

Investigating Robot-Assisted Second Language Teaching Under Social Interactive Education: A Systematic Review

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Abstract: Artificial Intelligence (AI) supported educational robots hold great promise for second language teaching. Robots using advanced AI capabilities such as emotion recognition and real-time feedback can create dynamic and interactive environments that improve engagement and educational outcomes. Additionally, they have the ground-breaking potential to enable personalised teaching adapted to the unique needs of different learners. This paper aims to systematically explore the recent developments of educational robots in second language learning and teaching through conducting a systematic literature review to investigate the research gaps and propose a novel framework for AI-supported personalised teaching with educational robots. This study utilised Scopus to search for recent publications (2017-2024), applying specific criteria such as keywords, publication dates, and subject areas to ensure the relevance of the results. These criteria have been carefully designed to identify high-quality research that is consistent with the scope of the study. Based on these search criteria, 25 studies were identified using the PRISMA method, which systematically screened and selected studies for inclusion criteria. The results highlight that the novelty and social interaction capabilities of educational robot design, coupled with the support of AI technology, provide language learners with engaging new learning opportunities. These robots, by incorporating advanced AI features, can simulate real-life social interactions, making language practice more immersive and motivating for learners. These opportunities enhance the interactivity of teaching sessions by instantly recognising students' questions and providing pertinent feedback. Therefore, this study suggests the benefits that AI and robotics offer for second language teaching, particularly in offering greater potential for personalised learning and interactive teaching. However, despite these advantages, this remains a key implementation challenge in integrating educational robotics with traditional teaching. The willingness of teachers to embrace educational robotics, the need to coordinate with current lessons, and the high cost of robotics are all still barriers that must be addressed. These limitations highlight the importance of further research and development to adapt different teaching environments, grounded on the initial design of the work. Future work includes a planned validation study in a second language school in Wales, scheduled for autumn 2025.

Keywords: Second Language Education; Educational Robotics; AI; Student-Robot Interaction.

1. Introduction

1.1 Background of Second Language Social Interactive Education

In the research of traditional second language teaching methods, researchers have proposed many educational theories and methods. Among them, Vygotsky (1986) proposed the theory of social constructionism, which emphasises the importance of language in society as a tool for regulating social relations. Based on the social constructionism theory, the second language social construction was derived, which suggests that the construction of linguistic knowledge is produced through socialised interaction and negotiation. Researchers proved that the social construction theory had a positive impact on students' learning of a second language learning in the classroom (Harun *et al.*, 2019; Newman and Latifi, 2021; Xiao and Zhao, 2022; Knoll and Becker, 2023). In a comfortable practice language environment, students can enhance learning through interaction and improvement (Wagner *et al.*, 2022). However, students' personal factors can affect participation in social interactive learning and influence learning outcomes (Alarnah *et al.*, 2021). It was found that the limitations of teachers' competence could not provide appropriate scaffolding for teaching because the gaps of the students were unknown (Hamidi and Bagherzadeh, 2018).

1.2 Educational Robotics in Second Language Acquisition

Following the limitations mentioned in 1.1, to date, there have been various scientific approaches to help with second language learning (Liu *et al.*, 2002; Zeng and Takatsuka, 2009). Among others, Robot-Assisted Second Language Acquisition (RASLA) receives attention for its social engagement and educational advantages (Gordon *et al.*, 2016). In second language education, improving the learning experience (Arar *et al.*, 2021) or as a social practice tool (Cheng *et al.*, 2022). However, there are limitations to a uniform method of educational robotics

teaching to students with diverse learning abilities (Kanero *et al.*, 2018). Therefore, the direction of this study is to provide the customised robotics teaching methods according to students' preferences.

There are multiple research studies to enhance interaction in RASLA through AI. Earlier studies have demonstrated the significant impact of learning companions in personalised second language learning (Gordon *et al.*, 2016). Chew and Chua (2020) found that educational robots could leverage computer vision techniques to discern students' emotions. AI also had a positive effect on the RASLA speaking part (Lin, Yeh and Chen, 2022). This paper systematically reviews the literature on educational robot-assisted second language education over the past nine years and proposes a conceptual framework of Personalised Learning Tutor (PLT). Investigating the impact of AI-supported educational robots on second language education under social construction theory.

