Exploring the Application of Artificial Intelligence in Foreign Language Education within School Settings: Systematic Literature Review

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Abstract

The systematic literature review explores the use of Artificial Intelligence (AI) tools in foreign language (FL) education within K-12 school settings. It aims to offer a comprehensive understanding of the current state of research, identify emerging trends and gaps in the literature, and provide valuable insights for educators and researchers in the field. We analysed 16 empirical studies conducted between 2019 and 2023, focusing on three key areas: the pedagogical integration of AI tools, their impact on language learning outcomes, and future research recommendations. The review provides insights into the pedagogical aspects of AI utilization, the theoretical frameworks of the studies, and the research methods employed. The findings highlight the specifics of using AI tools, their impact on language learning outcomes, and the challenges and potential benefits of implementing AI in K-12 FL education.

Keywords: Artificial Intelligence, Foreign Language education, School Settings, AI tools

1. Introduction

Artificial intelligence (AI) plays a special role in foreign language education (FL) around the world. The development of advanced AI tools, such as intelligent teaching systems, AI conversational agents, ChatGPT, robots, etc. in foreign language learning, has increased interest in their implementation, research in education, and the development of recommendations based on the obtained results (Divekar et al., 2021; Liu, 2023; Son et al., 2023). Systematic literature reviews which have explored AI in foreign language learning discuss the opportunities and challenges of implementing AI in foreign language teaching (Huang et al., 2023; Katsarou et al., 2023; Klimova et al., 2023; Tobing et al. 2023; Zhang & Zou 2020).

Recent systematic literature reviews have examined advanced technologies in language education (see Table 1). The reviews cover integrating these technologies into education and their impact on educational aspects (Liang et al., 2021; Zhang & Zou 2020; Tobing et al. 2023). Mobile learning, multimedia tools, and digital game elements are noted as effective tools for enhancing language learning experiences and motivation. Positive outcomes, including improved language skills and increased learner motivation, have been consistently reported. The studies also recognize challenges and limitations related to technology integration, emphasizing the need for ongoing research to address issues like short intervention periods and the effectiveness of

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technologies. The recommendations developed relate to the study of language skills and cognitive aspects, taking into account the development of technologies.

Table 1: Previous literature reviews on AI in foreign language education

Reviews on AI, FL, and Methodology	Focus of the studies	Findings	Contribution	Education level in the review
Tobing et al. (2023) • PRISMA[1] methodology and meta-analysis. • Empirical research from January 2018 to December 2022 • Analysis of 13 studies	Impact of new technologies on the English language learning process	• Improvement of language skills • Positive impact on language learning and students' confidence • Focus on Vocabulary Acquisition • Vague definition of AI tools' proper use • Lack of Innovative Technologies • Need for Teacher Education	• Identification of Technological Gaps • Focus on Effective Use of Technologies • Recommendations for Teacher Training	University
Ayotunde et al. (2023) • PRISMA methodology and meta-analysis • Articles published between 2011 and 2021 • Analysis of 25 articles	Impact of AI in foreign language learning with learning management systems	• AI tools in LMS enabling personalized learning • Improved language skills • Efficient Integration of AI for assessments, instant feedback, and teaching efficiency allowing educators to focus more on student guidance.	• Comprehensive synthesis of AI technologies integrated into LMS • AI's role in automating assessments, personalized learning, and feedback • Gaps in primary education • Crucial role of educators in effectively leveraging AI tools within LMS	Mixed
Sharadgah & Sa'di (2022) • Articles published between 2015 and 2021 • Analysis of 64 articles	Current research progress and understand challenges in the field of artificial intelligence (AI) in English language teaching (ELT)	• Increase in Research Output • Positive Impact of AI • Dominance of Mixed Research Methods • Technological Applications • Need for Quality and Reliability of Studies • Educator Involvement and Impact	• Critical Evaluation of AI Applications • Identification of Gaps and Misunderstandings • Focus on Validity and Reliability • Challenges in AI Implementation	Mixed
Jiang (2022) • Articles published between 2000 and 2022 • Analysis of 245 articles	The empowerment of EFL teaching and learning through AI	• AI applications in EFL teaching • Scarcity of empirical studies on AI's pedagogical impacts and ethical implications in EFL • Multi-modal analysis challenges of Deep Learning in EFL • Neglect of emotional and affective learning in AI-based EFL tools	• Synthesis of AI research in EFL: potential and challenges. • Need for innovation in multi-modal learning analytics and affective computing • Call for research on teachers' attitudes towards AI in EFL	Not specified
Woo & Choi (2021)	Recent developments in	• AI tools in language learning target various	• AI tools' utilization across language skills	Mixed

[1] Preferred Reporting Items for Systematic reviews and Meta-Analyses

• PRISMA guidelines • Articles from 2017 to 2020 • Analysis of53 articles	AI-based language learning tools, focusing on their types and impacts across various language skill areas in FL/SL	skill areas using different technologies • Positive impact of AI tools on language learning through assessment and feedback	• Learners' improved language skills and positive perceptions of AI tools' effectiveness and usability • Emphasis on diverse studies, pedagogical insights, and expansion to non-English languages and proficiency levels	
Our study • PRISMA guidelines • Between 2019 and 2023 • Analysis of 16 articles	Applications of Artificial Intelligence tools in FL teaching in K-12	• Positive influence of AI tools on FL learning • Emphasis on Affective factors in FL context, with AI chatbots being the most utilized tool • The need for personalized and flexible AI integration in FL • The balance between AI and human interaction	• Trends and themes identified • Pedagogical considerations outlined • Future research recommendations	K-12 (School Settings)

While several systematic literature reviews (SLRs) have explored the application of various AI models in FL education, there is a notable gap in the literature about trends, and AI tools utilised in school settings (Table 1). The reviews mainly analyse the studies conducted at schools or university/college levels with higher education learners (Ji et al., 2022; Liang et al., 2021; Sharadgah & Sa'di, 2022; Tobing et al., 2023; Zhang & Zou, 2020). This yields several valuable insights, but the current understanding lacks clarity on at which school levels AI applications are researched, the pedagogical and language aspects studied, and the overall findings—whether positive or negative—in school-based FL education studies. Moreover, there is insufficient common knowledge regarding crucial aspects, such as pedagogical considerations within school settings and for young learners that could substantiate the effective application and integration of AI in FL education.

