Innovation in Using Humanoid Robot for Immigrants' Well-being

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Abstract. In this paper, we present an exploratory study on using a social robot in a conversational setting to practice a second language, the use of AI (artificial intelligence) applications in second language learning, social adaptation and rights protection of migrant workers in Taiwan. This research mainly focuses on how to use humanoid robots to help immigrants learn languages, promote interpersonal communication, and seek immigrants' well-being. Immigrants' language learning is different from ordinary language learners, because immigrants need to learn the local language and integrate into the society. In addition, immigrants usually have jobs and cannot take language courses in regular classroom settings like ordinary language learners. Moreover, this article uses the impact of the pandemic as a starting point to explore the innovative models of humanoid robots in immigrant language learning and the possibility of seeking well-being for immigrants. This article focuses on the new immigrants of Taiwan, most of whom are Southeast Asians, and Indonesian are the largest population. The present project focuses on how a robot can adapt to immigrants to provide an engaging tutoring interaction that supports learning a second language.

Keywords: Computer-assisted language teaching; robot tutor; humanoid robot

1 Introduction

As of July 2021, nearly 780,000 foreigners were residing in Taiwan with valid residence permits, of which more than 620,000 were foreign migrant workers, and the maximum number of social welfare migrant workers was approximately 192,000. Due to the impact of the epidemic, the learning motivation of learners is low, which has a great direct impact on higher education, especially in global industries that have caused population mobility. Therefore, this study is a combination of business lectures, from the perspective of talent cultivation, providing and designing business consulting in Chinese and also for language learning using humanoid robot application with innovative and interactive learning mode.

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2 Migrant workers in Taiwan

Along with the social reality of Taiwan facing a declining rate of births and an increase in the number of adults, both in the industrial and social welfare sectors, Taiwan's need for foreign workers continues to show an increase. Since 1989, after making policies related to the use of foreign workers, the government has begun to invite their foreign workers from various countries including several countries from Southeast Asia. Based on government statistical data, the presence of foreign workers in Taiwan has been going on for more than 30 years until now. The data in March 2020 was recorded that it had reached seven hundred and ten thousand foreign workers, with the highest number of foreign workers coming from Indonesia (38.90%), Vietnam (30.82%), Philippines (22.08%), and Thailand (8.2%). For these Southeast Asia countries, Taiwan is a very desirable country and also one of the best choices for them to work in.

2.1 Indonesian Migrant Workers

Although the Ministry of Labor counts the largest number of migrant workers in Taiwan and Indonesia, most Indonesian migrant workers are engaged in the social welfare industry. Therefore, compared with other Southeast Asian countries, the number of Indonesian workers in social welfare is dominant, and the industrial category is still the majority of Vietnamese workers. According to the Ministry of Labor, social welfare work includes domestic helper, institutional nursing work, home nursing work and outreach nursing work. The reason why Taiwanese choose Indonesian migrant workers to do the social welfare industry is because migrant workers from Indonesia are more willing to learn Chinese than migrant workers from other countries. In particular, social welfare workers need to communicate with patients or employers, so they hope that the workers themselves have basic Chinese skills. After the Indonesian migrant workers are selected from the local agency, they need to stay in the training center for a period of time for work and language training. However, in recent years, Taiwan’s demand for Indonesian workers, especially in households, has been increasing. This increasing number of requests is not balanced with the sufficient quality of language by Indonesian workers. This increased number made their training hours shortened from three months to two or even one month. The increase in numbers does not provide sufficient language training for Indonesian workers. That is one of the reasons why so many migrant workers who have arrived in Taiwan still have language barriers in life or communication. Before the outbreak of the epidemic, the Taiwan Labor Bureau and local government units continued to offer classes and language training for migrant workers. However, due to the epidemic, all courses need some adjustments. This also became an issue for the Labor Bureau and local governments to consider how to maintain their Chinese training during the epidemic, while also maintaining the effectiveness of language learning. Using a robotic tutor also could be a good option to reach these goals.

a) 5G and Artificial Intelligence (AI)

