# A Robot as a Teaching Assistant in an English Class

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## Abstract

*Advancement in robotic research enables robot can assist human in many way. However, few researches have been done on applying on education. This paper reports field trials of using robot in an English learning classroom. In our experiment, the robot plays as a partner of a teacher. Five models of collaboration between teachers and robot are proposed. Teachers design the course flow in advance based on the learning content and these five models. Formative evaluations of the experiments are presented to show the impact of adopting robot in the classroom.*

## 1. Introduction

Humanoid agent interface is becoming increasingly popular. This type of agents can play as an information recommender, a personal assistant, and a news presenter[1]. At the same time, robotic research groups investigated aspects of human-robot interaction. Moreover, researchers try to develop robots that can used in education, home appliances, and entertainment. The humanoid form makes human-robot social interactions in a natural way[2]. Consequently, a number of companies, especially in Japan, constructed humanoid robots such as Asimo (Honda), HOAP-2(Fujitsu), and SDR-4X II (Sony)[3]. A physical robot, especially two-legged humanoid robot, gives strong impression and a tangible interface that is different from animated virtual characters on 2D display[1]. While interacting with robots, the feelings of involvement, concentration, enjoyment and intrinsic interest were also studied[4].

There is a direction worthy of exploration: robot as a partner of a teacher in a classroom. In Japan, a robot called Robovie played as a partner of pupils demonstrated positive effects for motivating children to study English[6]. Educators are now in a better position right now to take advantage of this emerging technologies to improve learning.

In this paper, we experiment how to introduce the humanoid robot called Robosapien [8] marketed by Wow Wee Company in a classroom. We will describe how the robot can help teacher in teaching English in a classroom and the interactions that are happened. We introduce the teacher partner robot system in section 2. The Five models of collaboration between teachers and robot are proposed in section 3. Section4 we will analysis each of the models which showed some benefits for teachers and students. And we will conclude our study in section5.

## 2. The robot platform

The robot platform in our design is a combination of various pieces of hardware and software. The software we developed integrates speeches, sounds and gestures control of the robot. The robot could speak and make sounds with gestures simultaneously.

### 2.1. Hardware & software

Currently, Full-sized humanoid robotic platforms are too expensive and beyond the scope of a project directed at education. RoboSapien is a low-cost humanoid robot, which is designed by MarkW. Tilden [9] and is marketed with great success by WowWee for the toy market. It is approximately 36cm in height and weights about 2.1kg, including 4 "D" size alkaline batteries. It can be programmed to perform a number of actions in succession, or perform one step at a time.

We extend Robosapien's remote controller with a DSP board that is connected to a Tablet PC. Thus, Robosapien could be controlled remotely by a Tablet PC. We use a Tablet PC as the robot control end

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because it is equipped with a sensitive screen designed to interact with a digital pen. And we can control the robot efficiently just by using the pen. By this method, the students wouldn't think that the robot is controlled by a person. The environment of our experiment is shown in Figure 1.

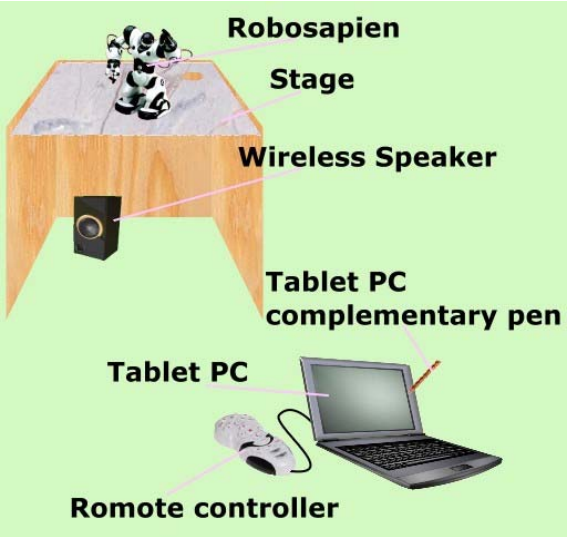


**Figure 1. The trail environment of devices**

Speech of the robot is generated by Microsoft Speech SDK for text-to-speech. The speaking rate, identity of the voice, and volume could be adjusted in real-time to fit the requirements. We put the wireless speaker under the stage. The volume of the wireless speaker is loud enough to cover the entire classroom. Thus, the students will think that the sound comes out from the robot.

Although Robosapien's eye could show some emotional state, it is too far for students to recognize it clearly in the classroom. We add many comic canned sounds to represent the emotion of the robot. Using these canned sounds is also a good way to help teacher manipulate the affection communication in the classroom. The Structure of the platform design is shown in Figure 2.