Our systematic literature review aims to investigate and synthesise the use of AI tools in FL teaching, specifically within school settings (K-12). The review provides an understanding of the current state of research and identifies evolving trends and gaps in the literature between 2019 and 2023 (See Table 1). It discusses the pedagogical aspects of AI utilisation, explores the theoretical frameworks of the studies, and reviews the research methods applied. The following research questions guided our review:

RQ1: What pedagogical or foreign language aspects have been researched regarding AI utilization, and which theoretical frameworks were these studies grounded on?
RQ2: What AI tools were found to be employed in Foreign Language (FL) teaching in schools between 2019 and 2023?
RQ3: What were the research methods and findings?
RQ4: What challenges and opportunities are associated with the integration of AI tools in FL teaching within school settings?

By conducting this review, we aim to benefit teachers, researchers, and AI developers. The review aims to provide teachers with insights into effective pedagogical practices for integrating AI tools in language teaching. The review identifies gaps in the literature and areas for further research. For AI developers, the review provides an understanding of the needs and preferences of teachers and students to develop user-friendly and effective AI tools. The review offers valuable insights and practical recommendations to enhance the integration of AI in foreign language education, particularly in school settings.

2. Literature review

Key Systematic Literature Reviews on AI in FL Teaching and Learning

The swift progress in AI has raised numerous questions and challenges related to its use in schools, particularly its impact on teacher assistance, and students' motivation to learn with AI (Chiu et al., 2023; Baha et al., 2023; Velander et al., 2023). AI's role in FL education has received considerable attention (Gallacher et al., 2018; Kim et al., 2021; Lin & Mubarok, 2021). In this section, we will discuss the significant literature reviews on AI in FL education starting with the most recent (see also Table 1).

Tobing et al. (2023) focused on the use of new technologies for teaching English at the university level. It highlighted their increasing importance despite limited research on practical implications. The review emphasizes that technology generally enhances language learning, though more statistically reliable data is needed. AI tools, particularly mobile vocabulary learning apps, have improved students' vocabulary and fluency. The review underscores the necessity for students and teachers to become familiar with AI technologies to select appropriate tools. While the review highlighted positive findings, it also found some limitations such as a short intervention period, a small number of latest technologies in the studies, and an unclear description of the proper use of these tools.

Ayotunde et al. (2023) explored AI's impact on foreign language learning using learning management systems (LMS). AI tools enhance language learning by providing personalized questions, automatic grading, and detailed performance evaluations, reducing teachers' workload and offering students flexible, personalized learning. The review notes a rise in articles during the pandemic, mainly on learning English in non-English-speaking countries, and calls for more research on primary education. It highlights the effectiveness of AI integration in LMS, especially with platforms like Moodle and Edmodo, in improving speaking, writing, reading, and listening skills. The review stresses the need for more empirical research, teacher professional development, and ethical concerns like data privacy.

Sharadgah and Sa'di (2022) examined AI's impact on English Language Teaching (ELT). The review finds a significant increase in research during this period, with most studies reporting positive effects of AI on ELT. The research mainly focuses on higher education, with limited studies on primary education. The mixed research method, combining qualitative and quantitative approaches, is commonly used, providing a profound understanding of AI's role in ELT. The review highlights the need for more research on educators' roles in integrating AI into ELT and calls for broader database searches and the inclusion of non-English articles.

Jiang (2022) highlighted AI's significant enhancement of English as a Foreign Language (EFL) teaching and learning, achieving positive effects and feedback despite some technical and implementation issues. AI applications such as Automated Essay Scoring (AES), Neural Machine Translation (NMT), Intelligent Tutoring Systems (ITS), and AI Chat Robots show steady progress. However, AI tools often neglect students' emotional states. Affective Computing (AC) could address it, though ethical issues such as privacy and data protection should be considered. The review calls for more empirical studies, professional development for teachers, and ethical considerations to maximize AI potential in EFL contexts.

Woo and Choi (2021) examined various AI tools - speaking, listening, writing, reading, pronunciation, grammar, and vocabulary. These tools have been shown to enhance learners' language skills and are perceived as useful. The review stresses the need for

both learners and teachers to familiarize themselves with AI technologies. Teachers can help learners choose suitable tools based on their needs and preferences. It also suggests that teachers start with short-term activities to gain experience with AI tools, enhancing their effective implementation. Learners generally find these tools effective, interesting, and easy to use.

Most reviews identify the top countries, China and the United States, conducting AI studies in FL education, and English is the most commonly discussed foreign language in these studies. The reviews consistently highlight AI's positive impact on FL learners, particularly in writing, reading, speaking, listening, vocabulary, and grammar. Several types of AI models and tools are scrutinized across the reviews. These include: Speech recognition, Chatbots, Intelligent Tutoring Systems (ITS), Natural Language Processing (NLP), Automated Essay Scoring (AES), and Neural Machine Translation (NMT).

The above-mentioned reviews highlight several limitations, including the lack of statistically reliable data to assess the effectiveness of AI, the lack of research on the implementation and practical use of AI tools in education, technical issues, and the inappropriate use of AI tools. Other concerns include the neglect of students' emotional states and ethical issues, including data privacy, less focus on primary education, and the role of teachers in implementing AI. These limitations point to the need for multidisciplinary research to explore how AI can be effectively used to meet the needs of students, teachers, and curricula in schools, which is crucial for the successful implementation and sustainable use of AI.