In 2020, under the GPT (Generative Pre-trained Transformer) system, Open-AI developed a pre-trained model GPT-3 with a parameter amount of 175 billion, which has become the strongest general language model in the NLP field. Q&A, text filling and other application tasks have shown the ability to be close to humans. Even though robotic teachers were originally used to teach science, technology, engineering, and mathematics (STEM) in

schools, they are now also programmed to teach languages or assist in language teaching (Belpaeme et al., 2018; Scassellati et al., 2018). However, humanoid robots are unlikely to replace the work of human teachers in the next few years. Human teachers and humanoid robots will work together to provide students with additional opportunities and personalized education. Although some people think that robots are expensive and have limitations, the researcher who reviewed the use of robots for second language acquisition showed that the effect of using robots is at least equivalent to that of other virtual agents [9]. In some studies, robots perform even better, such as: It can make learners feel interesting, happy, more focused, and more interpersonal. Especially when the robot addresses the user's name through the recognition system. Robots are also conducive to task-based language learning.

b) The Role of Future Language Teachers

The use of humanoid robots in education will therefore change the role of teachers. Teachers will no longer focus on common repetitive tasks but strengthen their roles as leaders, overall organizers, interpreters, and final evaluators. Not only to be used as one of the feasible solutions to the shortage of teachers, but it can also reflect the learner-centered learning model: humanoid robots can determine the personal preferences, motivations, and difficulties of each student, so as to match the student's learning speed and adapt to their demand.

2.2 Humanoid robot

Computer assisted language learning (CALL) becomes more realistic and motivating for learners through the introduction of humanoid robots. A robot assisted language learning (RALL) system is expected to provide an immersive environment for a second language (L2) learner to prepare for real face-to-face communication. There are some characteristics of why we consider using the humanoid robot as an ideal tool to enhance students' learning. First, when using the technology of the robot, we can gather everyone's knowledge for better teaching instruction (meanwhile individual teachers have limited knowledge). Second, we can update the knowledge in real-time (where the traditional teacher takes time for training). Third, a robot does not have physical limitations. The robot can not feel tired, but it requires charging, artificial intelligence infrastructure, and a good network environment. Fourth, humanoid robot interaction can activate the social areas of the brain [4]. But there is also a hypothesis that needs to be verified that robots are more useful as teaching aids than computers or other teaching tools because they can imitate human responses. Besides it, using the humanoid robot is applicable for teaching both for children and for adults. For children, they feel that learning with robots makes the learning activity more fun. And for adults, the humanoid robot also can help them to practice for their second language learning.

2.3 The Role of Robots and Teaching Content

From the previous work using the robot, we collect some related studies where they can prove the robots are capable of taking the role of a teacher. In this part, we can see the details of how they maximize the robot function to achieve some educational goals. The role and teaching content conducted as follows:

1. As a tutor for vocabulary teaching (Kose, Akalin, & Uluer, 2014; Wedenborn, 2015; Schodde, Bergmann, & Kopp, 2017);
2. Grammar teaching [5] (Ishida, Khalifa, Kato, & Yamamoto, 2016);

3. Language skills or conversation practice [5][9] (Lin, Lin, & Shen, 2019);
4. As a teaching assistant, assist real teachers with mechanical tasks in the classroom (Shen, Tsai, Wei, Lin, & Lin, 2019);
5. As a learning partner (Ishida et al., 2016; Khalifa et al., 2016; Khalifa et al., 2017);
6. As a host in a language exchange meeting or language café.

a) Humanoid robot application experiment

In this work, we use the type of Japanese robot to conduct the experiment by using the Mobile Robotic Phone (RoBoHon). We consider using this type since it has a lot of functions and the characteristics that we need for the humanoid robot for language teaching. RoBoHon itself can be operated by voice commands in three languages (Japanese, English, and Chinese). It also is equipped with basic functions such as speech output, speech recognition, sound output, and a mini projector. Differ from the usual type of robot, RoBoHon was created in a portable size that is convenient for the user to conduct a variety of experiments.

b) Listening training experiment

In this section we conduct various experiments by designing various exercises to help students practice their Chinese learning through listening exercises, and the forms of exercises provided are also quite diverse and adapted to the level of students in order to help them to increase the effect of the learning that takes place. Most of the previous studies use the robot to be a learner partner, but this time we set the robot as the main instructor that will lead the practice from beginning to end.