1.3 Problem Definitions and Research Motivation

Although educational robotics has shown a positive impact in second language teaching, there are still limitations in robotics design based on the previous works in multi-facets for real-life value engineering. Therefore, designing an intelligent teaching framework for educational robotics that adapts to students' learning abilities remains a research priority.

This review presented in this paper examines the current research on the impact of robot-assisted language teaching in language education and proposes a design framework to provide personalised second language education integration. The following research questions are initially defined:

- Q1. How can robots enhance second language learning?
- Q2. How to design educational robotics for second language educational scaffolding?
- Q3. What methods of student interaction with educational robots are effective?
- Q4. How can AI assist robots in second-language education?

1.4 Research Methodology and Inclusion Criteria

Based on the research questions provided in 1.3, this study used the Scopus indexed database (2004), launched by Elsevier, to search and preview analysis of the latest literature. The keywords were identified as: '**Second language**', '**Language**', '**Educational robot**', '**Classroom**', '**Teaching**', and '**AI**'. The articles were set to meet the following criteria to be selected for the review: (1) Published in English; (2) 'Robotics in language education' was within the topic; (3) Clear and rigorous research findings were provided; (4) Published between 2017-2024. This paper follows the PRISMA Preferred Reporting Items: Identification, Screening, Eligibility, and Inclusion. The purpose of PRISMA is to help the authors critically evaluate the analysis (Sarkis-Onofre *et al.*, 2021), and the progress results in Figure 1.

A total of 1,347 literature was found on Scopus, 664 literatures before 2017 were excluded, then 625 non-educational literatures were excluded according to the research direction, then 33 literatures that were unrelated to language teaching and those that could not be viewed were excluded, and finally, a total of 25 literatures were included in this literature review.

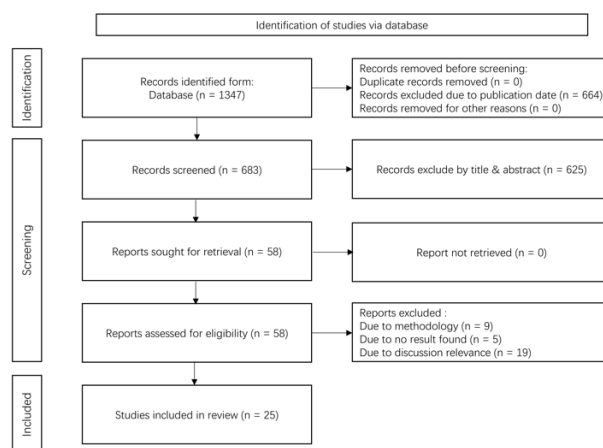


Figure 1: PRISMA diagram of data collection

2. Literature Review

2.1 Educational Robotics Supporting the Classroom

Researchers introduced educational robots in the classroom to encourage students' understanding of a second language through their interest in robots. For examples of some earlier works in this specialist area are the programmable humanoid educational robots at Monash University for Chinese Language learning, by not taking teachers' job (Chew & Chua, 2020); and LEGO Mindstorms robotics kits used by Segovia (2018) to teach six- to nine-year-olds how to complete the robotics curriculum and help students communicate in a second language. The potential of incorporating robotics and language learning was demonstrated by this research. Ververi (2020) drew on this idea to inform further research into the promotion of language learning because of students' interest in robots and the introduction of robots into the curriculum. The study reinforced the earlier findings that robots were effective at teaching and understanding. Recent studies have shown that adding the Dash robotics competition theme for young students (Lee and Chiu, 2024), with the primary purpose of allowing students to learn through hands-on manipulation and exploration. The result of measuring students' motivation through the English learning motivation scale showed an increase in motivation in English and a decrease in anxiety levels.