3. Methodology

The systematic literature review adhered to PRISMA (2020) guidelines, encompassing three phases: Identification of papers, screening, and inclusion. The criteria for article eligibility included language (English), relevance to foreign language learning, utilization of AI tools, school setting context, empirical data inclusion (qualitative, quantitative, or mixed), publication within the last five years (2019-2023), and publication in scientific peer-reviewed journals.

Exclusion criteria comprised other educational settings like college or university and various types of studies/theoretical descriptions (e.g., descriptive papers, conference/position papers). Studies related to first language, sign language, or computer language learning were excluded, along with those solely involving teachers and teacher education, as well as studies focused on the development or description of AI tools.

The Databases Scopus, Google Scholar, and Web of Science were systematically searched between October 2023 and January 2024. Keywords and search strings included terms such as "foreign language" OR "foreign language learning" OR "foreign language teaching" AND "Artificial Intelligence" OR "AI Tools" OR "Machine Learning" OR "Deep Learning" OR "Chatbots" OR "Speech Recognition" AND "Secondary Education" AND "Primary Schools" OR "Elementary School" OR "Middle School" OR "High School."

Initially retrieving 16,800 papers on Google Scholar, 13,783 on Web of Science, and 85 on Scopus, the search was refined using keywords and filters, yielding 344 references. These were uploaded to Rayyan.ai and subjected to screening based on titles and abstracts. 286 papers were excluded at this stage; 22 duplicates were removed, 206 papers were on AI tools at the university/college level, 17 on AI application in translation or linguistics, and 19 offering theoretical reviews of AI tools, and the rest were about AI tools or teacher education in this direction. Further examination of the full texts of 58 papers revealed only 16

empirical studies describing AI tool applications in foreign language classes within a school context. Two researchers worked on further analysing these studies to synthesize findings and identify key trends in AI tool applications for foreign language learning at the school level.

Data extraction process consisted of specific information extracted from each included study: publication year, school level, the number of study participants, exploited AI tool, target foreign language, participants' language level, theoretical framework, research methods, key findings, and challenges.

4. Results and analysis

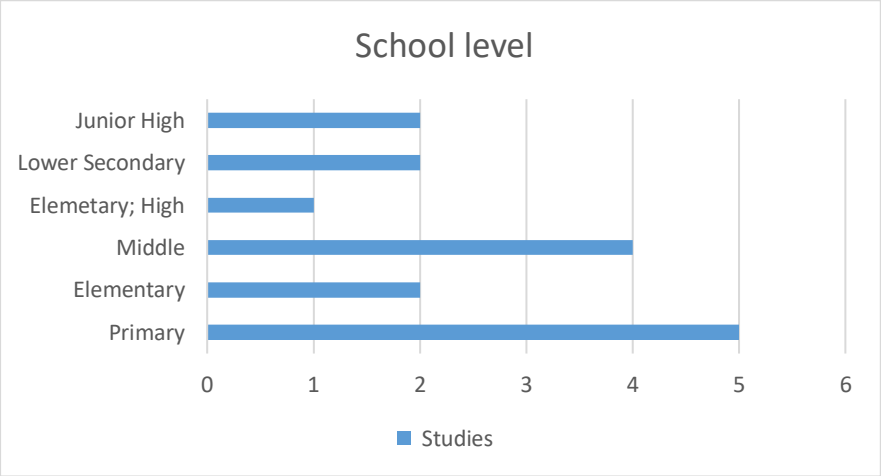
4.1. Characteristics of the studies

In this section, we present the results of the analysis of the studies and answer the research questions.

All 16 studies were carried out within school settings, with a distribution across different years indicating a notable increase over time: seven studies in 2023, six in 2022, one in 2021, two in 2020 and no studies in 2019. There might have been a gap in relevant literature in 2019. Geographically, two studies were conducted in Greece, two in Sweden, five in South Korea, three in China, and four specifically in Taiwan, China (See Table 3)

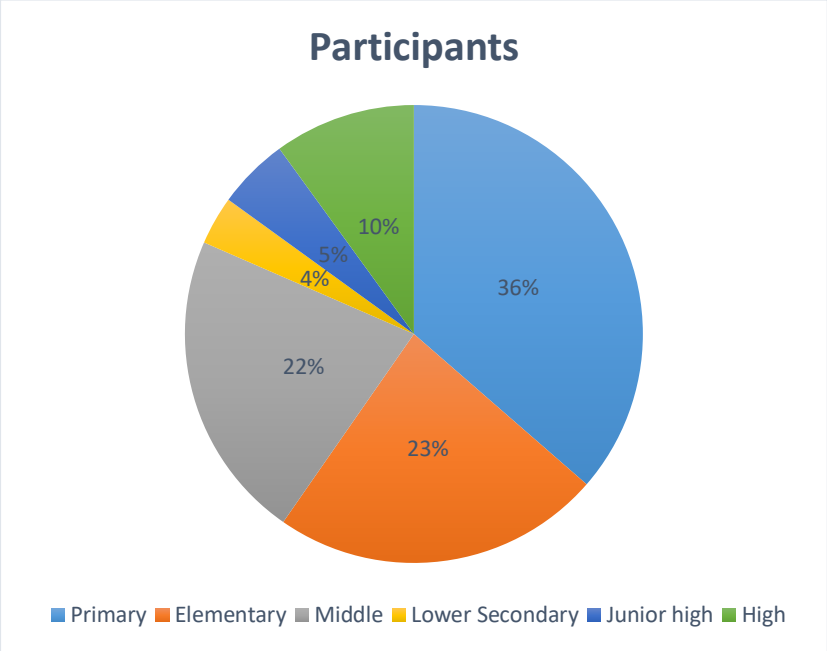
Regarding school levels, the studies covered a spectrum: five at the primary level, two at the elementary level, four at the middle level, two at the lower-secondary level, two at the junior high level, and one involving mixed levels, including elementary and high school (See Figure 1). Additionally, participants' ages and school grades are presented in Table 2. In some studies, grades were not specified. Given that the studies were conducted in different countries with varying school grade levels, participants' ages could be a more reliable characteristic. However, participants' ages were also not specified in some studies. Therefore, we included both age and grade to provide a more comprehensive overview.

