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Exploring the Possibility of Using Humanoid Robots as Instructional Tools for Teaching a Second Language in Primary School

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ABSTRACT

As robot technologies develop, 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 programming, mathematics, and science. However, few studies discuss the use of robots to facilitate the teaching of second languages. We discuss whether language teaching needs robot support, whether robots present an appropriate medium for language instruction, and what challenges must be overcome. In order to explore the possibility of using robots as an instructional tool for teaching a second language, this paper reviews prior studies concerning educational robots and analyzes the characteristics of robots and instructional media. Furthermore, we report on the design and testing of five instruction scenarios for teaching second language. Based on our empirical experience, we provide suggestions for future research directions in the realm of robots for language education.

Keyword

Educational robots, Language teaching, Robotics, Instructional tool

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 (Klassner, 2002; Klassner & Anderson, 2003; Ryu, Kwak, & Kim, 2008). Seymour Papert (1993) proposed an approach to learning in the classroom that he calls constructionism, as opposed to the traditional style of instructionism. In the constructionist approach, students 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 (Cooper, Keating, Harwin, & Dautenhahn, 1999). 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 non-engineering, non-technical instructors has been termed a "robotic revolution" (Hendler, 2000).

Weinberg and Yu (2003) describe three factors (unique learning experience, cost, and plug-and-play feel) to demonstrate that robots will successfully support education. First, robots are the physical embodiment of computations and provide unique experiences for the learner. They provide a wide design space for students to explore, to make hypotheses about how things work, and to conduct experiments to validate their beliefs and assumptions. Students can receive strong, visceral feedback from physically experiencing their work. An important example is the work by Turkle and Papert (1992), which led to the development of educational robot platforms. The second factor described by Weinberg and Yu is cost. Over the last decade, the cost of computation has dropped exponentially. As a result, robot controllers have been designed and marketed at prices that are accessible to schools with even modest budgets (Marin, Mikhak, Resnick, Silverman, & Berg, 2000). The third important factor is the plug-and-play feel of the new robot platforms. The multidisciplinary nature of robots has previously relegated their study to larger research institutions that have the range of prerequisite knowledge for engineering complex systems. Robot controllers, such as the Handy Board and the Mindstorm RCX, have mitigated this need by making it relatively simple to plug in motors and sensors and use well-known or simple programming environments.

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 second language learning. To complete our understanding of educational robots, we should explore potential benefits of using robots for second language education, optimal design of language education robots, and any limits and challenges that must be addressed. This study explores the possibility of using humanoid robots as instructional tools for teaching a

second language in primary school. In this paper, we survey current instructional media for teaching a second language and the roles of educational robots; we also propose five scenarios to realize the implementation of robots in language courses.

Current instructional tools for teaching elementary language

Instructional tools have been exploited generally in the elementary language classroom (Heinich, Molenda, Russell, & Smaldino, 2002). Common tools can be classified as visual, audio, video, computers, multimedia, Internet, and mobile devices (Chinnery, 2006). Paivio (1990) proposed dual coding theory, which provides theoretical justifications for the use of visuals in instructional presentations. Mayer and Moreno (1998) and Mayer (2001) showed that multimedia were significantly better than mono-media in facilitating learning. Instructional tools usually support one or more of the following in an instructional requirement: gain attention, recall prerequisites, present objectives, present new content, support learning through examples and visual elaboration, elicit student response, provide feedback, enhance retention and transfer, and assess performance (Smaldino, Russell, Heinich, & Molenda, 2004; Instructional Development Services, 2002). Using tools also facilitates students in developing language capabilities. Stockwell (2007) summarized the literature in computer-assisted language learning (CALL) from 2002 to 2005 and analyzed the studies about using different technologies to develop learners' different language abilities (grammar, vocabulary, pronunciation, reading, writing, listening, and speaking). Furthermore, the use of multimedia technology for foreign language instruction has expanded rapidly during the past two decades. Studies of the influence of using technologies on language instruction have also appeared in growing numbers (Al-Jarf, 2004; Meskill & Anthony, 2005; Schwienhorst, 2004; Weininger & Shield, 2003).