In contrast to traditional teaching methods, Konijn (2022) confirmed that in primary education, the use of a single robot was more effective than a combination of robots and tablets, leading to heightened student engagement and attention. Tolsdorf (2022) examined the educational effects of students switching between various educational robots during the same course, and this research found that students could quickly adapt to new robots. Feng and Wang (2023) used the e-reading mode of the educational robots with audio e-books and character-play-based reading, and the results showed that interesting interaction is the main factor affecting the reading effect. In addition to the help of the educational robots, the motivation to read, the amount of reading, and the ability to learn independently have been significantly improved. Liang and Hwang (2023) proposed a robot-based digital narrative telling method (DST) to enhance multimodal narrative competence and engagement in English language learners. Compared to students using the traditional animated DST method, the DST significantly improved students' speaking skills and outperformed the traditional method in terms of interaction. In addition, in terms of communication comprehension and engagement, the robot DST method also showed better results than the traditional method in terms of communication comprehension and engagement.

2.2 Robotics Education Scaffolding

To help students learn second languages, Jones and Castellano (2018) investigated the effectiveness of using the NAO robot as an autonomous educational tutor in self-regulated learning for primary school students. The results showed that students can quickly learn how to use the educational robots to study a second language through scaffolding. Demir-Lira (2020) used scaffolding guidance on another display to study the NAO robot as a tutor to teach vocabulary words to children. The robot's verbal cues helped these learners to learn more effectively. Additionally, the integration of educational robots and the Internet of things could create interactive teaching textbooks that visually and audibly pique students' interest in learning vocabulary, which in turn leads to a positive emotional state in students and a significant improvement in learning outcomes (Lin *et al.*, 2022).

2.3 Student-Robot Social Interaction

Educational robots with social interactive skills have earned interest in making learning more engaging. Vogt (2017) found that the body movements of the NAO humanoid robot can stimulate students' interest in learning. Moreover, Kory Westlund *et al.* (2017) explored the impact of a robot's performance, such as tone and emotion, on student learning. This study found that emotionally supportive interactions help students learn. Gavrilova (2019) uses the OP2 robot to teach English vocabulary to preschool students by simulating a story environment through robots. Arar *et al.* (2021) used the EMYS robot head to study the effectiveness of language learning supported by facial expressions and found that the social interaction of the robot's facial expression capabilities was helpful for students' learning. Similarly, Estévez *et al.* (2021) demonstrated that social robotics could improve students' English vocabulary comprehension. In addition, Aguilera *et al.*, (2024) designed a voice-controlled robotic system for early education and tested it on children aged four to six years old, giving voice commands through verbal ability, thus demonstrating the many possibilities of early education robots. However, not all social interactions are accepted, Yin *et al.*, (2024) used the educational robot AlphaMini to do educational

testing with 6–7-year-old students using word cards interacted with the robot, but the robot's social behaviours, such as gesture movements, did not have an impact on learning. The voice interactions were the most effective in increasing learning gains.

2.4 Intelligent Educational Robot Perception and Feedback.

AI supports robotics through vision (cameras), and interactive conversations (deep learning, mics and speaker of a robot), are a better design at understanding students' learning positions and showing the potential for personalised teaching. Tuna and Tuna (2019) use of NAO robots that are capable of multilingual interaction with the help of artificial intelligence and can provide real-time feedback can provide a positive impact on learners and uncover the possibilities of humanoid robots in second language teaching. Chew and Chua (2020) also used the NAO robot to explore the possibilities of a robotic Chinese language teacher, noting that AI-supported emotion detection features can be effective in providing feedback to enable students to have a positive attitude toward learning. Similarly, Hakim (2022) explored the effects of AI-supported robots providing proper feedback in language teaching and observed substantial increases in student engagement and motivation. Hsu *et al.* (2023) found that AI photo identification systems significantly improved scholar self-regulation and reduced learning anxiety. Fung *et al.* (2024) developed an educational robot system on vocabulary, phrases and sentence expansion aspects, tested on 6–10-year-old students from the same primary school and reviewed by the teacher. This study also demonstrates that the feedback provided by AI support enhances learners' interest in learning. The above authors argue for a similar approach, which is the positive engagement of the learning innovation and personalised support.

