An-Najah University Journal for Research – B
Humanities
مجلة جامعة النجاح للأبحاث – ب
العلوم الإنسانية

# Artificial Intelligence and Child Second Language Learning

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(Type: Full Article). Received: 24th Feb. 2025, Accepted: 15th Dec. 2025, Published: 1st Feb. 2026.
DOI: https://doi.org/10.35552/0247.40.2.2748

**Abstract: Objective:** This study investigates the effectiveness of Artificial Intelligence (AI) tools in enhancing children's second language (L2) learning, with a focus on cognitive and metacognitive skills. **Methodology:** A mixed-methods approach was used, combining both the statistical analysis of children's L2 achievement pre- and post-tests and content analysis of interviews with educators, parents, and AI developers. **Key Findings:** The study revealed that AI technologies, such as speech recognition systems and interactive learning environments, hold significant promise for enhancing children's L2 learning by providing immediate feedback tailored to learners' conditions. **Conclusions and Recommendations:** Nonetheless, its application should adhere to specific guidelines, as barriers, including ethical concerns, insufficient teacher training, and overdependence on technology, were identified.

**Keywords:** Children L2 Learning, Metacognitive Skills, AI Technologies, Language Development.

# الذكاء الاصطناعي وتعلم الأطفال للغة ثانية

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تاريخ التسليم: (2025/2/24)، تاريخ القبول: (2025/12/15)، تاريخ النشر: (2026/2/1)

**الملخص: الهدف:** تستكشف هذه الدراسة فعالية أدوات الذكاء الاصطناعي (AI) في تعزيز تعلم الأطفال للغة الثانية (L2)، مع التركيز على المهارات المعرفية وما وراء المعرفية. **المنهج:** تم استخدام نهج متعدد الأساليب، يجمع بين التحليل الإحصائي لاختبارات تحصيل الأطفال في اللغة الثانية قبل الاختبار وبعده وتحليل محتوى المقابلات مع المعلمين وأولياء الأمور ومطوري الذكاء الاصطناعي. **أهم النتائج:** كشفت الدراسة أن تقنيات الذكاء الاصطناعي، مثل أنظمة التعرف على الكلام وبيئات التعلم التفاعلية، حسّنت تعلم الأطفال للغة الثانية من خلال تقديم تغذية راجعة فورية مصممة حسب حال الأطفال. ومع ذلك، حددت الدراسة أيضاً حواجز، بما في ذلك المخاوف الأخلاقية، ونقص تدريب المعلمين، والاعتماد المفرط على التكنولوجيا. **الاستنتاجات والتوصيات:** تشير النتائج إلى أن الذكاء الاصطناعي يحمل وعوداً كبيرة لتعزيز تعلم اللغة لدى الأطفال في مرحلة الطفولة المبكرة. ومع ذلك، يجب أن يلتزم تطبيقه بإرشادات محددة.

**الكلمات المفتاحية:** تعلم اللغة الثانية للأطفال، المهارات ما وراء المعرفة، تقنيات الذكاء الاصطناعي، تنمية اللغة.

## Introduction

Additionally, AI-supported technology will also help in the aspect of metacognition by encouraging learners to evaluate their language, think further about their progress and use techniques to enhance their language (Mehmood, Gondal, Faiz, & Khurshid, 2025). These cognitive and metacognitive skills correspond with current theories of learning that advocate for student autonomy to drive positive learning outcomes and emphasize metacognition as a critical component of achieving the ultimate learning goal (McCauley & Christiansen, 2019). The most significant benefit, of course, is that AI can guide children as we consider strategies and outcomes, creating space and momentum for cognitive and metacognitive activity. Despite its advantages, AI in educational research raises challenges regarding ethics, dependence, decreased human communication, and socio-emotional learning effects (Nguyen, Lai, & Nguyen, 2024).

