom and family use.

3. Methods and Outcome

This study involved 31 third grade students who had participated in four consecutive rounds of robotic English teaching, each lasting about 50 minutes in length. The instructional design in this study employed the three major teaching approaches in the conceptual framework, Communicative Language Teaching, Total Physical Response, and Teaching Storytelling. PET visited the class four times, for about 50 minutes each time. The lessons were about the 26 English letters, self-introduction and body parts, conversation, and storytelling. The proficiency test was conducted at the end of the fourth season. Besides, a survey about the use of PET was administrated to the entire class and a focus group interview with 5 students was conducted afterwards with the consent obtained from their parents. Finally, the researchers' own classroom observations and video recordings were also used as a source for data collection.

The overall mean score of 4.2 (M=4.2) for the cutting-edge English instruction using PET indicated that generally speaking, the students were positive about their learning with PET in terms of elements such as joyfulness, interest, and motivation associated with their English learning. A negatively-skewed distribution of responses indicated the very successful role PET played in assisting teaching. When it comes to item-by-item data analysis, item 16, “I am looking forward to our future study of English in class” had a highest mean score of 4.53 (M=4.53), followed by item 10, “I’m willing to perform on the podium” with a second highest mean score of 4.52 (M=4.50). Item 11, “I like the pleasant atmosphere when studying the English in class” and item 6, “This is a fun and interesting English class” had a relatively high mean score of 4.36 (M=4.36) and 4.28 (M=4.28), respectively, which proved that using robots as teaching assistants in class created a more pleasant learning environment as well as a more positive learning experiences.

The interview data also indicated that the students enjoyed having PET because it helped the instructor to teach English and also believed that PET performed its job well. Student D mentioned that “This English study with PET was a very interesting and fun experience because PET could perform a variety of different movements and also served as a good teaching assistant.” In addition, the students believed that PET could enhance their motivation to study English and that HRI could also be valuable in other classes. Student A said, “I wish that PET could be here in class all the time and could also appear in the other classes to help us learn the other subjects because I feel I’m more motivated to study English.” Student C focused on the issue of confidence in studying English by saying, “I felt more confident and less anxious when PET was there, especially when being asked questions.”

The observation from the teacher reveals that PET assisted her in teaching by reducing the pressure and load of teaching and said that she would love to continue using PET as her teaching assistant in the future. She also found that the operation and interface of PET was simply and user friendly, but saw the need for an improvement in the richness and complexity of teaching materials, should PET be integrated into a semester-long lesson plan. To summarize, the multiple sources of data collected from both the teacher and the students showed that teaching assistant robots were highly valued and strongly recommended for in-class English instruction.

4. Conclusion

Given the world-wide need to teach younger and younger children foreign languages, and the resulting need to develop language teaching methodology suitable for these younger children, it is natural to assume that technology should play a prominent role. The researchers have demonstrated that a teaching assistant robot, such as PET, can accomplish multiple goals, such as fostering positive learning experiences, promoting active learning, motivating young students to learn, improving learning effectiveness, and providing a counterpoint to teacher-led classroom lessons. The researchers also believe that teaching assistant robots like PET could also be used to help teach other languages to younger children, with appropriate alternative databases. The researchers, therefore, have concluded that this field, using Human-Robot-Interaction to support EFL instruction for young students, has high potential and is deserving of extensive attention in the field of both education and technology development.

Acknowledgment

This research was partially supported by the National Science Council in Taiwan through Grant NSC 99-2628-E-150-046, NSC 101-2511-S-269-002-MY3 and NSC 100-2511-S-110-001-MY3.

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