Recent studies have demonstrated how AI, particularly Natural Language Processing (NLP), is being integrated into educational robotics to enhance second language teaching. Obadia *et al.* (2024) developed a low-cost robot with NLP capabilities that can naturally answer students' questions, thus assisting student-robot interaction. Similarly, Baksh *et al.* (2024) introduced a customisable low-cost social robot to provide multimodal interaction to increase student engagement. This study has shown that NLP can support robotics to play a tutor in learning companions. Furthermore, Hu, Fu and Yeh (2024) explored the effectiveness of AI-supported educational robotics which used NLP and machine learning, by analysing students' feedback and learning data, the robot can adapt teaching methods to students' needs, thus achieving a similar level of teaching as a human teacher. These studies highlight how AI-supported educational robotics enables natural interactions and personalised education with students' data. However, future research is still needed to assess the effectiveness of robotics in different learner situations and contexts.

3. Discussion and Initial Design

In total, 25 papers were selected for this review to answer the four questions about educational robot in language teaching in 1.3. they are categorised as below. Table 1 categorises the results of this literature review. The literature review highlights the advantages and potential of educational robots in second language teaching. A key finding is that integrating educational robots into the learning process can effectively inspire students to engage in language acquisition. Their unique features stimulate curiosity, encouraging interest in second language learning (Segovia, 2018; Ververi, 2020; Lee and Chiu, 2024). There are also studies that point to the ability of robots to have more appeal compared to virtual devices such as tablets (Koniijn 2022). A such this advantage is because the interactivity of educational robots, such as gestures, movements and facial expressions, and other social actions positively impact second language teaching (Vogt *et al.*, 2017; Gavrilova *et al.*, 2019; Yin *et al.*, 2024). With the social interactivity of educational robots, student interaction in the classroom has also improved (Arar *et al.*, 2021). At the same time, in the student and robotics interaction, the robot can assist in simulating the language situation, thus enhancing the students' learning experience and learning effect (Liang and Hwang, 2023).

Table 1: Literature Review Categories

Literature Categories	Count	References
A. Educational robots second language class scaffolding	3	Jones and Castellano (2018). Demir-Lira, <i>et al.</i> (2020). Lin, <i>et al.</i> (2022)
B. Practising the second language in robotics teaching tasks	3	Segovia and Souza (2018); Ververi, <i>et al.</i> (2020) Lee and Chiu (2024)
C. Comparison of educational robots with other teaching tools	4	Konijn, <i>et al.</i> (2022). Tolksdorf, <i>et al.</i> (2022). Feng and wang (2023). Liang and Hwang (2023)
D. Robot's social interaction enhances second language teaching	7	Vogt, <i>et al.</i> (2017). Kory Westlund, <i>et al.</i> (2017). Gavrilova, <i>et al.</i> (2019); Estévez, <i>et al.</i> (2021) Arar, <i>et al.</i> (2021); Aguilera <i>et al.</i> (2024); Yin <i>et al.</i> (2024)
E. Machine Learning in AI in Language Education Robotics	8	Tuna (2019). Chew and Chua (2020). Hakim, <i>et al.</i> (2022). Hsu, <i>et al.</i> (2023). Fung, <i>et al.</i> (2024). Jobaida <i>et al.</i> (2024); Hu, Fu and Yeh (2024); Baksh, <i>et. al.</i> (2024)

Educational robots can also support language education with various teaching methods. Using English in courses on robotics, such as storytelling or science competitions, students could learn English vocabulary and actively try to communicate to complete robotics tasks (Segovia, 2018; Ververi 2020; Liang and Hwang, 2023). There are positive results from robot-guided language instructions, students can easily study a second language with educational robotics guidance (Jones and Castellano, 2018; Demir-Lira *et al.*, 2020; Lin *et al.*, 2022). However, the ability of robots to be suitable for more areas and more teaching scenarios is still a challenge, and research on low-cost robots is a research option to speak of the popularisation of educational robots (Baksh *et al.*, 2024; Jubaira *et al.*, 2024).