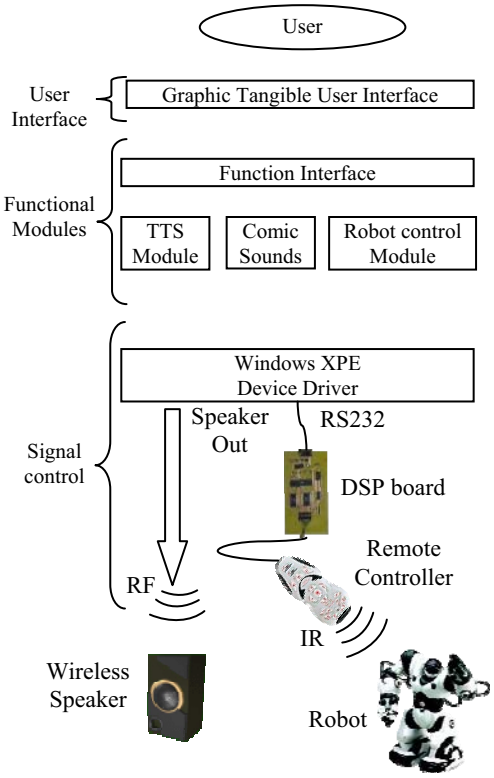


**Figure 2. Structure of the platform design**

## 2.2. Teacher & TA interface

In our design, there should be one person who takes the control of the robot as shown in Figure 3. This person controls the robot through the graphic user interface on the Tablet PC. He must watch the teacher's signal and the students' state to control the robot. The teacher in the class just grants the power of the class to the robot by announcing some activity such as "Ok, now listen to Sapien ..." or do some gesture to inform the control person.

**Figure 3. A person takes control of the robot (the arrow point)**

## 3. Modeling interactions in the classroom

Responding to the growing need to foster communicative abilities in English, Taiwan has recently include English as required class in the elementary schools. English has been taught at the fifth grader in Taiwan since the fall semester of 2001.There are six grades in a Taiwanese elementary school. The ages of students from the first grade to the sixth grade are about 6 to 12 years old. Because many pupils go to English cram school, their learning schedules are ahead of the classroom schedule. However, some other students never learn before the class. Therefore, the discrepancy of English capabilities in the class is quite big. Hence, students in the classroom may be out patience or act the giddy goat if the class doesn't attract them.

Knowing that humanoid robot may be a powerful tool in education we have developed five interaction models to motivate students to involve in the learning activities in the classroom. The interaction models are described as bellow:

### 3.1. Storytelling model

The use of stories as an effective way to motivate children to learn a second language is a good way[10]. In this model, we edited some short stories according to the learning content. In the beginning of this interaction, the teacher will announce: “Let Sapien tells a story for us." (The teacher announced in Chinese.) Then, the robot begins to tell a story. When the robot finishes a short paragraph, it stops and the teacher asks students questions about the content in the story. When the student answered the question correctly, the robot would give him/her an acclamation sound. The robot will re-announce the correct answer after the questioning activity.

### 3.2. Q&A model

In this model, the robot will randomly pick a student to come to it, and ask him/her some simple questions in English. If he/she answered correctly, the robot will give him/her an acclamation sound, otherwise a ludicrous sound. Finally, the robot asks the student to go back to his/her seat.

### 3.3. Cheerleader model

In the class, the teacher may hold a competition game in which students could be divided into groups. The competition events include Q&A, picking the corresponding word or picture, performing actions. When a student utters the right answer, the robot will perform a dance or cheer sound for them.

### 3.4. Let's act model

In this model, the English teacher will ask the students in English to perform some actions such raise hand, turn around, and go somewhere. This model includes two parts.

First, the teacher empowers the robot to do this command task. The robot ordered the students to do some gesture and the robot also performed the actions.

Second, the students will be granted to order the robot. The robot will randomly choose a student to do this task.

### 3.5. Pronunciation leading model

In this model, the teacher let the robot leads everybody to speak English words. And the robot changes its speaking rate and voice simultaneously and so do students.

**Figure 4. The teacher is teaching with the robot**

**Figure 5. The robot is speaking to students**

**Figure 6. A student was called by the robot to answer a question**

For the purposes of this learning English class, we have developed these structured Human-robot interactions. After the trail, emotional states of students and some other phenomena were annotated. The results are discussed in the following section.