Figure 1: School levels in the studies



In total, the 16 studies involved 1371 participants, with a distribution across various school levels. Specifically, 36% of the participants were at the primary level, 23% - the elementary level, 22% - the middle level, 10% - the high school level, 5% - the junior high level, and 4% -the lower secondary level (See Figure 2).

Figure 2: Participants at differen school levels



4.2. The foreign languages in the studies and learners' language levels

The studies encompass a few target languages, primarily focusing on English, with one study on French and one - German. The target audience for these studies comprises learners at the early stages of language acquisition, ranging from beginners to those with elementary and intermediate language proficiency levels. The treatment period lasted from at least two weeks to sixteen weeks.

Table 2: Characteristics of the studies

#	Authors	Participants' number	Participants' age/ grade	Target language & Level	AI tool	Treatment period	Focus of the study
1	(Athanassopoulos et al., 2023)	8 students	Aged 15/ 3rd grade of Junior High School	German Pre-Intermediate	ChatGPT	45 min.-lesson twice weekly - for 2 weeks	FL writing (Vocabulary and grammar)
2	(Wang et al., 2023)	16 students	6th grade of primary school	English Beginner ("Basic")	AI Coach	15 min. every school day for three months	Interaction with AI tool for the FL learning
3	(Chen Hsieh & Lee, 2023)	52 students	*/9th grade	English Beginner and Elementary	Robot Kebbi Air	12 weeks	Affective aspects (positive /negative emotions, grit) and learners' perceptions

4	(Yuan, 2023)	74 students and 2 teachers	Aged 12/ 5th grade	English Beginner	AI Chatbot Mondly	10 min. three times a week, for 3 months	Oral competence & Willingness to talk
5	(Jeon, 2023)	53 students	Aged 12/**	English Beginner	AI Chatbot created on Google Dialogflow	Two experimental sessions of 25 min. on two successive days	Vocabulary
6	(Ericsson & Johansson, 2023)	22 students	Aged 13-14/ 7th grade	English Beginner-Elementary	AI-Spoken Dialogue System on Enskill	25 min. 10 sessions over 4 months	Learning experience and speaking skills
7	(Ericsson et al., 2023)	25 students	Aged 13-14/ 7th grade	English Beginner	AI-Spoken Dialogue System in Enskill, (Virtual Human)	15 min. four sessions over two weeks	Speaking skills
8	(Mageira et al., 2022)	61 students	Aged 15-17/ High-school students/**	English, French from Beginner to Proficient	AI chatbot - AsasaraBot	2 sessions (Duration not specified)	CLIL (Learning of foreign language and cultural content)
9	(Liu et al., 2022)	68 students	Aged 11-12/ 5th grade	English Beginner ("initial")	AI Chatbot	80 min. for six weeks	Interaction with a chatbot, students' engagement and interest in extensive reading
10	(Lee & Jeon, 2022)	67 students	Aged 9/**	English Beginner	Voice-controlled agent – Google Dialogflow	3 tasks of 20-30 min. duration	Learners' perceptions of AI tool and justifications of these perceptions
11	(Tai & Chen, 2022)	92 students	Aged 14-15, 9th grade	English Elementary to Intermediate	Google Assistant app, Google Nest Hub, Google Nest Mini	45 min. sessions twice a week for 10 weeks	Listening comprehension
12	(Yang et al., 2022)	177 students 137 students	Aged 10-11/ 5th-6th graders Aged 15/ 1st grade of High school	English Beginner to pre-intermediate	Task-based voice chatbot Ellie	10-15 min. task – in total 3 tasks 2-3 sessions a week- over three weeks	Implementation of AI tool as a conversation partner
13	(Wang et al., 2022)	327 students	Aged 6-8/ 1st grade	English Beginner	AI coach	10-15 min. every day for two and a half months	The impact of Learners' perceptions of AI on learners' L2 enjoyment and learning outcomes
14	(Jeon, 2022)	36 students	Aged 12/**	English Beginner	AI Chatbot created on Google Dialogflow	a 40 min. lesson per week for 16 weeks	Learners' motivation to learn
15	(Han, 2020)	44 students	*/ 1st grade of middle school	English (Level not specified)	AI chatbot - Echodot	20-min. session a week for 10 weeks	Speaking skills and affective domains
16	(Tai & Chen, 2020)	112 students	Aged 15-16/ 8th grade	English Elementary to Intermediate	Google Assistant App, Google Home Hub	Eight 50 min. sessions for 2 weeks	learners' perceptions toward AI tool

**Age not specified; **Grade not specified*

RQ1: What pedagogical or foreign language aspects have been researched regarding the AI application?