The most important things about educational robots are the social interaction and feedback. Researchers have conducted a lot of research on AI-powered education to support personalised feedback and learning (Tuna, 2019; Hakim, 2022). In these studies, AI methods are used for speech recognition, emotion recognition, image recognition, and voice dialogues. Emotion recognition uses machine learning models to analyse vocal tones, facial expressions and contextual cues, enabling the system to understand and adapt to the user's emotional state, and the voice dialogue system integrates advanced AI algorithms to facilitate seamless communication between users and robots, providing more engaging and intuitive interactions, these applications showcase the transformative power of AI in delivering tailored and impactful educational experiences (Chew *et al.*, 2020; Hakim *et al.*, 2022; Hsu *et al.*, 2023; Hu, Fu and Yeh, 2024).

Large Language Model (LLM) is integrated into chat robots offers excellent potential for language education (Jeon, Lee and Choe, 2023; Pack and Maloney, 2023). These AI-supported robotics can be customised to suit the needs, learning styles, and progress of each student. By analysing the learner's actions and learning progress, these robots can personalise their teaching to provide more appropriate explanations, exercises, and feedback. Robots can also spark curiosity, respond to questions, and engage in dialogue. However, the application of educational robots in second language education is still very challenging. How to adapt educational robots to different teaching contents and whether the robots can cope with unexpected situations are also elements to be considered (Vogt, 2017). In general, the combination of LLM and educational robots has the potential to personalise language teaching.

This study introduces the Personalised Learning Tutor (PLT) framework in Figure 2, educational robots can interact with students socially (dialogues and actions) (Vogt, 2017), as well as to generate personalised lessons based on students' learning needs (Chew, 2020; Arar, 2021; Wu, 2023), and the ability to realise Contextual learning through visual interaction (Lin *et al.*, 2022; Cheng *et al.* 2024). The PLT framework can provide

personalised learning content and interactions for students, and the physical presence and realistic interactions of the robots can reflect the student-robot companion for second language learning, in addition to the promise that teachers can use multiple robots to meet the challenges of personalised teaching in a multi-person classroom.