Previous research shows that media can facilitate language learning in several ways, including facilitating communication, reducing anxiety, encouraging oral discussion, developing the writing-thinking connection, nurturing social or cooperative learning, promoting egalitarian class structures, enhancing student motivation, facilitating cross-cultural awareness, and improving writing skills (Yang & Chen, 2007). However, current instructional tools usually have two common drawbacks: they are difficult to customize and hard to interact with. Previous studies have shown that simply adopting a new technology does not necessarily improve learning (Hegarty, 2004). The efficiency of using media to support learning would be reduced if the learning content carried by the media did not fit with the learners' level. In fact, students' level in every class is different. Hence, to match the content with learners' level, media must allow instructors to adjust the material. On the other hand, current media still present visual information two-dimensionally. People interact with tangible objects more naturally and become more engaged with them than with video (Xie, Antle, & Motamedi, 2008). Therefore, this study attempted to investigate the possibility of using robots as learning tools to support language teaching. This paper discusses the chance for instructors to exploit robots as tools to develop interactive and customized learning activities.

From the viewpoint of language teaching, the total physical response approach (Asher, 1982) emphasizes learning through actions. Traditionally, a teacher plays the role of commander, and the students are the actors. It is also important in this approach to give students the right to give commands during the learning activity. However, not all teachers and students are willing to be dominated by other students. In this context, robots could fill the role of actors that follow students' commands (Wu, Chang, Liu, & Chen, 2008). Furthermore, the stress of communication and of context in learning activities was emphasized in the natural approach. Krashen and Terrell (1983), who proposed the affective filter hypothesis, believed that strong motivation, self-confidence, and a relaxed mood were beneficial for language learning. Certain tools could be used to aid instructors in designing learning activities. For example, some pictures or videos might be used to increase students' motivation to comprehend the learning materials. Puppets could be interlocutors that aid students in communication. However, such tools are limited in direct interaction and communication with learners. Humanoid robots could be programmed to "hear" and to "speak" to support teaching (Shih, Chang, & Chen, 2007) and to enhance users' enjoyment and engagement (Xie, Antle, & Motamedi, 2008). In addition, the communicative approach and task-based language teaching (TBLT) approach have become popular for teaching English in modern Asian countries (Kam, 2004; Nunan, 2003). These approaches focus on guiding learners to communicate and usually ask students to do meaningful tasks using the target language, for example, visiting the doctor or calling customer service for help. Littlewood (2003) summarizes some concerns in implementing TBLT in East Asian classrooms, including classroom management (Morris et al., 1996), avoidance of English (Li, 2003; Carless, 2004), and minimal demands on language competence (Carless, 2004; Lee, 2005). Using robots in task-based learning activities might reduce the problem of classroom management by playing the role of stimulator or

manager, both of which a teacher needed play before. On the other hand, robots might also reduce the problem of English avoidance. They could be designed as foreigners, and students would have to speak English to communicate with them (Kanda & Ishiguro, 2005).

Characteristics of robots

Our study analyzed robots with seven common characteristics that might support instruction. Based on these characteristics, five scenarios were design to facilitate language teaching. Our goal was to understand the relation between robots and language teaching and then to provide suggestions for further research. The seven analyzed characteristics of robots are as follows:

Repeatability

Robots perform easy, repetitious actions without complaining. This attribute helps not only teachers who reuse learning content but also children who need oral practice. An elementary school teacher usually uses the same teaching content in multiple classes across many semesters. Repeated practice greatly benefits students' comprehension and familiarity with a language. It is not easy to find a partner with whom to continually practice conversation, especially for children who are still developing socially. Consequently, robots with this feature are well suited to assist with language learning.