The studies encompass a broad spectrum of investigations into the influence of AI tools on the aspects of foreign language education at the school level (See Table 2). The impact of AI chatbots on oral English competence and willingness to communicate is examined as well as the effects on vocabulary learning and the simultaneous learning of foreign language and cultural content (Ericsson et al., 2023; Ericsson & Johansson, 2023; Jeon, 2023; Mageira et al., 2022; Wang et al., 2023; Yuan, 2023) Additionally, the experiences of learners in using conversational AI for developing speaking skills are examined, focusing on the affordances that affect motivation (Han, 2020; Jeon, 2022; Tai & Chen, 2020; Wang et al., 2022). Lower secondary school students' perspectives on practising foreign language speaking skills with virtual humans are explored in a social digital space, while the effective implementation of AI as a conversation partner or AI coach is investigated (Wang et al., 2022, 2023). Further research investigates how the perceived social, cognitive, and teaching presences of AI predict learners' enjoyment and learning outcomes (Chen Hsieh & Lee, 2023; Lee & Jeon, 2022; Yang et al., 2022). Additionally, the effects of AI chatbots on students' speaking competence and affective domains are examined, along with perceptions toward Intelligent Personal Assistants, their impact on listening comprehension, and preferences for interaction styles (Tai & Chen, 2020, 2022). The use of ChatGPT in improving L2 writing for students with a refugee/migrant background is assessed (Athanassopoulos et al., 2023). Another study focuses on elementary students' interaction with AI chatbots, examining their impact on engagement and interest in extensive reading (Liu et al., 2022). Lastly, investigations into digital storytelling outcomes, emotions, grit, and perceptions are conducted in the context of robot-assisted and PowerPoint-assisted presentations (Chen Hsieh & Lee, 2023).

These studies stress the transformative potential of AI chatbots in enhancing oral English competence, vocabulary learning, and cultural understanding. They also highlight the motivational benefits of using conversational AI for developing speaking skills and the evolving role of AI as a conversation partner or coach. Moreover, research exploring the social, cognitive, and teaching presences of AI indicates their significant influence on learners' enjoyment as well as learning outcomes.

4.3. Theoretical frameworks of the studies

The studies under the review have distinct theoretical frameworks based on Second Language Acquisition theories related to behaviourism, psychological theories, and sociocultural theories (see Table 3). Dynamic Assessment (DA) and Cognitive Load theory were combined to improve vocabulary learning (Jeon, 2023). Integration of AI chatbots to enhance cultural and language learning through the CLIL approach in secondary education has been demonstrated (Mageira et al., 2022). Chen Hsieh & Lee, (2023) combined robot-assisted language learning with Experiential Learning Theory and Learning by doing. As for ChatGPT, it has been employed for diverse language learning tasks, building on Task-Based Language teaching principles (Athanassopoulos et al., 2023; Kim et al., 2023). Ericsson & Johansson (2023) designed their study following a new theoretical framework of Student-Conversational-Interaction (Ericsson & Jansson, 2021). Human-AI interactions using the Community of Inquiry (CoI) framework have been analysed, examining social, cognitive, and teaching presences along with the Students' Approaches to Learning (SAL) Framework (Wang et al., 2023; Wang et al., 2022). Task-based language teaching with AI chatbots for young EFL learners has been explored (Yang et al., 2022), alongside CoI in human-AI interactions in online education settings (Wang et al., 2022). Intelligent Personal Assistant (IPA)-supported language learning has been investigated for its real-time interactivity and role in enhancing language practice through the Interaction Hypothesis (Tai & Chen, 2022). Anthropomorphism in educational virtual agents (VCAs)

has been analysed, highlighting cognitive and motivational factors (Lee & Jeon, 2022). The effectiveness of chatbots as book talk companions was studied within Interest-driven Social Approaches (Liu et al., 2022). Affordances in language learning environments with chatbots have been examined, emphasising pedagogical, technological, and social influences (Jeon, 2022). The impact of human-robot interaction on language education, focusing on anxiety reduction and increased comfort through AI chatbot interactions, has been explored (Han, 2020). AI and automatic speech recognition technologies in improving second language speaking skills have been investigated, emphasising learners' willingness to communicate (WTC) with IPAs like Google Assistant (Tai & Chen, 2020).

In some studies, a dominant framework was evident, but the authors also referenced additional frameworks or theoretical concepts to link the application of AI (Dialogue-based computer-assisted language learning, Technology/AI -AI-assisted language learning). This approach reflects a combination of different theoretical models from both language and technology education. The trend across these studies indicates a shift towards integrating advanced technological tools with established educational theories, showcasing a more holistic approach to enhancing foreign language education.

Table 3: Theoretical frameworks and research methods in the study

#	**Author**	**study Country**	**School level**	**Theoretical background**	**Methods & instruments**
1	(Athanassopoulos et al., 2023)	Greece	Junior High	• Task-Based Language Teaching (TBLT) • Affordances Theory	Mixed: Qualitative characteristics: Total Words, unique Words, average words per Sentence, and most frequent words measured by ChatGPT
2	(Wang et al., 2023)	China	Primary	• Community of Inquiry (CoI) (Garrison & Arbaugh, 2007) • Students' Approaches to Learning (SAL) Framework	Qualitative: reflection essays, cluster analysis and epistemic network analysis.
3	(Chen Hsieh & Lee, 2023)	Taiwan, China	Middle	• Experiential Learning Theory (ELT) (Kolb, 1984) • Learning by doing (Dewey, 1938) • Robot-assisted language learning	Mixed: pre-/post-tests, questionnaire about emotions, a grit survey, a perception survey, and reflective journals
4	(Yuan, 2023)	China	Elementary	Willingness to Communicate (WTC) (MacIntyre et al., 1998; Paas et al., 2003)	Mixed: pre-test, post-test to measure proficiency; WTC questionnaire, control and experimental groups, interview with teachers and students
5	(Jeon, 2023)	South Korea	Primary	• Cognitive Load Theory (CLT) (Pass, Renkl, & Sweller, 2003) • Dynamic Assessment (DA) (Rassaei, 2020)	Mixed: Quasi-experimental: randomly assigned three groups: Two post-tests, Analysis of Interaction records between the chatbots and learners
6	(Ericsson & Johansson, 2023)	Sweden	Lower Secondary	Framework of Student-Conversational-interaction (including four interrelated dimensions of *educational experience*; cognitive, emotional, social, and teaching) (FoSCAI) (Ericsson & Jansson, 2021)	Mixed: Quantitative and qualitative: questionnaires and systematic logbook reflections