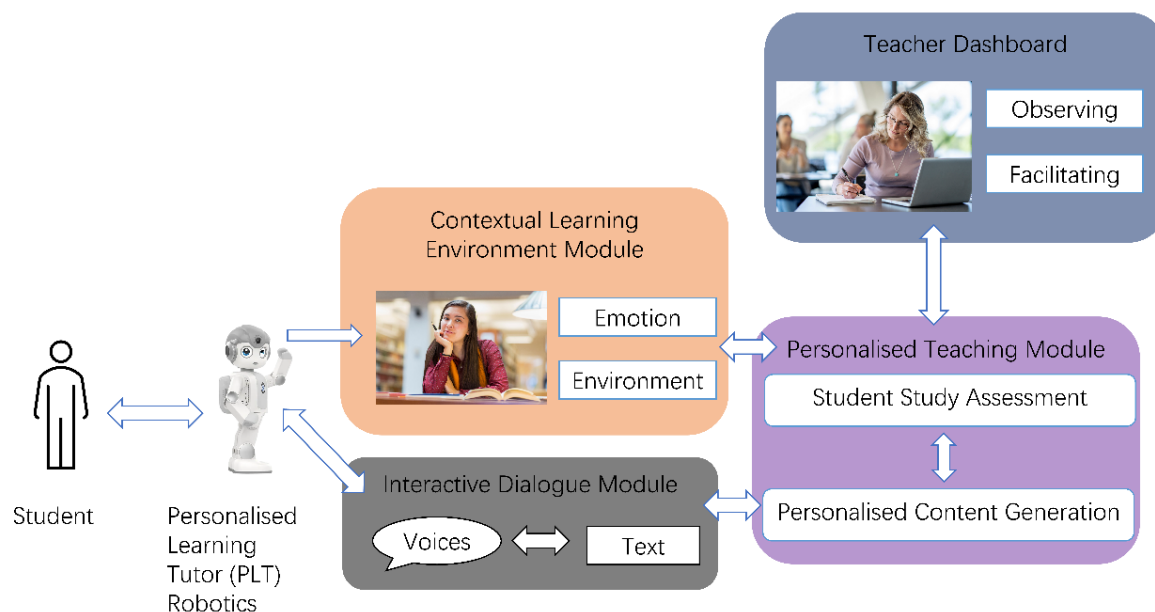


Figure 2: PLT Framework

4. Conclusion and Limitations

This research discusses the use of educational robots in second language teaching and reveals that they have an important role to play in enhancing the learning experience, improving learning efficiency, and developing students' language skills. Robots can stimulate students' interest in language learning through their socially interactive, novel teaching modes, and improve learning outcomes through personalised feedback and interaction. In addition, AI support can further enhance the pedagogical capabilities of educational robots, with sentiment analysis, free language interaction, and dynamic feedback providing more appropriate learning support for students. Low-cost educational robots also offer the possibility of universal access. However, robots should provide educational support rather than completely replace teachers' job, even though educational robots have evolved from teaching tools to participants in teaching, and robots can provide comprehensive teaching, but further research is needed in the future to clarify the role and tasks of robots in teaching. As a result, research on educational robots should not only be technologically upgraded but also integrated with conventional pedagogy for effective teaching implementation.

Therefore, in future research, how to make the robot accurately provide the teaching content needed by students is the key to personalised teaching. Secondly, further research can be done in the interaction of the robot so that the robot can do the interaction with the objects in the real environment through the camera. In addition, the different abilities of students in different countries and regions need to be considered, and the applicability of the PLT framework needs to be verified.

Although studies have found that educational robots have good results in second language education, there are still some limitations in current research on AI educational robots. Firstly, many studies focused mainly on short-term experiments in a controlled environment, limiting the generalisability of robots in real classrooms, and the effectiveness of educational robotics in long-term learning engagement has not been fully explored. Secondly, while robotics can offer the potential to personalised education, its suitability for different learning styles, and ages remains unclear. Educational robots depend on limited data inputs, which may not reflect the real classroom complexity. Finally, there is a lack of evaluation of ethical issues, especially the learner data security and potential bias in artificial intelligence algorithms are critical to developing student-robot interaction,

therefore, ethical design standards that comply with the General Data Protection Regulation (GDPR) need to be discussed in future research.

Ethics Declaration

This paper is a literature review and did not involve any participants, and the study was not subject to ethical review.

AI Declaration

The use of AI for articles was limited to vocabulary and grammar checking and corrections.