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More importantly, we need empirical research regarding the impact of AI-supported learning of L2 on the metacognitive and cognitive development of children and whether AI-supported learning affects the resourcing and complementarity of old-fashioned teaching practice. An increasing number of these same studies support the aforementioned findings. Almheles (2023) mentions that with personalized experience, the impact of AI on L2 acquisition in children can be profound through educational learning in a personalized way. This study demonstrates how AI can monitor or assess learners' performance and generate feedback systems that will exploit the best and worst of learners' performance. It explains that smart tutoring systems can recognize and even spell out the type of grammatical or pronunciation error and offer instant fixes, speeding up learning. The research also discusses AI's capability to monitor a learner's processing with time and to modify difficulty and content delivered to the learner, which, in turn, sustains engagement with the learning task and allows for further growth as an L2 learner.

This is believed to facilitate both the cognitive and metacognitive aspects of L2 learning, suggesting that AI is intended to be a technological tool for upgrading L2 education. Su and Yang (2022) undertook a survey on the role of AI in childhood education. It was emphasized that with AI tools, child learning can improve its linguistic and cognitive development very effectively. Moreover, Dupoux (2018) has proposed how students' cognitive structure for language learning is changing as it involves AI and outlines a direction as to how AI contributes to learners' cognitive skills in the development of language. These findings indicate the advantages of using AI in language learning but demand further research studies on how AI can play an important role in early L2 learning. The existing literature on promoting children's L2 learning through AI does however remain relatively scarce in the area. Taking into account existing gaps in literature and empirical research, together with the data collected, this research provides new knowledge on potential and problems with AI technologies in language learning at early stages of development.

**Statement of the Problem**

The use of AI-supported education has transformed L2 learning and opened up possible uses for formative assessment and instruction in children's L2 learning where children can have their L2 learning monitored and receive formative feedback in real-time to assist them to make improvements in their own L2 learning process. L2 learning is typically stagnant and provides little opportunity for flexibility for each child to develop language skills at their own pace, but in contrast, children L2's learning is increasingly benefiting from the growing popularity of AI-supported education, which will be beneficial for those children whose L2 language development does not follow the AI typical-development trajectory. The increasing use of AI in children's L2 learning and concern about over-reliance on AI tools in education is prevalent, potentially keeping children from having genuine human interaction even as we look to replace their needs with virtual developments for children. Alnajjar et al. (2023) recommend the inclusion of cognitive and metacognitive activities in technology-based learning programs to increase learning opportunity, reflection, and a more inclusive experience.

This study will help determine how AI learning tools, in contrast to regular learning, are less socially rich and developmentally specific to the issues of communication, while at the same time reflect upon and explore

pedagogy by asking the question of how does the use of AI in children's L2 learning and regular learning practices compare with children's L2 learning communication and interactions? Moreover, this study seeks to shift the conversation about technological relativism for children within early education towards a more sophisticated balance of response. The study also aims to rethink the AI applications in the development of children's language and examine the cognitive processes that AI supports in learning an L2. Furthermore, it analyzes the problems and ethical issues related to AI applications in the processes of L2 learning. Finally, guidelines are suggested for properly implementing AI in early childhood education.

**Significance of the study**

The significance of the current study lies in understanding the drawbacks and advantages of using AI tools and their applications in teaching L2 to children in the early stages of development, in order to determine the extent of AI benefits and avoid the adverse effects resulting from it. Additionally, understand how AI tools affect the development of cognitive, social, and emotional growth in children, contributing to the building of confidence and the acquisition of vocabulary, grammatical structures, and pronunciation improved of L2. The results of the current study can contribute to providing educational guidance for the effective use of AI tools in developing learning objectives and creating suitable tools for teaching children L2.

**Research Questions**

This study was designed to answer the following questions:

1. How do AI-based language learning tools influence vocabulary acquisition, grammar proficiency, and pronunciation in children aged 6 to 10 who are learning a second language L2?
2. What are the perceptions of educators, AI application developers, and parents regarding the integration of AI tools in children's L2 learning?

**Theoretical Background**

Recently, AI has emerged as a catalyst for change in several areas of education. One area that is showing incredible potential is L2 learning for children. In the case of children learning a new language, cognitive and metacognitive skills determine how successful they will be at learning vocabulary, grammar, and communicative competence; however, the extent to which they can do this is not the case in L1 acquisition. The cognitive and metacognitive processes are critical for early childhood education and language use. Cognitive developmental theories focus on the cognitive processes involved in language acquisition, such as memory, attention, and problem-solving, and how children process the language they hear. In contrast, metacognition is an individual's capacity to perceive and control cognition.

