Using humanoid robots as instructional media in elementary language education

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Abstract
As robot technologies have developed rapidly, many researchers have tried to use robots to support education. Studies have shown that robots can help students develop problem-solving abilities and learn computer programs, mathematics, and science. However, few studies discuss the use of robots to facilitate language teaching and learning. It is worth discussing whether language education needs robot support, whether robots present an appropriate medium for language instruction, and what challenges must be overcome. This paper reviews past studies of educational robots, and we designed tested five language instruction scenarios using a teacher and a robot. Based on our empirical experience, we provide suggestions for future research into, and design of, robots for language education.

1. Introduction
Using robots to support teaching and learning, from secondary school to undergraduate courses to graduate education, has become a popular research topic in recent years [6]. The first man to implement an educational robot was Seymour Papert [5], a founding father of this field. He proposed an approach to learning in the classroom that he calls “constructionism”, as opposed to the traditional style of “instructionism”. In this approach, students can learn from designing, and assembling their own robots. Since robots capture the imagination of many younger people, they have been validated as useful aids for the teaching of mathematics and physics [16]. Furthermore, the use of robots is not limited to traditional engineering departments but is distributed across a variety of arts and science courses. The use of robotics by nonengineering, nontechnical instructors has been termed a “robotic revolution” [2].

The development of educational robots is still in the initial stages. Robot technologies bring new developments to education. The literature includes many studies that have tried to use robots to support learning, especially in mathematics and science. However, there are still few papers that discuss the value of robots in language learning. To complete our understanding of educational robots, we should explore potential benefits of using robots for language education, optimal design of language education robots, and limits and challenges that must be addressed. This study explores the possibility of using humanoid robots as instructional media in elementary language education. In this paper, we survey current instructional media for teaching language and roles of educational robots; we also propose five paradigms to realize the implementation of robots in language courses.

2. Related works
The roles of educational robots have some familiar forms. These roles are usually produced by the objects that have existed while learning originally. By reviewing past research, we identified three categories of roles: learning materials, learning companions / pets, and teaching assistants.

Learning materials
The classic example of robots as learning materials is the LEGO Mindstorms for Schools. In 1984, LEGO collaborated with the Media Lab at MIT. They developed instruction kits which combine toys with advanced technologies. LEGO Mindstorms are collectable and programmable teaching tools. Learners can design and develop their own robots in a competition and learn in the process. This results not only in development of motivation but also in improvement of capability in mathematics, science, programming, problem solving, and collaboration [16].

Learning companions / pets
Humanoid robots can naturally be regarded as learning companions. In one field study [4], two robots visited a children’s elementary school in Japan for two weeks, with the purpose of teaching children English. This experiment showed that the children’s recall of new words improved, and that there was a positive correlation between the frequencies of interacting with the robot and learning performance. However, motivation decreased
over time. Although the effects are modest and the study length was short, the results of this study are impressive because this study is the first practical demonstration that students can learn from a humanoid robot.

**Teaching assistant**

While those who use learning companions are mainly students, the robots used as teaching assistants serve teachers to teach in classes. Robot IROBI [3] has been applied as an assistant in a classroom. This instructional medium displays information to students with a monitor in the belly of the IROBI. Moreover, the robot can move its arm to direct students to the key point in the monitor. In 2008, guidelines for designing the proper body feature for a teaching assistant robot in order to provide more effective interaction were proposed [20], such that the interaction between teachers and students could become more varied.

These studies indicate the potential for using robots to support education and suggest a variety of educational robot roles. Currently, many studies focus on applying robots to assist students in learning science or mathematics. However, few researchers have studied using robots to support language education. The goal of this paper is to discover this new research field, to explore the possibility of using humanoid robots as instructional media in elementary language education, to analyze the characteristics of robots in order to facilitate language instruction activities, and to reveal the possible influences to language courses by robots.

**3. Five paradigms**

This study deployed a robot partner for teachers in the classroom in order to realize the effect of robots on learning, and to discuss the optimal use of robots for promoting language education. After conferring with the elementary language teachers, we collaboratively designed five robot modes according to the condition of the classroom and the characteristics of robot that we would specify them in the discussion section. The modes are story-telling mode, oral reading mode, cheer mode, action command mode and Q&A mode.

**4. Conclusion**

As advanced robot technologies have developed rapidly, using robots to support teaching and learning has become a trend. In this decade, researchers have provided much evidence that the robot is a great teaching aid for mathematics and science. Further, educational robots are helpful to students developing collaborative and problem solving abilities. However, there are still few studies which discuss robots in language instruction. What are the advantages and disadvantages of utilizing robots to support language education? How do we design and develop the educational robot to be a practical instructional medium in language education? These are important and fundamental problems for future research. Educational robots will be completed when they can be used for both science and art.

This study does not aim to replace teachers with robots, but attempts to discover a new instructional medium for aiding language education. Using robots in a language classroom to support teaching and learning is now possible. Robots have unique features that distinguish them from human and current media; those characteristics provide robots with great potential to become a useful instructional medium in language education. In the future, we will explore more deeply the relationship between robots and learning performance in language learning.

**5. References**


