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Current Insights on Using Social Robots to Support Second Language (L2) International Students in Higher Education

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Abstract

New digital technologies such as social robots are embodied computers with human-like features and conversational capabilities that can socially interact with people. Social robots have been used in education as a learning tool to support second language learning. This essay discusses current research literature that has explored how social robots could be utilized to support second language (L2) international students studying at English-speaking universities. Insights into the potential application and limitations of using social robots to support L2 students outside their home countries to promote their social and academic well-being will also be discussed. Based on a synthesis of current and relevant research gathered from the literature, the affordances of using social robots for L2 students included learning L2 through human-robot interactions, enhanced motivation, and engagement in their learning environments. However, the limitations of the use of this technology included attitudes towards robot-assisted learning (e.g., unfamiliarity with learning with a social robot) and the novelty effect of social robots. Further research is needed to deepen our understanding of not only the role of social robots for supporting language learning, but also how they could aid L2 students in their successful transition to a foreign university, culture, and social context.

Keywords: higher education, international students, social robots, second language learning, student support

Introduction

Internationalisation of higher education (HE) contributes significantly to both human capital and economic growth worldwide. A total of 6.1 million international students worldwide received their higher education in a country other than their country of birth (OECD, 2021). The top five most common study destinations are the United States (US), the United Kingdom (UK), Australia, France, and Germany (UNESCO, 2016) and new HE providers have emerged, such as China, Russia, and Malaysia (Qureshi & Khawaja, 2021). The majority of international students worldwide have

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culturally and linguistically diverse backgrounds, with those from Asian countries representing the largest cohort (OECD, 2022). Traditionally, in English-speaking countries, English language entry requirements have been used to ensure second language (L2) students' language skills meet literacy standards in higher education via International English Language Testing Systems (IELTS) and the Test of English as a Foreign Language (TOEFL). Despite the fact that insufficient language proficiency is frequently cited and often debated, these tests are not an accurate measure for predicting how students will perform in their undergraduate/postgraduate studies (Arkoudis, 2018).

Although studying overseas provides a wide range of benefits for international students such as improving second language (L2) proficiency, enhancing intercultural awareness, and personal and academic growth (Park et al., 2022) the fuller implications of these students' growth are still emerging and are much debated. During their transitional period, many L2 students are known to encounter challenges such as "psychological stress (e.g., anxiety, depression, stress, feeling of worthlessness), homesickness, loneliness, cultural differences, social isolation, academic performance stress, racial discrimination, and language barriers" (Park et al., 2022, p. 404). Regardless of how proficient they are with the language, L2 students do need time to learn the new language (e.g., different accents, colloquialisms, discipline-specific language usage, etc.) and adapt to new learning environments (e.g., academic conventions, learning styles, etc.) (Park, 2021). Hence, L2 students may develop insufficient confidence in using L2 and a fear of judgement due to stereotypes and discrimination (Kettle, 2013; Park, 2021). Universities need to go beyond simple directions about how to study in HE institutions in order to meet the diverse well-being and academic needs of students accordingly (Park, 2021).

In this 21st century, online digital technologies are integral to university teaching and learning, student support, engagement, and operation. The COVID-19 pandemic promoted HE institutions to re-envision the structure and delivery of online learning (both academic and non-academic activities) and its support services in order to improve the international student experience (Manzoor & Bart, 2021; Sumbogo et al., 2021). Social media (e.g., YouTube, Facebook, Twitter) is also known to play a significant role in L2 students' social and academic experience; for example, maintaining social networks and making them feel less stressed and isolated (Chen et al., 2022), and finding a place in the everyday practices of university life (Chen et al., 2022; Henderson et al., 2015). Alongside recordings of lectures, many students used a video-sharing website such as YouTube to find external video content to supplement their study needs (Henderson et al., 2015; Park, 2021). To become familiar with the localized English varieties (e.g., first language (L1) accent, slang and idiomatic expressions), L2 students also used YouTube as a platform to learn the language more authentically (Park, 2021).