Reference

- Aguilera, C.A. et al. (2024) "Voice-controlled robotics in early education: Implementing and validating child-directed interactions using a collaborative robot and artificial intelligence", *Applied Sciences*, 14(6), p. 2408.
- Arar, C., Belabour, A. and Telli, A. (2021) "Adoption of social robots as pedagogical aids for efficient learning of second language vocabulary to children", *Journal of e-Learning and Knowledge Society*, 17(3), pp. 119–126.
- Baksh, F., Zorec, M.B. and Kusuma, K. (2024) "Open-source robotic study companion with multimodal human–robot interaction to improve the learning experience of university students", *Applied Sciences*, 14(13), p. 5644.
- Chen, W., Sun, P., and Yang, Z. (2022) "Understanding Chinese second language learners' foreign language learning boredom in online classes: Its conceptual structure and sources", *Journal of Multilingual and Multicultural Development*, 45(8), pp. 3291–3307.
- Cheng, Y.-W. et al. (2022) "The impact of learning support facilitated by a robot and IoT-based tangible objects on children's game-based language learning", *Computer Assisted Language Learning*, 37(7), pp. 2142–2173.
- Chew, E. and Chua, X.N. (2020) "Robotic Chinese language tutor: personalising progress assessment and feedback or taking over your job?", *On the Horizon*, 28(3), pp. 113–124.
- Demir-Lira, Ö.E., et al (2020) "L2 Vocabulary Teaching by Social Robots: The Role of Gestures and On-Screen Cues as Scaffolds", *Frontiers in Education*, Vol. 5, p. 599636.
- Estévez, D., et al. (2021) "A case study of a robot-assisted speech therapy for children with language disorders", *Sustainability (Switzerland)*, 13(5), p. 2771.
- Feng, Y. and Wang, X. (2023) "A comparative study on the development of Chinese and English abilities of Chinese primary school students through two bilingual reading modes: Human-AI robot interaction and paper books", *Frontiers in Psychology*, 14, p. 1200675.
- Fung, K.Y. et al. (2024) "Humanoid robot-empowered language learning based on self-determination theory", *Education and Information Technologies*, 29(14), pp. 18927–18957.
- Gavrilova, I. et al. (2019) "Pilot study of teaching the English language for preschool children with a small-size humanoid robot assistant", In 2019 12th international conference on developments in eSystems engineering (DeSE), IEEE, pp. 253–260.
- Gordon, G. et al. (2016) "Affective Personalization of a Social Robot Tutor for Children's Second Language Skills", In *Proceedings of the AAAI Conference on Artificial Intelligence*, Vol. 30, No. 1.
- Hakim, V.G.A. et al. (2022) "Hakim, V.G.A. et al. (2022) "Robots in situated learning classrooms with immediate feedback mechanisms to improve students' learning performance", *Computers & Education*, 182, p. 104483.
- Hamidi, E. and Bagherzadeh, R. (2018) "The logical problem of scaffolding in second language acquisition", *Asian-Pacific Journal of Second and Foreign Language Education*, 3, pp. 1–14.
- Harun, H. et al. (2019) "Concept Based Instruction: Enhancing Grammar Competence in L2 Learners", *RELJ Journal*, 50(2), pp. 252–268.
- Havik, T., and Westergård, E. (2019) "Do teachers matter? Students' perceptions of classroom interactions and student engagement", *Scandinavian journal of educational research*, 64(4), pp.488–507.
- Hsu, T.-C., Chang, C. and Jen, T.-H. (2024) "Artificial intelligence image recognition using self-regulation learning strategies: Effects on vocabulary acquisition, learning anxiety, and learning behaviours of English language learners", *Interactive Learning Environments*, 32(6), pp. 3060–3078.
- Hu, Y.-H., Fu, J.S. and Yeh, H.-C. (2024) "Developing an early-warning system through robotic process automation: Are intelligent tutoring robots as effective as human teachers?", *Interactive Learning Environments*, 32(6), pp. 2803–2816.
- Jeon, J., Lee, S. and Choe, H. (2023) "Beyond ChatGPT: A conceptual framework and systematic review of speech-recognition chatbots for language learning", *Computers & Education*, 206, p. 104898.
- Jobaida, N. et al. (2024) "Design and Development of a Low-Cost Voice Interactive Children Educational Robot "TINY" with Natural Language Processing", in 2024 International Conference on Image Processing and Robotics (ICIPRoB). 2024 International Conference on Image Processing and Robotics (ICIPRoB), pp. 1–6. IEEE.
- Johnson, J.S., Newport, E.L. (1989) "Critical period effects in second language learning: The influence of maturational state on the acquisition of English as a second language", *Cognitive Psychology*. 21(1), pp. 60–99