7	(Ericsson et al., 2023)	Sweden	Lower Secondary	• "Pedagogical approach of learning through practice, with the active use of the target language in task-based teaching and learning in line with the communicative approach." - (Chapelle, 2009); (Blake, 2017) • Interaction hypothesis (Long, 1996) • Dialogue-based computer assisted language learning (Blake, 2017)	Qualitative: questionnaires, logbooks, and interviews
8	(Mageira et al., 2022)	Greece	Junior High	Content and Language Integrated Learning (CLIL approach)	Mixed: experimental, a pre-test and a post-test
9	(Liu et al., 2022)	Taiwan, China	Elementary	Interest-driven social approach (Chambers, 1985)	Mixed: Analysis of interaction (dialogues) between the chatbot and students, flow questionnaire, Godspeed questionnaire (Bartneck, 2023), pre- and post-interest questionnaire, situational interest questionnaire, open-ended interviews
10	(Lee & Jeon, 2022)	South Korea	Primary	Anthropomorphism Theory (Epley et al., 2007)	Mixed: drawing task and in-depth interview
11	(Tai & Chen, 2022)	Taiwan, China	Middle	Interaction hypothesis (Long, 2017)	Mixed, Quazi-experimental: randomly divided into two experimental groups and one control group; English listening tests and qualitative data - questionnaires and interviews
12	(Yang et al., 2022)	South Korea	Elementary; High	Task-Based Language Teaching (TBLT)	Quantitative: Survey questionnaire
13	(Wang et al., 2022)	China	Primary	• Community of Inquiry (CoI) (Garrison & Arbaugh, 2007) • AI-supported language learning (Randall, 2019)	Mix: Midterm English test scores, frequencies of English shadowing and scores of English shadowing given by the AI coach (Hamada, 2016); survey
14	(Jeon, 2022)	South Korea	Primary	Affordances (Gibson, 1986) (Stoffregen, 2018)	Mixed: individual in-depth interviews, student-chatbot interaction logs; Qualitative analysis of the interview transcripts
15	(Han, 2020)	South Korea	Middle	• Affective factors in SLA (Brown, 2007) • Technology assisted language learning (Walker & White, 2013)	Quazi-experimental: NEAT speaking test as pre- and post-tests; structured questionnaire surveys before and after the treatment
16	(Tai & Chen, 2020)	Taiwan, China	Middle	Willingness to Communicate (WTC) (MacIntyre et al., 1998)	Mixed: Pre- and post- WTC questionnaires

RQ2: What AI tools were found to be employed in Foreign Language teaching in schools between 2019 and 2023?

Various AI tools were employed across the studies in language learning (See Table 2). These tools include AI Chatbots Mondly, AsasaraBot, Ellie and Echodot, each designed to facilitate different language learning aspects (Han, 2020; Mageira et al., 2022;

Yang et al., 2022; Yuan, 2023). Additionally, AI Spoken Dialogue Systems developed on Enskill (Virtual Human) and Google Dialogflow were utilised, emphasizing interactive spoken conversations (Ericsson et al., 2023; Ericsson & Johansson, 2023; Jeon, 2022, 2023; Lee & Jeon, 2022). Notably, the studies also involved the integration of Google Assistant across different devices like Google Home Hub and Google Nest Mini, highlighting the versatility of AI in language learning (Tai & Chen, 2020b, 2022). The presence of AI coaches, ChatGPT and robots like Kebbi Air further exemplifies the diverse AI tools explored in these studies (Athanassopoulos et al., 2023; Chen Hsieh & Lee, 2023; Liu et al., 2022; Wang et al., 2022, 2023).

The reviewed studies demonstrate the extensive use of various AI tools and technologies, such as AI Chatbots, Spoken Dialogue Systems, Google Assistant, AI coaches, and robots, in diverse aspects of language learning.

RQ3: What were the research methods and findings?

4.4. Research methods and instruments

In the studies under review, various research methods and instruments were employed to comprehensively investigate the applications of Artificial Intelligence (AI) tools in school settings (See Table 3). The research encompassed different methodologies and instruments, such as pre-/post-tests and survey questionnaires, reflection essays, interviews, and logbook reflections. Most studies (12) utilized a mixed-methods approach, combining both quantitative and qualitative instruments, showcasing a commitment to a holistic understanding of the research questions. For instance, the incorporation of AI-driven language analysis tools like ChatGPT demonstrated an innovative integration of technology for qualitative exploration (Athanassopoulos et al., 2023). Furthermore, in Tai & Chen's (2022) study, a quasi-experimental design was applied, where groups were randomly assigned and subjected to specific interventions. The instruments, such as interaction logs and drawing tasks, highlighted a nuanced exploration of AI integration in education. This methodological diversity reflects the complexity of the research domain (See Table 3).

4.5. Research findings

These studies highlight the transformative potential of AI tools and related technologies in language education. They offer innovative ways to enhance learning experiences, boost confidence, and foster motivation among students. The following findings were observed in these studies:

Effectiveness of AI Tools versus Traditional Methods in EFL Education - Studies comparing AI tools (e.g., robots like Kebbi Air) with traditional methods (e.g., PowerPoint presentations) find AI tools more effective in fostering positive emotions, grit, motivation, and critical thinking skills (Chen Hsieh & Lee, 2023). AI chatbots effectively manage cognitive load and support learner development through tailored instruction, particularly in vocabulary acquisition (Jeon, 2023).