The present article addresses the potential of new emerging technologies such as social robots in supporting L2 international students. More recently the proliferation of social robots, which are viewed as embodied computers that can communicate with people through human-like behaviours are becoming increasingly popular in education to assist students (Randall, 2019). Social robots are distinctive compared with other forms of technology (e.g., gamification and virtual reality) due to their verbal and nonverbal interactive behaviours (Ao & Yu, 2022; Neumann, 2020). Despite various definitions of social robots in detail, Ao and Yu (2022) highlighted different characteristics of social robots such as, they may have human-like physical features (e.g., arms, legs), resemble animals (e.g., pet-like), adapt themselves to social contexts, and interact and communicate positively with humans. Social robots are deemed distinctive as tutors, peers, and teaching assistants from other technologies due to their ability to verbally and non-verbally interact with humans through speech, facial expressions and gestures (e.g., pointing) (Ao & Yu, 2022; Engwall & Lopes, 2022). These tools have the potential to reduce learning anxiety, reinforce interpersonal interactions, and improve social engagement and classroom participation supporting students and teachers in HE (e.g., Ao & Yu, 2022; Donnermann et al., 2022; Iio et al., 2019; Kanero et al., 2022; Khalifa et al., 2019).

The main objective of this essay is to gain a deeper understanding of the potential role social robots play in supporting L2 university students' language learning (including attitudes, motivation, and engagement), social well-being and academic success. This paper is structured as follows: we first discuss how social robots have been found to support L2 university students' language learning and outcomes with social robots and student attitudes towards social robots. All

references to "L2 learners" in the next section refer to research study participants of a first language (L1) who learn L2 in contexts where the target language is not the official language and thus not spoken outside classroom. We then outline the possibilities of social robots as potential learning tools for L2 international students' social well-being and academic success.

Student Language Learning and Attitudes Towards Social Robots

Social robots may be humanoid or pet-like in appearance and can communicate via speech, gestures, and facial expressions (Neumann, 2020; Zinina et al., 2023). The friendly features of social robots allow people to perceive them as helpful, trustworthy, informative, and assistive agents (Zinina et al., 2023). Social robots are also adaptive in that they can be designed to flexibly use their sensors to detect students' motivational and educational needs and change their responses accordingly (Kanero et al., 2022). Social robots, according to Engwall and Lopes (2022), can be used in three different ways; for example, (a) as a teaching assistant with a human teacher as a "motivational enhancement" by introducing this new method in traditional classroom teaching and learning (p. 1283), (b) as a tutor interacting with students without a human teacher present and practice conversation and give feedback to students (e.g., vocabulary and pronunciation), and (c) as a peer, robots can learn the language together with students and interact with them to complete a task using the target language.

Scholars have noted that the existing literature on social robots focuses on school-age children with less work conducted with adult L2 learners (e.g., Engwall et al., 2022; Iio et al., 2019; Nomoto et al., 2022). The benefits of using social robots in educational settings have been found to vary across students from diverse backgrounds (Kanero et al., 2022). Recent studies conducted in the field of Robot-Assisted Learning (RALL) (e.g., "the use of robots to teach people language expressions or comprehension skills—such as speaking, writing, reading, or listening"; (Randall, 2019, p. 2) that have been conducted in non-English speaking universities (Ao & Yu, 2022; Banaeian & Gilanlioglu, 2021; Donnermann et al., 2022). These studies have focused on the following areas: (a) L2 acquisition focusing on speaking and vocabulary and (b) the effects of robots on L2 motivation/anxiety and affective factors such as attitudes (Ao & Yu, 2022; Banaeian & Gilanlioglu, 2021; Donnermann et al., 2022; Iio et al., 2019; Kanero et al., 2022; Yu-Li et al., 2022). These studies have shown that the use of social robots in higher education can enhance L2 language skills, learning motivation and engagement, increase enjoyment and decrease learning anxiety. The details of the research findings along with methodological approaches are discussed more thoroughly in the following paragraphs.

Practicing a second/foreign language can be stressful for L2 students as slang and cultural aspects of L2 can be challenging to understand and learn (Iio et al., 2019). This may result in L2 students reducing their contribution in classes as they may become anxious about their L2 communication skills, making mistakes, and initiating conversations or discussions in L2, which leads to a loss of speaking opportunities (Iio et al., 2019; Park, 2021). Iio et al. (2019) argued that RALL can be one of the solutions to these issues. Khalifa et al. (2019) showed how RALL could support L2 learners at a Japanese university (N = 80) to improve their grammar patterns during conversations with two robots. This experimental research proposed the joint-in-type-robot-assisted language learning (JI-RALL) using an NAO social robot (e.g., a common type of robot in L2 acquisition), in which one robot acted as a language teacher/tutor and the other robot took the role of a peer to integrate implicit learning by listening to the conversations between the two robots on several topics for four consecutive weeks. The experimental results indicated positive effects of implicit learning enhanced students' ability to construct utterances with more appropriate grammar patterns in verbal communication.