2.4 Vocabulary Exercise - "Guess What I'm Doing"

In this experiment, we use the function of body movements that have been designed and built inside the robot to perform some demonstrations related to a group of words according to the material being taught. For example, we combine material about types of activities or sports, and the robot can demonstrate various movements to help students enrich or review the vocabulary by guessing the robot movement as showed in 'Figure 1'.

Fig. 1. RoBoHon while playing soccer

2.5 Pronunciation Teaching

The technology of robot assisted language is not only able to help students to overcome the vocabulary exercise, however it also can help students to correct their pronunciation. As the practice that we design for Indonesian students, 'Figure 2' showed us how the student made the drill with RoBoHon. In this lesson, it required the student to listen and speak to respond. With the participant in 'Figure 2', we found out that she has the problem and difficulty in Chinese pronunciation. It is proven by the robot when she had difficulties distinguishing the aspirated and unaspirated sound. While on 'Figure 3', we tested the accuracy of the robot recognition voice. The subject pronounces voiceless unaspirated g[k] in the word "gēge" as voiced sound, but the robot still recognizes it as the word "gēge", and it comes different for other words such as "kèběn", "kělè", when the subject pronounced the voiceless aspirated sound k[k'] as unaspirated, the robot can correctly identify the error. Based on this experiment, we found out that there are still limitations of robots in speech recognition.

Fig. 2. Indonesian student with beginner level who is practicing her aspirated & unaspirated sound.

Fig. 3. Subjects were testing the accuracy of robot recognition voice.

2.6 Chinese Idioms Teaching

In the exercise here, the robot demonstrates how it can also help students with intermediate to upper levels of Chinese who want to learn the Chinese idiom 井底之蛙 *(Jǐngdǐzhīwā)*. In this section, the robot uses Japanese language for explanations according to the participant native language. This robot helps her by telling the story of origins with “human-like” movements as a person who is explaining, in order to help the students to understand the language context of the idiom.

Fig. 4. Robot using storytelling to help student to understand the context of Chinese Idiom

2.7 Recognize the Chinese Character Recognition

This part demonstrates how robots can also help students to practice or review lessons on Chinese characters, by giving them a "True" or "False" question, where they need to choose one of the right answers by listening to the sound that will be pronounced by the robot. To make it more convenient to answer, they need to answer the question by pressing the keyboard keys provided according to the directions given.

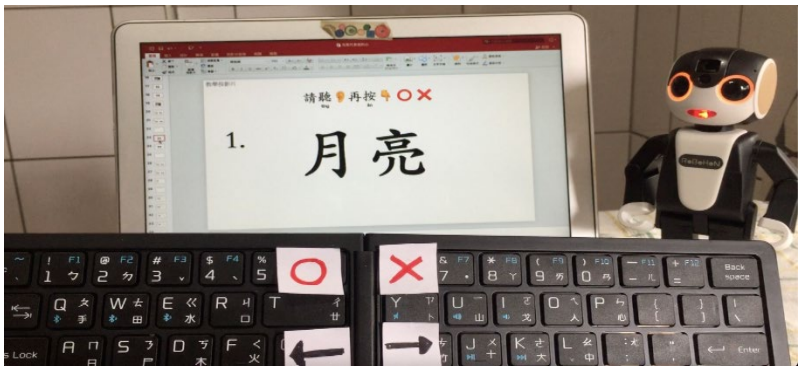

Fig. 5. Screen display and keyboard (as a tool) for student to answer

2.8 Learn Chinese By Singing Chinese Song

In this experiment, the design of the material used is to combine the material "Learning Mandarin with songs" and the robot, by playing the song to be studied and asking students what they think about the song. This exercise is suitable for students with an intermediate level and above.

Fig. 6. The textbook that we use for learning Mandarin with Chinese songs.

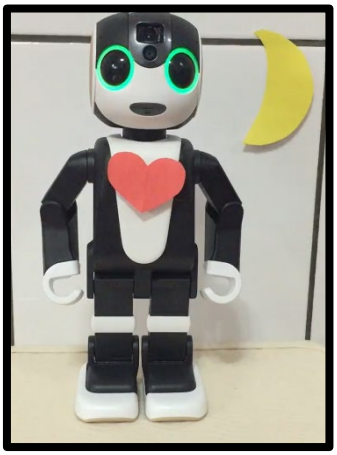

Fig. 7. Robot that interact with student by learning Chinese classic song “The Moon Represents My Heart

3 Multilingual Interactive Robot Language Teaching Application: Explore the humanoid robot interaction mode of robot-assisted language teaching”

Tuna A and Tuna G [11] believed, somehow, the robot also needed to have multiple languages even though they know that English is being used widely for social interaction. With the type of robots like NAO, they can also be programmed to have multilingual interaction skills. It will be helpful to create a real-life conversation in foreign language.