Human-like Interaction and Motivation - AI chatbots provide opportunities for human-like interaction, increasing motivation to speak outside the classroom and engaging students in daily tasks (Ericsson et al., 2023). AI chatbots help promote learner-centric education, reduce language anxiety, and boost learners' confidence in using a new language (Yuan, 2023). Chatbots simulate real-life situations for young EFL students, offering practical language practice with high task success rates (Yang et al., 2022). Students feel a high level of social connection with chatbots due to their anthropomorphism, intelligence, and likability, enhancing engagement and motivation (Liu et al., 2022). Student perceptions of English language competencies impact

motivation to learn through chatbots. Technological affordances compensate for interactional constraints, reducing social anxiety and encouraging more active English communication. AI-assisted language learning activities increase students' willingness to communicate, fostering confidence in their English abilities (Tai & Chen, 2020). Virtual conversational agents are appreciated for their social attributes and potential as effective language partners, despite some technical limitations (Lee & Jeon, 2022).

Cognitive Presence and Personalized Learning are crucial for L2 enjoyment, with AI coaches providing a supportive and personalized learning environment (Wang et al., 2022). Chatbot technology allows for self-paced learning in a friendly environment outside the classroom, with positive feedback from participants (Mageira et al., 2022). AI chatbots have a positive impact on low-proficiency students (especially females), helping to bridge proficiency gaps and provide targeted support (Ericsson & Johansson, 2023).

Several studies mention **the gains in language skills**: Interaction with Intelligent Personal Assistants (IPAs) like Google Assistant improves listening comprehension, offering dynamic learning experiences (Tai & Chen, 2022). Voice-based AI chatbots enhance speaking competence, providing meaningful oral communication opportunities and positively impacting beliefs, motivation, interest, and anxiety related to language learning (Han, 2020). Tools like ChatGPT improve unique word usage, and sentence length in L2 writing, although human supervision is needed to prevent misuse (Athanassopoulos et al., 2023).

AI Effectiveness and Instructor Role - Research extends the CoI theory, suggesting AI's effectiveness depends on students' learning approaches and expectations. It emphasizes the role of human instructors in facilitating AI adoption and calls for improved algorithms for personalized feedback (Wang et al., 2023).

The findings indicate the potential of AI technologies to enhance language learning experiences, promote learner engagement and motivation, and improve language proficiency across various skill domains.

RQ4: What challenges and opportunities are associated with the integration of AI tools in FL teaching within school environments?

Analysing challenges and synthesizing common issues from the studies reveal several themes related to the effective integration of AI tools in language education. These themes were divided into three groups: methodological, technological, and pedagogical considerations (See Table 4).

Table 4: Challenges and opportunities given in the studies

Methodological Issues	Technological Challenges	Pedagogical Considerations
Sample Size & Generalizability; Novelty bias -Yuan (2023), Jeon (2022), Han (2020), Tai & Chen (2020), Athanassopoulos et al. (2023), and Ericsson et al. (2023) Wang et al. (2022), Chen Hsieh & Lee (2023), Jeon (2023), Lee & Jeon (2022), and Athanassopoulos et al. (2023) ***Short Duration of Study***- Yuan (2023), Yang et al. (2022), Tai & Chen (2020),	***Technical limitations*** - Yang et al. (2022), Mageira et al. (2022), Ericsson et al. (2023) (Jeon, 2022) (Lee & Jeon, 2022) ***AI Appearance and Affection*** - Wang et al. (2022)	***Inclusion of participants of Different Age Groups, proficiency level and Cultural Backgrounds*** - Lee & Jeon (2022), Chen Hsieh & Lee (2023), Yang et al., (2022) ***Parental Attitudes Towards AI -*** Yuan (2023) ***Variability in Interaction -*** Yang et al. (2022), Tai & Chen (2020)

Athanassopoulos et al. (2023) and Ericsson & Johansson (2023) ***Teachers' Perspectives and Objective Grading-*** Ericsson & Johansson (2023) ***Controlled Speaking Sessions-*** Ericsson & Johansson (2023) ***Testing Intervals and Systematic Testing Methods -*** Jeon (2023) **Previous experience with AI tool -**Lee & Jeon (2022)		***Affordance of AI Agents -*** Wang et al. (2023), Jeon (2021), Lee & Jeon (2022) ***Social and Cognitive Aspects -*** Ericsson & Johansson (2023) ***Language Proficiency and Contextual Considerations*** - Jeon (2022, 2023) ***Application of different Theoretical Frameworks*** - Wang et al. (2023) **Few tasks utilized to investigate the effectiveness of AI chatbots** -Yang et al., (2022) Tai & Chen, (2022)

The limitations in the methodological issues of the studies include the small number of participants, which does not allow for the generalization of the findings to larger populations. To overcome this limitation, a large number of participants is considered by Yuan (2023), Jeon (2022), Han (2020), Tai and Chen (2020), Athanassopoulos et al. (2023), and Eriksson et al. (2023). It is also worth noting that the participation of students from different backgrounds and educational levels are considered by Wang et al. (2022), Chen Hsieh & Lee (2023), Jeon (2023), Lee & Jeon (2022), and Athanassopoulos et al. (2023). Another limitation is the short-term nature of the studies, which limits the evaluation of the effectiveness of AI in language learning. In this regard, studies by Yuan (2023), Yang et al. (2022), Tai & Chen (2020), Athanassopoulos et al. (2023), and Ericsson & Johansson (2023) suggest that long-term studies are needed to examine the sustainable impact of AI chatbots on language learning. The participation of teachers and parents in the studies to evaluate AI instruments is indicated by Ericsson & Johansson (2023) and Yuan (2023). Regarding the study of conversational sessions, Ericsson & Johansson (2023) believe that these sessions should be controlled and the learning process should be without long breaks to analyze the results of students' learning. In this way, students' language skills will be systematically observed and challenges will be noticed in a more structured environment. The time interval between tests conducted in the studies is another limitation (Jeon, 2023). Testing should be conducted systematically and across multiple interactions with AI tools to more accurately measure learning outcomes. In turn, a more accurate description of the impact of AI on learning outcomes will help us better understand the capabilities and limitations of AI in FL teaching.