Cognitive processes relate to activities such as pronunciation, word recall, and the use of grammatical structures. On the other hand,' metacognition' allows learners to assess their progress, plan for future lessons, and adapt to new learning methods as need (Alnajjar et al., 2023). In the given processes, AI can operate as a tool in teaching L2 learning and self-regulation skills. Su & Yang (2022) indicate that AI technologies such as adaptive learning systems and speech recognition software provide constructive feedback to enable children to understand their learning process. AI can also support metacognitive processes by offering feedback on the child's performance, which can help a child change their learning strategies. These technologies enhance value of cognition and metacognition as learners must

track and control their learning behavior based on AI insights.

## Literature Review

The use of AI-supported technology has proven pivotal in children's L2 learning. Several studies examined how AI technology may help present separate lessons, provide instant results, and offer customized learning that fits every child (Almelhes, 2023; Dupoux, 2018; Ghareeb, 2020; Li, 2022; Oh et al., 2022; Su & Yang, 2022; Yang, 2022; Zou et al., 2023). This literature review examines children's L2 learning supported with AI technologies, the use of mobile devices in L2 learning, the difficulties and concerns that emerge with integrating AI-supported tools and applications in L2 learning at early stages.

## AI and Children's L2 Learning

AI has been utilized as a transformative methodology for children's second language (L2); it enables adaptive learning scenarios to grow intellectual and metacognitive abilities. Almelhes (2023) suggested that it is possible to realize L2 learning environments on which AI adoption is based, and to further develop the learner autonomy, personalization and engagement via AI tutoring systems, and AI-driven feedback loops. These features also involve cognitive functions such as memory, pattern recognition and problem-solving, as well as promoting metacognitive awareness through self-monitoring and self-regulation. Academically, Dupoux (2018) stressed that AI can mirror methods of infant language learning by imitating perception, segmentation, and categorization activities that support natural language learning. These models demonstrate the ways in which AI can scaffold children's cognitive pathways in phonological, lexical, and syntactic progression.

Recent research also emphasizes how AI contributes to the improvement of metacognition in children. AI-enabled social robots not only increased children's vocabulary but also promoted self-reflection and self-correction aspects of metacognition (Arar, Belazoui & Telli, 2021). Also, Al Aqlobi, Alduais, and Alasmari (2024) stated that AI-based platforms create self-motivated learning through real-time analytics and performance dashboards that help children to organize, track, and assess their learning experiences. Such studies indicate that AI technologies can provide cognitive boost through focused attention, memory consolidation and comprehension, and also promote metacognitive behavior, such as evaluation of students' own behavior and the strategic learning process used in context. To sum up, AI role in children's L2 learning is to improve language learning as well as forming cognitive flexibility and reflective awareness for sustainable language learning.

## AI-Powered Programs for Speech Evaluation

Algorithms-based speech assessment solutions are an important interplay between SLM, cognitive processing, and metacognitive regulation. Zou et al. (2023) showed that AI-based speech evaluation programs raise both the pronunciation and fluency of learners by giving automatic, personalized feedback of personalized language assessment. It engages the lower-order cognitive mechanisms, e.g., auditory discrimination and articulation, as well as higher-order metacognitive functions (e.g., monitoring speech output and making adjustments in accordance with feedback). Also, Ghareeb (2020) claimed that AI supported oral language tools promoted children's confidence and language accuracy in spoken language thus indicates that repeated practice through AI supports better processing efficiency and metacognitive control for the production of speech. Recent data further enhances this realization. Aryanti and Santosa (2024) found that AI apps which provide users

with real-time pronunciation visualization enhance self-awareness since this supports self-determination in which learners self-examine their performances against target models, one of the essential metacognitive tasks.