Sometimes the students still need their native language to help them for a better understanding of the target language. Humanoid robots can also be useful in the school with the student who has a special background such as an immigrant who can't be sure with language and the culture where they moved in. In this case, a multilingual robot is a suitable tool for a teaching assistant to cover their native language while the teacher only can say one or two languages in the class.

3.1 Robot Interaction Feedback - Learners' Feedback

To allow for adaptation and personalization in the course of tutoring, it is of great importance to record the interaction processes, and the learner's feedback, including: (1) Tracing the learner's knowledge state regarding their Chinese proficiency level; (2) Tracing the learner's affective state regarding the engagement in the interaction; (3) Collecting information about the factors which may cause the human-robot interaction succeed or fail. Three participants were interviewed after their interaction with the humanoid robot. We got some feedback from the participants about what they are feeling when they interact with the robot since they never had this experience before. We test them with the same exercise but they are divided based on their Chinese level. We had beginners (TOCFL Level A1), pre-intermediate (TOCFL Level B1), and intermediate students (TOCFL Level B2) that were involved in this experiment. Based on their level background, we got different feedback and results from these participants.

In this practice, even though RoBoHon can speak Chinese, we try to add Bahasa Indonesia as an additional output sound to help the student get easier to understand the instruction. For the beginner student, she thinks that it's a good supplement that helps her to understand how to do the exercise. She knows when to listen and when she needs to answer. Using a keyboard as a tool to answer is also a good option to make it easier to answer. But we have different feedback with the pre-intermediate and intermediate participants. It is enough to use the target language as an instruction language, and no need to add more native language since the instruction part is easy for them to understand. As the purpose of this study that we set before, we hope the robot can help the student to be able to differentiate the aspirated and unaspirated sound since many Indonesian students had this problem in pronunciation. For the beginner student, when she has an incorrect pronunciation in Chinese, she feels pressured when the robots are trying to correct her pronunciation. While the intermediate student feels that it will be better if the robot is set to be more like a teacher who gives her a compliment when the answer is right or courageous sentences to let her try again rather than to say "You're wrong!" or "Wrong answer". She thinks how the response of the robot also could affect her feeling and motivation to continue the exercise or not.

Furthermore, the robot also had a response time problem when the students could not get a quick response. Sometimes they need to wait for a few seconds waiting for the robot to give them a response [7], and sometimes they need to repeat or try to answer louder just in case the robot can't recognize their voice if the volume is too low. Also due to network instability or artificial intelligence recognizing problems, sometimes the participant may not interact smoothly or the robot or could not identify errors. After a few times experiment they found out sometimes ever her pronounce was right, but the recognition result of the robot was different with what her pronounce. This voice recognition problem also happened with NAO (another type of humanoid robot), when the robot can't recognize the students voice and they are afraid that this problem can affect the student who has lower confidence or has lower self-esteem where they need to speak loudly[1]. Even though they have different responses about their

interaction with the robot, as long as the response time of the robot could be faster, all of them surely agree that RoBoHon can help them to practice and to correct their pronunciation problem. They also agree that using a robot to help to practice is a very fresh, new, and interesting way for them, while this is the first experience for them to have direct interaction with the robot. In addition, RoBoHon has been set with some gestures, where the robot can do some movement or dancing, and this function makes students more interested with this humanoid robot. This activity makes them feel that the robots are more attractive, like they are really being interacted with a partner and not only just a machine. To conclude what we got from their feedback, we give some suggestion for the future work:

1. Instructional with the native language of the participant is good for the beginner student, but it will not be suitable with intermediate level and up.
2. Based on the student level background, we need to adjust the speed speech of the robot.
3. It will be better if the robot can respond at normal speed, it will depend on what type of robot that we use since this is a technological problem that still needs further development.
4. Make sure all of the equipment (such as the screen, keyboard, speaker, etc.) and the availability of internet connection, since it could affect the experiment process.