Flexibility

Robot flexibility allows teachers to adjust and design appropriate robot-supported instructional activities for relevant teaching and learning requirements. Learners are no longer limited by the learning content designed by the manufacturer, and teachers are similarly not limited to certain instructional material. Moreover, extending the concept of flexibility, it may be possible in the future for students and teachers to select the instructional activities and content collaboratively with the robots. This opportunity might engage children to participate in the development of their own language courses and thereby reduce the distance between teachers and students.

Digitization

Robots are digital. Hence, using robots as instructional tools leverages the sharable and preservable characteristics of digital data. As an extension of this attribute, a robot-supported language instruction database, can be developed to record teachers' experiences. This would not only help instructors to instruct more effectively but also assist developers in designing more functional robots for language teaching. Moreover, a robot can communicate with computers through a wireless channel such as Bluetooth or Wi-Fi. This enables a robot to interact with students via the support of software and materials in computers.

Humanoid appearance

Robots arouse curiosity and fantasy, and robots that look like people are more engaging. Irrespective of the subject, motivation plays an important role in learning performance. Language learning involves skill training that focuses on usage more than comprehension, in contrast to scientific instruction that focuses primarily on comprehension. A humanoid robot might increase students' motivation to practise language skills in a more natural way than a radio.

Body movement

Movements are an important attribute in language expression. Robots with gestures not only increase motivation but guide children by using appropriate gestures while speaking. In foreign language learning, this feature can even help students understand unknown words spoken by the robot. Although teachers can also gesticulate, certain comical or exaggerated motions may be difficult to perform.

Interaction

One fundamental function of robots is their ability to interact with people. This feature allows robots to become teaching assistants and supports more realistic language expression. Dialogue practice is important in language classes. Often one teacher plays both roles or chooses a student to play one role in a conversation practice scenario. Robots could also participate in such settings. In addition, through voice recognition technology, robots can offer appropriate responses when interacting with people (House, Malkin, & Bilmes, 2009). This feature allows robots to participate in conversation practice. In addition, by analyzing interaction records, instructors can access the learning status of students in more detail.

Anthropomorphism

Children treat robots that have human-like appearance and body movement as real speakers and listeners, in direct contrast to other instructional media. But they also know that a robot is not a real person. Therefore, students do not worry that they will be despised or scoffed at for odd pronunciations or incorrect syntax during conversation. This may reduce students' anxiety and improve their willingness to participate in dialogue exercises, especially in foreign languages.

We analyzed the characteristics of robots and attempted to describe the relationship between robots and instructional media. That led us to estimate the value of, and predict the direction of, scenarios in which robots may support second language teaching. The following figure describes the relationship between robot attributes and instructional tool goals.

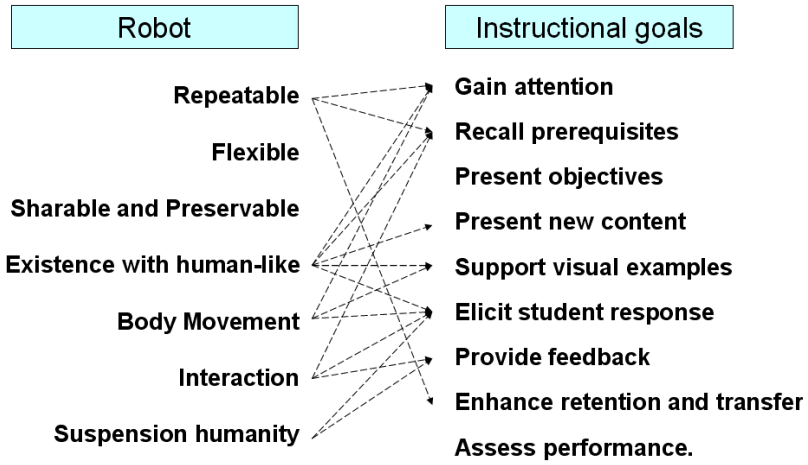

Figure 1. The relationship between robot attributes and instructional tool goals

Related work

We identified three categories of educational robot 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 to develop instructional kits that 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 increased motivation but also in improved skills in mathematics, science, programming, problem solving, and collaboration (Klassner & Anderson, 2003). In language learning, robots could also be designed as learning materials. Ito, Nguyen, and Sugimoto (2008) devised a

system named GENTORO that allowed children to create and express their story by using handheld projectors and mobile robots. Their research indicated that the robot could encourage students' motivation for learning and help them to present their achievement. However, there were few discussions about how to use robots to assist in teaching.