In addition, Yoon and Polio (2023) find that AI feedback builds learner autonomy and self-regulated learning, as students build up their own strategies for better accuracy in practice without constant teacher intervention. These findings make clear that AI-driven feedback loops are a way to boost metacognitive regulation by guiding the learner in planning, controlling and evaluating their speaking performances. AI speech systems, from a theoretical viewpoint, implement Vygotsky's Zone of Proximal Development (ZPD) by providing immediate support and scaffolding at each learner's developmental level. Cognitive processes including attention, working memory and pattern recognition are bolstered through repeated use, and metacognitive strategies emerge as learners process and modify the AI feedback. In order for it to be successful, it will depend on how seriously and appropriately the information supplied by the AI feedback is presented so that the students remember it as they intended, rather than passively absorbing the content. AI-supported speech evaluations are systems of cognitive learning, and a metacognitive accelerator to promote reflective self-directed learning.

**AI in Early Childhood Education**

The use of AI in early childhood education (ECE) helps in developing the foundational cognitive and metacognitive skills required for lifelong language learning. According to Li (2022), the development of AI-based mobile resources empowers preschool age children to handle multimodal language content, stimulating them in various ways such as increasing attention, auditory discrimination, and memory retention of important cognitive functions for learning a language. As well, Oh et al. (2022), showed that systems using a deep-learning screening tool had the ability to detect early language and cognitive delays, illustrating the diagnostic capacity of AI to identify individual patterns of development, and personalize interventions. Yang (2022) further highlighted that teaching AI literacy in early childhood promotes cognitive curiosity and critical thinking, two major components essential for metacognitive development. Al-Othman (2024) also indicated ethical and pedagogical aspects of adopting AI and pointed out the necessity for maintaining the balance between technological development and emotional or social growth. Recent studies have followed this line of thought with a focus on the possibility of advancing metacognitive contemplation with AI. For example, Su and Yang (2024) demonstrate that AI-mediated curricula inspire the young learner to make strategies for deciding task completion, encouraging early self-regulation.

Similarly, Solichah and Shafia (2024) and Springer (2025) suggest that AI competence in preschool teachers is effective for metacognitive facilitation, as the teacher has to orient children's thinking towards their own in relation to AI systems. On a theoretical level, AI in ECE operates as a cognitive developmental scaffold that fosters cognitive functions, specifically attention, memory, and comprehension, as well as metacognitive functions that include self-monitoring, planning, and evaluation, which are essential in the area of instruction and learning. Such adaptive systems provide personalized instruction that is responsive to each student's unique learning path. Ethical implications, teacher development, and equitable screen time remain fundamental to ensuring that AI fosters, not inhibit, holistic development. Therefore, a properly implemented AI can turn early childhood classrooms into reflective, inquiry-

based spaces for children to learn not just the content to think about, but how to think about what they learn.

AI technologies build self-regulation through metacognitive interventions which emphasize the concepts of planning, self-evaluation, and strategy-adjustment skills that are critical to maintaining lifelong learning beyond immediate teaching experience. The first part demonstrated that AI facilitates comprehension and reflective learning via adaptive tutoring and feedback systems. The second emphasized AI speech evaluation tools as metacognitive trainers for learners, who need to monitor self-control and self-correct as they go along. The third showed that early childhood exposure to AI will promote basic cognitive skills e.g., pattern recognition as well as early metacognitive habits e.g., a sense of learning processes. Combined, they indicate that AI's pedagogical usefulness is based on its co-regulation as a cognitive enhancer that enhances information processing efficiency and a metacognitive scaffold that nurtures reflective autonomous learning. Accordingly, for the current study, such a framework can provide evidence for one hypothesis that AI-based training programs can improve children's L2 learning skills by activating two domains. Therefore, AI does not exist solely as a technology tool, but rather it serves as a holistic cognitive-metacognitive system that aids sustainability, self-regulated second language development in young learners.

## Methodology

### Study Design

The study embraced both quantitative and qualitative methods; the qualitative technique was used to understand how AI tool developers, parents, and teachers perceive the adoption of AI tools in teaching children a second language. Regarding the quantitative technique, a questionnaire was included to measure the contribution and effectiveness of AI tools in teaching children L2.