In a similar type of study conducted by Iio et al. (2019), nine Japanese L2 university learners practiced speaking with the robot for 30 minutes for seven days and their performance was measured and compared via pre- and post-tests. The effect of RALL (in this case, CommU—visually simple social robot) on various speech elements such as grammar and lexicon (e.g., vocabulary) including the number of words used per minute and aspects of pronunciation (e.g., phonemes, intonation, and rhythm). The results showed that students were able to use a larger number of words per minute and decreased grammar and lexical errors in every post-test. Further, their pronunciation became more native-like in every post-test, even though intonation and rhythm did not change. This means that some phonological variations of the learners' L1

transferred to L2, which is a natural phenomenon in L2 acquisition (Kettle, 2013), remained to some degree, whereas the accuracy of pronunciation was attainable.

A similar study conducted by Yu-Li et al. (2022) is interesting in that it provides qualitative insights into L2 learners' self-reported learning outcomes focusing on how they perceived learning with a social robot called, Robot Robert. This ten-week intervention study included several teaching cycles regarding English tour guide practice and the major concern was to evaluate teaching effectiveness using the robot. Although only two postgraduate L2 learners at a university of science and technology in Taiwan participated in verbal communication practice with the robot, they reported that learning with the robot and exchanging ideas was fun and interesting. They also felt that they were able to improve their L2 speaking fluency with a good memory of new vocabulary. These learners additionally stated that it would be useful for students who do not feel comfortable in the classroom setting and shy to verbally participate in their learning. Further, the learners expressed that RALL provides an interactive learning experience as they had to actively interact with the robot instead of listening to the instructor. Hence, Yu-Li et al. (2022) concluded that the social robot provided a positive way of increasing student motivation and willingness to use the RALL method of language learning.

Banaeian and Gilanlioglu (2021) investigated whether a NAO social robot as a teaching assistant influences first-year university L2 learners (N = 65) in North Cyprus. A quasi-experimental design using a mixed methods approach encompassed a pre- and post-test to examine the effect of the robot on the learners' vocabulary learning. These learners were undertaking an L2 vocabulary course as part of the regular program during the experiment. When comparing the control (non-RALL) and experimental groups, the control group scored slightly higher than the experimental group. Banaeian and Gilanlioglu (2021) presumed that this may be because L2 learners could be cautious about integrating such technology into their learning space compared with young children. Another factor that might explain this finding could be related to the role and function of the robot in learning environments. For example, some learners in the interviews mentioned that they had difficulties understanding the clarifications and examples provided by the robot due to its fast speech rate, which means the learners' listening skills needed to be considered to apply RALL more appropriately. Even so, L2 learners felt that the robot was helpful for them to learn new vocabulary. More than 60% of the students were satisfied with the robot's ability and believed that it was an appropriate tool in their learning space.

Another experimental research study conducted by Kanero et al. (2021) also showed a relationship between L2 learners' attitudes towards a robot and their learning outcomes. A total of 102 two native Turkish-speaking university L2 learners were taught eight English words in a one-on-one lesson either with a NAO social robot (N = 51) or with a human tutor (N = 51). The results showed that these learners in both groups learned vocabulary equally well, indicating that they benefited similarly from interactions with either the robot or human. Further, statistical analysis revealed that the learners' attitudes toward robots (e.g., impressions of the robot tutor) and anxiety about L2 learning were associated with their learning outcomes. L2 learners with negative attitudes towards robots and L2 anxiety learned fewer words in the robot tutor condition. Hence, going beyond the exploration of the influence of these affective factors on learning outcomes, Kanero et al. (2021) claimed that future research needs to pay attention to testing the unique features of robots and the nature of human-robot interactions (e.g., students' attitudes and behaviours during the lesson). In a similar study, Zinina et al. (2023) explored Latin vocabulary learning for L2 Russian university learners (N = 43) and their attitudes towards a companion social robot called F-2 Robot as a new learning tool. Using an experimental mixed methods design, they compared two groups—computer-based learning and robot-assisted learning groups. Descriptive analysis revealed that 25 learners (59.5% of the study sample) enjoyed learning with the robot, followed by 10 learners who preferred the computer (23.8%) and 7 learners who rated both methods equally (16.7%). The social robot was perceived as more "friendly, cheerful, emotional, responsive, and attractive" compared with the computer (p. 113). While learning was successful in both experimental conditions, in the post-experiment interview, students favored the robot as a means of language learning and its effectiveness (86.1%).