Learning companions/pets

Humanoid robots can naturally be regarded as learning companions. Kanda, Hirano, Eaton, and Ishiguro (2004) designed a robot named Robovie that behaved as an English peer tutor for Japanese students. In their field study, the robot did encourage some children to improve their English. In 2005, Kanda and Ishiguro explored more deeply designing an interactive robot to teach English and establish longitudinal relationships with children. By comparing the situation before and two weeks after the Robovies had been placed in a corridor, the researchers showed that children's recall of new words improved and that there was a positive correlation between frequency of interacting with the robot and learning performance. Their study was the first practical confirmation that students can learn from a humanoid robot. However, the design of Robovie was focused on interaction between the robot and children. Our study discusses extensively the complete language classroom, in which a robot would interact with both teachers and students.

Teaching assistant

Although those who use learning companions are mainly students, robots can also be used as teaching assistants. Their main function is to accompany and encourage students to learn. The key purpose of a teaching assistant is to help instructors to present materials. For example, Robot IROBI (Jeonghye, Dongho, KyungSeon, SungJu, & KyungChul, 2005) has been used as an assistant in a classroom. Information is displayed to students via a monitor in the belly of the IROBI. Moreover, the robot can move its arm to direct students to key points on the monitor. In 2008, guidelines were proposed for designing appropriate body features for a teaching assistant robot to provide more effective interaction (Ryu, Kwak, & Kim, 2008).

These studies indicate the potential for using robots to support education and suggest a variety of educational robot roles. Many studies focus on using robots to assist students in learning science or mathematics. However, few researchers have studied the use of robots to support language teaching, although Kanda et al. have begun a preliminary study of robots in language classes. It is necessary to more broadly and comprehensively discuss the use of robots as instructional tools to support language teaching and learning. The goal of this paper is to explore this new research direction to understand humanoid robots as an instructional tool for teaching a second language in primary school. In the following section, we introduce five empirical scenarios for the use of robots in language courses.

Five scenarios

Our study deployed a robot partner for classroom teachers in order to assess the effects of robots on learning and to explore the optimal use of robots for promoting language teaching. After conferring with various elementary school language teachers, we collaboratively designed five robot modes consistent with the condition of classroom and the characteristics of our robot. These included a storytelling mode, an oral reading mode, a cheerleader mode, an action command mode, and a question-and-answer mode. The following figures (Figures 2 & 3) show the teacher and the robot teaching collaboratively in a language classroom.

Storytelling mode

Telling a story is an effective way to stimulate students to learn a language (Garvie, 1990). The robot can present stories in male or female voices, a capability that can allow for excellent role-play. It is usually not easy for teachers to imitate various voices. When the robot plays a story, it can perform comic actions or provide sound effects for increased engagement.

Oral reading mode

According to the audiolingual method (Brown, 2000; Castagnaro, 2006), if students exercise their verbal ability and pronunciation by reading and memorizing constantly, they will speak more fluently. We designed an oral reading mode in which the robot could lead students to recite vocabulary and sentences. The robot could change its speed of speaking, and students would subsequently imitate that speed. The male/female voice transitions allowed students to practice speaking in the roles of different characters. When robots led the reading class, the teacher was able to concentrate on students' pronunciation and intonation.