- Jones, A., and Castellano, G. (2018) "Adaptive robotic tutors that support self-regulated learning: A longer-term investigation with primary school children", *International Journal of Social Robotics*, 10, pp. 357-370.
- Kanero, J. et al. (2018) "Who Can Benefit from Robots? Effects of Individual Differences in Robot-Assisted Language Learning", in 2018 Joint IEEE 8th International Conference on Development and Learning and Epigenetic Robotics (ICDL-EpiRob). 2018 Joint IEEE 8th International Conference on Development and Learning and Epigenetic Robotics (ICDL-EpiRob), pp. 212–217. IEEE.
- Knoll, A. and Becker, A. (2023) "Children's agency in interactions: how children use language(s) and contribute to the language ecology in Swiss bilingual German English daycare centres", *International Journal of Multilingualism*, 20(4), pp. 1304–1318.
- Konijn, E.A. et al. (2022) "Social Robots for (Second) Language Learning in (Migrant) Primary School Children", *International Journal of Social Robotics*, 14(3), pp. 827-843.
- Kory Westlund, J.M. et al. (2017) "Flat vs. Expressive Storytelling: Young Children's Learning and Retention of a Social Robot's Narrative", *Frontiers in Human Neuroscience*, 11, p. 295.
- Lee, Y.N. and Chiu, F.Y. (2024) "A study on primary school students' English learning motivation through international robot competitions", in 2024 12th International Conference on Information and Education Technology (ICIET). 2024 12th International Conference on Information and Education Technology (ICIET), pp. 232–236. IEEE.
- Liang, J.-C. and Hwang, G.-J. (2023) "A robot-based digital storytelling approach to enhancing EFL learners' multimodal storytelling ability and narrative engagement", *Computers & Education*, 201, p. 104827.
- Lin, V. et al. (2022) "Enhancing EFL vocabulary learning with multimodal cues supported by an educational robot and an IoT-based 3D book", *System*, 104, p. 102691.
- Lin, V., Yeh, H.-C. and Chen, N.-S. (2022) "A Systematic Review on Oral Interactions in Robot-Assisted Language Learning", *Electronics*, 11(2), p. 290.
- Liu, M., et al. (2002) "A look at the research on computer-based technology use in second language learning: A review of the literature from 1990–2000", *Journal of research on technology in education*, 34(3), pp. 250-273.
- Newman, S. and Latifi, A. (2021) "Vygotsky, education, and teacher education", *Journal of Education for Teaching*, 47(1), pp. 4–17.
- Pack, A. and Maloney, J. (2023) "Using generative artificial intelligence for language education research: Insights from using OpenAI's ChatGPT", *TESOL Quarterly*, 57(4), pp. 1571–1582.
- Sarkis-Onofre, R. et al. (2021) "How to properly use the PRISMA Statement", *Systematic Reviews*, 10, pp. 1-3.
- Scopus, available at <https://www.scopus-com>
- Segovia, M.V., Souza, A.A.D.S. (2018) "Educational Robotics as a Motivational Tool for the English Teaching-Learning Process for Children", *Proceedings - 15th Latin American Robotics Symposium, 6th Brazilian Robotics Symposium and 9th Workshop on Robotics in Education (WRE)*, pp. 585-590. IEEE.
- Tolksdorf, N.F., et al. (2022) "Who is that?! Does Changing the Robot as a Learning Companion Impact Preschoolers' Language Learning?", *ACM/IEEE International Conference on Human-Robot Interaction*, 2022-March, pp. 1069-1074. IEEE.
- Tuna, A. and Tuna, G. (2019) "The Use of Humanoid Robots with Multilingual Interaction Skills in Teaching a Foreign Language: Opportunities, Research Challenges and Future Research Directions", *Centre for Educational Policy Studies Journal*, 9(3), pp. 95–115.
- Ververi, C. et al. (2020) "Introducing Robotics to an English for Academic Purposes Curriculum in Higher Education: The Student Experience", in 2020 IEEE Global Engineering Education Conference (EDUCON), 2020 IEEE Global Engineering Education Conference (EDUCON), pp. 20–21. IEEE.
- Vogt, P., et al. (2017) "Child-robot interactions for second language tutoring to preschool children", *Frontiers in Human Neuroscience*, 11, p. 73.
- Vygotsky, L. (1986) *Thought and language*, Cambridge, MA: MIT Press.
- Wagner, M.-N.L. et al. (2022) "Improving the Effectiveness of Teaching: The Impact of Interactive Methods in Teaching English Students as They Increase Their Proficiency Level to B2", *Theory and Practice in Language Studies*, 12(11), p. 2232.
- Wu, Y. (2023) "English Learning Analysis and Individualized Teaching Strategies Based on Big Data Technology", In *International Conference on Computational Finance and Business Analytics*, pp. 421-430, Cham: Springer Nature, Switzerland.
- Xiao, Y. and Zhao, A. (2022) "A Case Study on the Impacts of Social Contexts on a Chinese English as a Foreign Language Learner's L1 and L2 Identities Development", *Frontiers in Psychology*, 12, p. 772777.
- Yin, J. et al. (2024) "The Influence of Robot Social Behaviors on Second Language Learning in Preschoolers", *International Journal of Human-Computer Interaction*, 40(7), pp. 1600–1608.
- Zakareh, B.I. et al (2021) "Social interactions as a barrier to second language learning: A sociocultural perspective", *International Journal of English Language and Literature Studies*, 10(2), pp. 145-157
- Zeng, G., and Takatsuka, S. (2009) "Text-based peer-peer collaborative dialogue in a computer-mediated learning environment in the EFL context", *System*, 37(3), pp. 434–446.