In summary, the benefits of social robots appear across universities in non-English speaking countries, such as Turkey, Taiwan, Russia, Japan, and North Cyprus. These studies mainly focused on speaking and vocabulary learning and perceptions of social robots as a new form of learning method in university settings. Learning with social robots has been

found to be efficient and/or equally effective as human tutors making learning more active, engaging, and personalized. However, to deepen knowledge about the effectiveness of social robots more research is needed to examine the long-term effects on language learning and experiences of RALL. Although some studies stated participating L2 learners' language proficiency (e.g., beginners/intermediate, or high proficiency) (Yu-Li et al., 2022; Zinina et al., 2023), no detailed information was provided regarding how it was measured or reported by L2 learners. This has become a particular challenge in the study of Khalifa et al. (2019) because there existed difficulties in providing feedback to each student due to their varying levels of L2 proficiency. In addition, technological difficulties were also noted by other studies (Banaeian & Gilanlioglu, 2021; Khalifa et al., 2019). Even with state-of-the-art engines, due to various levels of pronunciation, lexical, syntactical, and semantic errors made by L2 learners, recognition of L2 speech was a challenge at times (Banaeian & Gilanlioglu, 2021; Khalifa et al., 2019). Affective factors such as anxiety and some demographic characteristics such as familiarity with new technology and/or willingness to learn with digital technology should also be taken into consideration in future studies because these can influence the perceived usefulness of social robots and student learning outcomes (Banaeian & Gilanlioglu, 2021; Kanero et al., 2021).

Student Motivation and Engagement

Researchers have highlighted the use of social robots for enhancing L2 university student motivation, engagement, and willingness to learn (Banaeian & Gilanlioglu, 2021; Engwall & Lopes, 2022; Randall, 2019). A qualitative study conducted by Donnermann et al. (2022) in Germany investigated the applicability of a Pepper social robot in teaching and learning at the University of Wuerzburg. Even though this study was not specifically focused on measuring language-related learning outcomes, it is unique in the sense that it mainly addressed university students' ($N = 28$) perceptions and attitudes towards the integration of robots in their learning space by implementing a robot-supported learning environment as complementary training to a university course (e.g., digital media). This study found that students had favorable attitudes towards the robot showing a willingness to use it again for learning. Students also liked the robot's ability to provide them with feedback on their language. More importantly, the robot was perceived to enhance their motivation, attention, and concentration. While positive effects of robot-support tutoring were found, some students mentioned that the robot's explanation could be more in detail or shorter when their answer was partly incorrect. For others, the robot's arm gestures were distracting, whereas some viewed them positively. As particular features of the robot and the way they provide feedback to students seemed to affect their learning experience, Donnermann et al. (2022) argued that more flexible and personalized interactions are required with adjustments in the robot's gestures depending on the student's preference.

The findings of Kanero et al. (2022) emphasized the importance of careful consideration of other factors such as L2 learners' individual preferences and familiarity with new digital technology. Kanero et al. (2022) in the Turkish context discussed that learning with a NAO robot was not seen as the most beneficial form of decreasing learning anxiety because L2 anxiety had a negative influence when learning from a robot tutor, not a human tutor. One possible explanation according to Kanero et al. (2022) is that having a one-on-one session with the tutor robot might have felt unfamiliar and increased L2 learner anxiety. Further, learning might have been even more challenging for students in the robot tutor condition, if they had negative attitudes towards the robot (Kanero et al., 2022). While learning in both robot tutor and human tutor conditions was useful for vocabulary learning, L2 learners with more negative attitudes towards the robot had lower learning outcomes in the robot tutor condition.

Deublein et al. (2018) took a further step to investigate the effects of a social robot's (Reeti robot) motivational behaviours on L2 learners' motivation and learning outcomes using attention, relevance, confidence, and satisfaction (ARCS) scales. A total of 39 German university L2 learners acquiring Spanish as L2 participated in this quantitative study. The robots' motivating utterances and non-verbal behaviours were not significantly associated with ARCS. Comparing ARCS scales to their learning outcomes, the correlation between students' confidence and their language learning outcome was significant with a moderate effect size. In general, students reported a relatively high motivation level with a

comparatively high rate of interaction experience with the robot, which means that social robots in an educational setting were perceived as motivating and interesting (Deublein et al., 2018). However, despite the usefulness of social robots and their effectiveness, the novelty effect of social robots can influence student outcomes, therefore, studies of longer duration should be conducted to reduce this novelty effect.