Figure 2. Teacher telling a story with a robot

Figure 3. Students giving the robot commands

Cheerleader mode

Children engage in a learning activity enthusiastically if they are encouraged. At this time in their lives, students concentrate and have great learning experiences (Csikszentmihalyi, 1990). In the classroom, teachers traditionally lead certain games in which students are divided into groups or play individually. The games may include Q & A, picking out the right words or pictures, or talking about body movements. In competitive games, a teacher must not only to play the role of a fair judge but also be a coach who encourages the students and gives them advice. It is hard to play both roles simultaneously. In this context, the robot can share the teacher's job and encourage students to participate in the games. When the team or an individual wins the game, the robot will dance and shout for joy.

Cheerful activity at the right moment not only encourages students to participate in the learning activities but also makes them more expressive.

Action command mode

According to the total physical response method (Asher, 1982), children acquire comprehension ability by responding to commands given by their parents before they can speak. After understanding the meanings of words, they begin to speak naturally. In the command mode, the robot asks students to perform a certain task, such as putting their hands up, turning around, going somewhere, etcetera. Students can ask the robot to do the same things. In this mode, the robot automatically obeys the children's instructions. The feeling of respect might encourage students to practise their speaking skills more readily.

Question-and-answer mode

Communicative language teaching (Higgs & Clifford, 1982; Finocchiaro & Brumfit, 1983) is based on the premise that language education is designed to instruct students to develop their communicative competence, which requires students to use language to communicate, comment, and talk about their feelings. We designed the question-and-answer mode to address these needs. The robot can chat with an individual child, and the child is invited to introduce him- or herself to the robot. This is helpful for learning a foreign language because we can present the robot as a foreigner with whom students need to talk. This may encourage students to use the foreign language to communicate.

Methodology

The five scenarios were tested in an elementary school for five weeks. Every week we practised a different scenario. In three fifth-grade language classes, three teachers and one hundred children experienced teaching and learning with a robot. We collaborated with teachers in creating lesson plans in advance.

Before class

We made a rudimentary survey of the instructional methods, activities, subjects, and teaching tools in the classroom. Besides desks and chairs, there was a PC, a projector, and a CD player. We placed the teacher's microphone close to the lectern at a location convenient for the robot. Before class, the teaching assistant controlling the robot discussed the activities and planned the lesson with the teacher. The assistant also entered robot phrases into the computer. To avoid subsequent mistakes, the teacher, teaching assistant, and robot all rehearsed the lesson.

During class

In the storytelling mode, the teachers would say "Now, let Sapien tell us a story," and the robot would begin to tell a story with certain gestures. It would pause after every paragraph of the story, so that the instructors could explain the story or ask children questions. In oral reading mode, teachers allowed the robot to encourage the children to read certain vocabulary and sentences. While reciting, the robot could change speed or intonation to simulate different voices for the children to imitate. The cheerleader mode was embedded in certain competitive activities in the language class, such as answering the teacher's questions, picking the right word card or picture, or adopting the correct pose. For such activities, the robot would reward correct answers or winning teams with a dance. The action command mode was divided into two stages. First, students were commanded by the robot. The robot performed certain motions and asked students to follow suit. Second, the robot would choose one student and ask him to tell the robot to do something. In the question-and-answer mode, the robot also randomly chose a student and asked him or her a quiz question. If the student gave the correct answer, the robot would respond with an exclamation of joy. If the student did not know the answer, the robot would ask other students to give him or her hints.

Discussion

The following describes the teachers' opinions and the students' reactions separately. After our initial discussions with the teachers, we discovered three teacher concerns. First, compared to other tools, robots are expensive and complex. Instructors worry that children will destroy or damage the hardware. Second, instructional tools must correspond to learning content. Without the appropriate learning content and instructional activities, robots themselves are of no advantage in supporting teaching. Third, certain language teachers, especially those who teach liberal arts, are skeptical of such advanced technologies and are reluctant to use them. They feel that it is too complicated and difficult to manipulate robots for teaching. Although teachers are concerned about the cost, appropriate learning content, and complexity, they also have high expectations for the use of robots in teaching. At the end of our experiment, we interviewed the teachers again and asked about their feeling with respect to the five scenarios. One teacher said "it is difficult to tell a story and play the different roles in the story at the same time. The robot helped me." The robot could readily change intonation to play different roles in the story. This feature was also an advantage in the oral reading mode. A teacher stated "with different tones and reading speeds, we could engage students' attention." Commenting on the cheerleader mode, a fifth-grade language teacher said "the result was great! It is very interesting to see the robot dance. All the children hope to win, so that they can see the robot dance for them.…" The action command mode was the first example of children giving orders to an instructional tool. One teacher indicated that "through the action command mode, the robot can encourage children to practise language skills naturally." In the question-and-answer mode, as a result of the anthropomorphic characteristics of the robot, special benefit was seen by low-achieving students. The teacher said, "to talk to the robot seems easier for my weaker students. I think this is because the robot is neither a human nor a teacher. That may reduce students' anxiety."