3.2 Sharing The Hardships and Difficulties of New Migrants' Work In Starting Business

Taiwan is a welcoming place for those who want to travel, study, work, or even stay. We can see this evidence by the number of new migrants in Taiwan that have reached 197.552 people as of September 2021. According to this number, most of them still can not fluently speak Chinese, which leads to a very minimum chance for them to be accepted in a general place for working. Responding to this issue, the local government keeps trying to improve the social situation to create more opportunities for them to have more chances and be accepted as a part of the society. We also did an interview before, with one of the new migrants from Kamboja that came to Taiwan 8 years ago. She confessed, even though she can speak Chinese fluently, she has three children to raise with her husband, so she decides to do her own business to get more money to fulfill her family's needs by doing her own business. In particular, the immigrants need to learn the local language and integrate into the society. With a robotic tutor we believe it can be a good solution to the new migrant who wants to improve their second language according to their needs, since the robot does not have differential treatment or other inappropriate behaviors due to race, religion, nationality, and cultural background.

3.3 Business Consultation for New Migrants in Taiwan

When someone is in a foreign country, it is not easy for them to get a job, especially for the new migrants in Taiwan. Generally, not all of them can easily get a proper job for them to build their career. That's the reason why most of them are trying to make money by doing their own business. While someone meets this situation, they usually will look for someone who can help and give them some advice who understands more about how to run their business. In this section, we were trying to use the robot to help them provide consulting services to the new migrants who want to consult with a specific topic, such as a topic of business. In this chance, the robot takes the whole part to become a consulting service in direct interaction with the consumers who want to know how to sell products on the internet. In addition to

understanding what consumers need, robots also help consumers in providing options or business advice according to market conditions based on information that is available at that time.

Fig. 8. The robot takes the role of consulting business

3.4 Business Chinese Learning

For a better understanding in business, the new migrants also need to have good communication in Chinese. With the same purpose that we mentioned before, we want to help the new migrant, not only to understand how to run a business but also to master some of the Chinese terms in related fields. According to the previous study[1], they have evidence where they found out that robots could be a promising tool for language learning especially in studying vocabulary. The participants mostly like to practice and they think that using robots really facilitates them to learn new words. Through this study, we also try to design the vocabulary test to help the new migrant to have enough knowledge about related terms or words that didn't used in the general topic. Based on the project that we have, we introduce them to a more specific business topic about "cross-border e-commerce", and the exercises are given with multiple-choice questions. We give them a quiz to make sure whether they know or not about the business terms. Even if the answers given by the answerer are right or wrong, the robot will explain the meanings of all of these terms, to help them understand the related words in the business world.

3.5 Humanoid robot training for prospective Chinese teachers

For using a humanoid robot, especially in teaching Chinese, we still need more studies and experiments to keep developing and maximize the function of the robot in order to get better results. But in the future, the involvement and presence of humanoid robots in the teaching and learning process is expected to:

1. Help students improve their creativity, build and strengthen their cognitive development;
2. Help students become active problem solvers and engage them in their own learning;
3. Promote knowledge transfer through activity-based projects;
4. Apply scientific thinking through inquiry activities;
5. Emphasize meaningful problem-based learning through the integration and application of knowledge;
6. Cultivate the ability to think about problems, focusing on logical reasoning, analytical reasoning and critical thinking;

7. Research on interactive language selection, robot command and feedback mood.

4 Conclusion

Through this paper, we hope to encourage Chinese teachers to explore how to use robots to guide second language teaching. Since language learning relies on language-based, social and cultural learning centered on teacher-student interaction and repeated practice, robots are expected to become an educational tool that supports second language learning. Here are three guiding principles for the development of second language teaching robots. The first is to attach importance to the research and development of artificial intelligence infrastructure. The second is to attach importance to the interaction process between second language learners and robots. The ideal goal should be enjoyable, challenging and well-founded in the design of teaching and acquisition activities (which can help second language acquisition: learning motivation and learning effectiveness) to ensure that second language learners can obtain optimized learning. The third is how to effectively evaluate the effectiveness of learning through robots. The basic construction of artificial intelligence required in the research of Chinese second language teaching robots includes: robots must have perceptual capabilities, capable of text recognition, speech recognition, object recognition, natural language processing mechanisms and machine translation, and anthropomorphic interaction.

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