Overall, the studies conducted at universities located in Germany and Turkey demonstrated that social robots provide a more interactive and engaging form of learning that motivates and enhances their interests within the learning environments. To boost L2 students' confidence, motivation, engagement, and learning gains in new social and academic settings, the design and application of social robots should therefore incorporate an understanding of the demographic characteristics of students (e.g., familiarity with robots and/or willingness to learn with digital technology, motivation/expectation levels). When designing the features, speech, and behaviours of robots, a specific domain (e.g., the role of robots in teaching and learning) could be considered as the effectiveness of robots acting as instructor/tutor depends on the efficacy of the information transfer (Randall, 2019). Students' learning styles and preferences could also be considered when designing materials and protocols; for example, how the robot behaviours/movement should be designed and in which role the robot can be utilized to better support these students. Before robots can be used within university settings in a meaningful way for L2 students, future research is needed to increase our understanding of the full potential of social robots as a social and academic support tool in higher education.

Potential Use of Social Robots

For L2 international students, the process of transition and social and academic integration into new university settings can be daunting and overwhelming (Moon et al., 2020; Park et al., 2022). Regardless of how proficient they are with their L2, feelings of insecurity and lack of sense of belonging are common experiences for L2 university students studying overseas (Park et al., 2022). Feeling discomfort and loss of confidence may be a natural phenomenon when moving to a new country where people speak different languages and embrace different cultures. This initial overwhelming experience can influence their transition experience, limit their classroom interactions, and socializing opportunities on campus (Moon et al., 2020; Park et al., 2022). In this respect, social robots have the potential to support aspects of these needs. Early-stage intervention for L2 students with a social robot could make a meaningful contribution to their social well-being and academic success. Among the benefits of social robots, ones that can be highlighted in higher education contexts over other technologies are: (a) personalized learning in a natural and interpersonal way through interactions, (b) an increase in motivation and engagement, and (c) L2 performance improvement. Nevertheless, findings from existing research studies are multi-layered and complex, therefore, further exploration regarding how to integrate social robots in higher education for L2 students is warranted.

Some L2 students upon arrival in a host country feel surprised and disappointed as they realize the way they sound (e.g., accent and pronunciation) is different from L1 speakers and their insufficient communication skills, leading to a loss of confidence (Park et al, 2022). Given the findings from previous literature (Iio et al., 2019; Khalifa et al., 2019), social robots can contribute to enhancing L2 students' communication skills including pronunciation and grammar patterns. Unfortunately, L2 students often set up language goals such as achieving a native-like accent/fluency and believe that it would be helpful for their social and academic life on campus (Dovchin, 2020; Park, 2021). Through trial and error, these students realize that such goals are hard to achieve and the way they sound is valuable as it signifies that they can speak more than one language (Park, 2021). Hence, it is important to support newly arrived L2 students to have realistic goals and feasible strategies to improve their L2. Focusing on empowering learning experiences, social robots can be programmed with knowledge of the target language and can provide more interesting and enjoyable language-learning opportunities by personalizing the activity selections and interactions (Belpaeme et al., 2018). Further, L2 students may not be concerned about misjudgment or not being heard (e.g., accent stereotyping and language discrimination) because they can practice communication skills with a non-judgmental robot in a safe environment, which can increase their L2 motivation, confidence, and willingness to learn. Although speculative, social robots in the future could be programmed to provide

practical guidance and pragmatic solutions to these students to become more confident in being themselves and retaining their personal and cultural identity.

Implications and Conclusion

In this essay, we explored current insights on social robots and L2 international students and found that it seems plausible that social robots could play a useful role in supporting L2 international students in HE settings at home and abroad. As this essay is narrative in nature, it only provides current insights into this topic, generalizations cannot be made and the points made should be cautiously interpreted. A wider search of the research literature and both short-term and long-term studies are needed that directly measure L2 learning effects and the interactions and engagement between the L2 international student and the social robot. Furthermore, before social robots are more readily adopted across a wider range of countries, designing appropriate materials and resources considering student needs and preferences (e.g., based on their L1 cultural backgrounds and language proficiency) would be necessary to maximize the students' social and academic success. Further, it is important to consider whether student attitudes towards social robots as affective factors (e.g., attitudes towards social robots and anxiety) and demographic characteristics (e.g., familiarity with social robots and/or willingness to adopt new technology) can have either a negative or positive effect on their social well-being and academic outcomes. The long-term social and educational benefits of social robots in higher education need to be evaluated through follow-up sessions and for a longer duration time to help reduce the novelty effect. Importantly, it is crucial to note that social robots are not a substitute for human interaction and support and their effectiveness must be rigorously examined.

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