Moreover, teachers also mentioned four points that may improve the performance of robots in language courses. The first is the detail of robot movements. One teacher said, "…the robot exhibited insufficiently fine-grain movements, and I was disappointed that the robot often spoke without moving." In our experiment, the robots sometimes exhibited random movements, but were often still. However, although students were more excited when they saw unexpected movement, the teaching process was more fluid when the robot acted predictably. A second concern was the distraction that resulted from the assistant being in the classroom to control the robot. The teacher said "my teaching assistant would distract the students. I would have preferred for him to be as far away from my classroom as possible." The third suggestion concerns voice variety. One teacher indicated that "it would be better if the robot could play different roles by using different voices. I think it would be interesting if the robot were able to speak like our president." Different voices, such as an elderly man, a young child, or a celebrity, might stimulate children to listen and speak more. The fourth is insufficient emotion. The teacher said "the robot is a very good tool that supports my teaching. But it is so cold. It cannot interact emotionally like humans do." Robots can communicate and transmit knowledge. However, they have difficulty expressing emotions that are necessary for language learning, especially in the context of storytelling or drama scenarios. In summary, teachers responded positively to the use of the robot in language courses, and were interested in participating in our follow-up experiment.

We assessed students' practical experience using video recordings and found that the students exhibited different behaviors during instructional activities that involved the robot.

1. Students responded loudly. For example, after the robot had introduced itself, the teacher asked the students if they liked it, and the students answered "yes" immediately without further prompting. Then, when the teacher asked the students to say good morning to Sapien, all of the class greeted Sapien loudly and in unison.
2. Students raised their hands and spoke more often. Extroverted students would speak frequently, but shy students spoke less often. However, we found that some of the shy children began to answer teacher's questions by raising their hands in our experiment, even though they often hoped the teacher would not see them.
3. Students asked questions. Students were eager to understand what the robot could do. The robot might encourage students to pay more attention in the classroom.
4. Students laughed and shouted. Students laughed primarily in response to the robot being silly. The class was animated and all students participated enthusiastically.
5. Students stood up, were thoughtful during the lesson, and listened quietly. Upon seeing the robot, the students stood up to see what it did. When the robot presented teaching activities, the students didn't make any noise. They were also very interested in observing the interactions between the teacher and the robot. The students demonstrated positive and engaging reactions.

6. Students discussed the robot with excitement. From beginning to end, the children were interested in the robot and they discussed many details such as its age, voice, actions, reactions, the real identity of the robot, whether there was someone controlling it, whether the robot could see the students, etcetera. Their behavior indicated that the robot encouraged concentration and participation in the classroom.

Based on the experience, including the situations in the classroom and the teachers' interview, we conclude that robots can offer two new possibilities in language teaching and may improve current instructional tools in four respects. The first new possibility is that the robot can serve as an interactive interlocutor for teachers and pupils. With a robot, teachers presented dialogue in a more natural way, and students were able to practise their listening comprehension and oral skills repeatedly. Another new possibility is that teachers and students can design their own teaching materials that subsequently get performed by the robot. Teachers can adjust the difficulty depending on the students' level. Students can present what they learned by asking the robot to make a speech. Moreover, there are four more global benefits. (1) The humanoid robot can perform rich gestures. Non-verbal signals are an important part of communication. (2) The robot can change intonation or speed of speaking to present material. (3) The human appearance of a robot attracted attention, even from weaker students. This may motivate them to participate more in the language class. (4) Robots' ability to interact and recognize students' commands could offer students a more natural way to perform language drills than can other media.