## 4. Observations of the experiments

We chose three classes of the fifth grade for experiment. We give each class as the name class A, class B and class C. There are 33 students in class A, 35 students in class B, and 32 students in class C. The teacher of these three classes is the same. The students have English course twice a week. The time interval of each course is 40 minutes. The experiment was carried out in the first course of the week for two weeks since 26th December year 2005. Here we describe the observation of our experiments in each model:

### 4.1. In storytelling model

In the first week, we let the robot introduce itself as the story in storytelling model. In the performing time, all the students were very concentrated in listening and watching what the robot was performing. When questioning time, most students were so eager to answer the teacher's question about the story. Usually, the students are not so involved in the activities.

In the second week, we let the robot tell a short story composed of contents in the textbook. There are three roles in the story including a boy, a girl and an aside (male). The robot changed its voice according to the role it played. The students were so excited while the robot changes its voice. However, they were too excited and noisy so that they paid less attention to what the robot spoke. Therefore, they answered fewer questions this time.

### 4.2. In Q&A model

Most students were shy when he/she was called by the robot, but still some students were so excited when the robot called someone up. The teacher will scaffold the student to understand what the robot was asking him/her. Although the students might know the answer, they were just shy to speak loud in English.

### 4.3. In cheerleader model

In this interaction, we found that students participate in the competition activities more enthusiastically than usual. The robot makes them have more enjoyment in the activities.

### 4.4. In let's act model

In the first part of this interaction, most students could follow what the robot orders them to do. In the second part, in the beginning the assigned students who were called to give orders may give simple commands that Robosapien could do. But later, students began to make fun on it, ordered it to perform some actions that it could not do, such as: squat. Because we give the age of Robosapien in this experiment is only six years old, 'he' may make mistake when performing the commands given by the students. In this moment, the robot would generate some frustrated sounds to inform the student it couldn't perform the action.

### 4.5. In pronunciation leading model

Because the robot could speak words in different rate and voices, students repeat after the robot with full of joy. They spoke the words loudly. And with the robot's cheer, we believe the student were more willing to speak out in English.

After the experiment, we conducted a questionnaire (written in Chinese) to students in each class to verify their attitude to the robot in class. The questions in the questionnaire use a scale going from 1= strongly disagree to 5= strongly agree. Here we select 7 questions in the questionnaire to show some thought of students:

Q03. When the robot cheers me I will feel very happy.
Q05. I think the robot's motion is very funny.
Q07. The robot can always attract me to the content the class is giving.

Q12.Compare to CD player speaking, I more like the robot's speaking.
Q13. The robot makes me more like this class.
Q17. The robot performs with the teacher very well.
Q18. I wish the robot will appear in class next time.

The grades of means and standard deviation of these 7 questions are shown in Table 1.

**Table 1. Grades of means and standard deviation of these 7 questions from the three classes**

| | Classes | | | | | |
|---|---|---|---|---|---|---|
| | ClassA | | ClassB | | ClassC | |
| Questions | M | SD | M | SD | M | SD |
| Q03. | 3.61 | 1.20 | 4.24 | 1.28 | 3.97 | 1.23 |
| Q05. | 4.12 | 0.99 | 4.41 | 1.16 | 4.10 | 1.42 |
| Q07. | 3.58 | 1.17 | 3.77 | 1.35 | 3.94 | 1.09 |
| Q12. | 3.67 | 1.27 | 3.86 | 1.17 | 3.94 | 1.22 |
| Q13. | 3.79 | 1.17 | 3.97 | 1.25 | 3.75 | 1.39 |
| Q17. | 3.97 | 1.06 | 4.06 | 1.28 | 4.32 | 1.01 |
| Q18. | 4.09 | 1.42 | 4.46 | 1.20 | 4.41 | 1.24 |

The result of the questionnaire shows a success in our job, but in the second week, we found students paid less attention on the robot when the robot asked them to be attentive. This phenomenon confirms findings by Kanda et al. [6] that the novelty effect wears out over time.

## 5. Conclusions and future works

This study was a field trial rather than a true experiment with controls. We introduce a humanoid robot into a English class to assist the teacher in teaching and motivate students to involve in learning activities. Most students in the three classes had a positive attitude to this robot, and had great interest in the robot's performance. Although in the beginning, the teacher may have some doubt about the robot's performance and don't know how to cooperate with it. The interaction models we conduct give a good example in this design. It is very important to let the teacher know what the robot can do and what it can not do. Practice before a class is necessary.

Robosapien V1 is too small to be used in a classroom where are about 100 square meters and filled with more than 30 students. With the development of robotics, it is possible to have a cheap and more suitable robot to perform in the classroom.

To log each student's state in the robot's system when he/she has interaction with the robot is a potential benefit. This may let the robot likely knows the students by informing him/her how he/she did in this interaction compared to the last time. And this may help teacher to know each student's state more, especially for the teacher need to teach many classes.

## 6. Acknowledgements

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