The studies have identified technological limitations. For example, in the case of chatbots, the limitations of voice recognition platforms and the appropriateness of task design are crucial to their effectiveness (Yang et al. 2022). These limitations hinder their active implementation and hinder the use of chatbots in FL learning environments. Other examples of limitations in this group include the difficulties of sending audio messages and embedding files (Mageira et al. 2022). These challenges reduce learner engagement and the effectiveness of chatbots in FL education. By addressing these issues, learning environments will become more dynamic and interactive. Other challenges include natural language processing (NLP), speech recognition (Ericsson et al., 2023), and the visual side of AI chatbots (Wang et al., 2022). The latter may affect students' attitudes towards AI tools and their learning outcomes. Positive student perceptions of the visual side of AI enhance student engagement and motivation.

Pedagogical considerations related to the implementation of AI in FL are presented in several themes: Chen Hsieh and Lee (2023) emphasize that various learners should be involved in foreign language learning when using AI tools to achieve more representative research results. For example, Lee & Jeon (2022) advocate involving different age groups and cultural backgrounds when using AI conversational agents. Tasks and interaction modes in AI tools should be diverse (Yang et al. 2022; Tai & Chen, 2020) and different types of AI agents should have different anthropomorphic or methanotrophic designs as they impact learning outcomes (Wang et al., 2023; Jeon, 2022; Lee & Jeon, 2022); different types of AI enhance student engagement and interaction in foreign language learning. In AI-student interaction, social and cognitive dimensions of learning outcomes should be analyzed (Ericsson & Johansson, 2023). Contextual differences, students' language proficiency, their lack of willingness to communicate

with AI chatbots, and preferences for peer conversation should be considered while using AI tools in FL education (Jeon, 2022, 2023).

The above topics emphasize the need to use AI tools tailored to meet the learners' needs and interdisciplinary approaches in research. These approaches will integrate different theories and enrich the basis for the use of AI in FL teaching.

5. Discussion

The paper reviews the use of AI in FL education in a school setting by exploring the empirical studies, published between 2019 and 2023. The following findings are worth noting: the most frequently used AI technologies and the topics researched, the limitations of AI tools, and their potential.

One of the important findings of this research is that AI technologies, such as chatbots, adaptive learning platforms, and robots, improve the learning process, increase student engagement, and facilitate understanding of cultural nuances of issues. These tools reduce cognitive load while teaching vocabulary. The most researched topics are attitudes, motivation, and willingness to speak in the context of language learning in the reviewed studies, and AI chatbots were the most frequently used tool.

Regarding the school level, most studies were conducted in primary education. One reason may be that it is easier to use simple AI tools, with limited functions, for language learning at the primary level. Furthermore, these tools are mainly used by beginners due to their simple design and limited functionality, and at the initial level, participants usually have no prior AI experience. In addition, students are learning FL for the first time, which allows for objective research.

Studies have shown that it is necessary to overcome technological limitations. Continuous progress is important for AI tools in FL education. For example, improvements in natural language processing and speech recognition will develop the accuracy of students' understanding and responses and increase the capabilities of AI tools in FL teaching (Jiang, 2022). In addition, it is important to refine algorithms to provide personalized feedback (Sharadgah & Sa'di, 2022). Advanced AI tools will improve the learning environment, make it more personalized, reduce anxiety, and provide flexible learning experiences (Sharadgah & Sa'di, 2022; Tobing et al., 2023; Woo & Choi, 2021).

Students' perceptions of the AI role in the learning process and their interactions influence the learning process and outcomes. If students perceive AI as a teacher, this can be stressful for them and negatively affect L2 learning. On the other hand, when students perceive AI as a friend/peer, it creates a more pleasant learning atmosphere and develops a stronger connection to language learning, especially for younger students. Balancing AI and human interaction in the educational process is another important aspect. Teachers create the learning context for the use of AI tools, provide support to students, and appropriately hold them accountable for balancing AI-student interaction. The role of teachers is more than just testing and adapting new technologies and methods; it should be directed through continuous professional development, supported by Ayotund et al. (2023) and Sharadgah & Sa'di (2022).

What factors should teachers, AI developers, and researchers consider when implementing AI tools in FL education in classroom settings? First, students have different abilities and preferences, which are crucial in determining the effectiveness of AI tools. Second, students have different levels of competence and interpret learning activities differently. AI developers should design AI tools with this in mind. AI tools should facilitate active student engagement and the training of various skills. Third, through interaction with AI, students acquire and retain information, although this may be superficial learning, where students focus on small details. Instead, new knowledge should be embedded in an existing cognitive framework. Therefore, more attention should be paid to developing students' critical thinking skills and actively using them in learning. Fourth, AI in FL teaching should be

carefully planned and inclusive. Such an approach will improve student learning outcomes and engagement. It is essential to provide appropriate training to teachers and students to use AI and to build collaboration between them.

We have developed recommendations in several directions. Researchers should study the external side of AI and how it affects students in the classroom. For example, it is important to consider the technical characteristics of AI chatbots, such as color, size, and gender, in future research. Its design and anthropomorphic characteristics affect students' attitudes and interactions with AI. AI developers can create more effective and engaging educational tools that meet the needs of students. Various factors such as student age, cultural background, gender, and language proficiency should be considered in research to draw conclusions in different educational contexts. Teacher involvement and interdisciplinary approaches in the studies provide a more comprehensive examination of the role and impact of AI in FL education.

6. Conclusion

In this systematic literature review, we analyzed AI tools, their challenges, and opportunities in FL education at the school level. The findings highlight their possible impact on language learning in school settings (K-12). Despite positive findings such as reduced student anxiety and enhanced engagement, the paper emphasizes the need for teacher involvement in the learning process and presents recommendations for further research on the use of AI tools in FL education.

Limitations

The paper may not cover the latest developments or the long-term effects of AI in FL education. Researchers may have inadvertently revealed bias in their reasoning.

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