Finally, we note that there exist significant challenges and limitations to the development of language educational robots. First, the price of each robot is still a problem. It costs too much to deploy a robot for every teacher. However, these costs are acceptable for researchers who need to perform qualitative and quantitative experiments. For example, the robot in this study was adapted from the commercial robot toy, Robosapien, which costs 250 USD. According to Moore's law, the development of technology will result in lower robot prices over time. Second, "robot" is a term more often associated with movie theaters than with language educators. It is a challenge to design human-robot interfaces that teachers can easily use. Insufficient teacher training and guidance may cause the robot to become nothing more than a distracting toy in the classroom. Hence, teacher preparation and design of human-robot interface that maximizes a teacher's ability to convey learning content are challenges that require further work. Third, robot technologies are currently inadequate. Although we have tested robot performance in elementary school language courses, successful implementation requires the integration of several complex technologies, such as voice recognition, speech synthesis, image identification, wireless control, machine learning, etcetera. Many of these technologies are still in research labs and are not ready for commercial environments. For example, until recently, it was difficult for robots to recognize voices in a noisy environment. Fourth, it is challenging to maintain high student motivation following the initial introduction of the robot. Kanda & Ishiguro (2005) have shown that children's motivation rises quickly and significantly when there is a robot in the classroom. They have also pointed out that this stimulation is rarely maintained. Future research should examine ways to extend the duration of motivation.

Conclusion

As robot technologies develop, the use of robots to support teaching and learning has gained popularity. Over the past decade, researchers have provided substantial evidence that the robot is a great teaching aid for mathematics and science. Furthermore, educational robots are helpful to students in developing collaboration and problem solving abilities. This paper reviewed prior research concerning robots in education and instructional media and discussed the potential for using robots as an instructional tool for teaching language by analyzing the characteristics of robots and by documenting our empirical experience. Currently, the roles of educational robots can be described in terms of three categories: learning materials, learning companions (pets), and teaching assistants. We also believe that there will be additional robot educational roles in the future, for example, using robots as communication mediators to support group learning.

We analyzed the characteristics of robots, including repeatability, flexibility, digital data representation, humanoid appearance, body movement, interaction, and anthropomorphism. These characteristics suggest that robots have the potential to be useful in language teaching. Five scenarios in this study also highlighted the effectiveness of supporting a teacher with a robot in an elementary language course. Students responded with high motivation levels. They practised listening and speaking by interacting with the robot. The robot also exhibited gestures and body movements in the conversation so that it could partner with the teacher to tell stories. In our result, the children's reactions and the teachers' opinions indicated that robots could create an interactive and engaging learning

experience. Instructors had more time to guide weaker students when the robot was the main focus of attention. The important factors that influence whether the robot is likely to be useful in language instruction include usability and the availability of appropriate learning activities and content. Compared to other instructional tools for teaching languages, robots have the advantages of being able to demonstrate highly mobile behaviors and extensive repetition. However, based on current technologies, there are many challenges and limitations to the expanded use of language instructional robots. Problems include lack of adequate teacher training, complicated technologies, decaying motivation, and the inability of robots to adequately portray emotion.

The fact that students usually do not need the second language in everyday life is a problem in teaching a second language. For example, even in the TBLT approach, students could complete tasks through minimal use of the second language. Over the long term, we expect to develop an authentic learning environment (Herrington & Kervin, 2007; Herrington & Oliver, 2000) with robots that can easily fit the learning materials and communicate with students. Robots may also play the role of foreigner in the classroom. That might lead learners more easily and more naturally to engage in learning activities with high motivation. In the future, we will explore more deeply the relationship between robots and performance in language learning.

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