### Data Sources and Collection

Data for this study was collected from multiple sources. Using multiple sources enhances the validity of the collected data (Yin, 2009).

Phase One: Using SurveyMonkey, the researchers constructed a cross-sectional survey on the impact of AI-based technologies on children's L2 learning and distributed it to parents, educators, and AI developers. These technologies involve various AI-based tools and gadgets already utilized in foreign language instruction, including speech recognition software and smartphone apps in Early Childhood Education (ECE) settings. Examining such AI resources was only one part of the process, as they demonstrated what technology looks like when used to assist children. The survey enabled the researchers to collect biographical information, as well as understand the participants' attitudes, levels of efficacy, and satisfaction with integrating AI technology into children's L2 learning.

Phase Two: The researchers conducted semi-structured and focus group interviews with parents, educators, and AI developers, which allowed the researchers "to enter into the other person's perspective" (Patton, 2014, p. 341) to fathom some of the pedagogical and technological issues related to integrating AI-supported applications in children's L2 learning.

Phase Three: Pre- and post-tests were utilized to gauge the children's L2 learning progress before and after using AI-supported tools and applications. The children were between 6 and 10 years old, at the beginning stages of learning English. They had a range of diverse socioeconomic backgrounds and attended local elementary schools that taught English as a foreign language. Most children

had little or no exposure to English outside the school site. The speaking appropriateness checkers for pronunciation and fluency were used for the testing phase. The writing and grammar check applications were used to evaluate the accuracy of sentence and structural knowledge. The final tests were the vocabulary quizzes, which assessed the children's retention of new words that they learned or acquired during the program.

**Validity, Reliability, and Objectivity**

The study employed objective and subjective measures to ensure the study's findings were reliable. Children's L2 performance on pre- and post-tests was compared using a similar cohort and the test-retest protocols were uniformly applied across sessions. Based on the internal consistency calculated, Cronbach's alpha was calculated, indicating the high correlation between test items. The inter-item reliability of the questionnaires for educators, AI developers, and parents was studied using Cronbach's alpha. This level of reliability and validity was necessary to determine the proficiency of the children before they received baseline AI-based learning interventions. Internal validity was achieved by comparing pre-test and post-test findings. As such, AI technologies are the only source of L2 learning and improvement. This means that external validity of the study was increased as the diverse socioeconomic, educational, and geographic backgrounds of participants participated in the study. Five experts of the language, mostly linguistics, TESOL, and applied linguistics, reviewed the instrument to check that the data within it was accurate relative to content. The clarity and interpretability of the items were evidenced by the authors. However, objectivity was achieved in the interviews.

**Participants**

This study included two groups of participants. The first group consisted of one hundred children who were between the ages of 6 and 10. The children were at the early stages of learning English, their first language being Arabic. They represented a range of different socioeconomic contexts and attended local elementary schools where English was taught as a foreign language. Most of the children had little or no exposure to English outside of the school site. Finally, the way children were selected facilitated a portion of the comparison between the children's L2 proficiency pre- and post-exposure to AI-based technologies. Once again, the children were selected based on purposive sampling methods because it enabled the researchers to select the children to assess L2 during pre- and post-exposure to AI-type technologies. The second group was made up of twenty parents, ten educators, and ten AI developers recruited through convenience sampling because of their willingness and ability to participate in the study. The parents, educators, and developers were surveyed and interviewed to collect information related to their attitudes, perceptions of efficacy, and satisfaction related to integrating AI technologies in the L2 or children's second language learning and inquired into a few issues related to AI technologies in pedagogical, technological, and ethical spaces.

**Data analysis**

The data analysis involved a combination of methodologies to assess the impact of integrating AI-supported tools and applications on children's L2 learning, which was quantitative and qualitative in nature. The quantitative survey data were analyzed descriptively and using inferential statistics, including t-tests, to measure the impact of integrating AI-supported tools and applications on children's L2 learning. The qualitative data

from the semi-structured and focus group interviews were analyzed following transcription of the audio recordings. Thematic analysis was used to identify trends, for example, the participants' attitudes, perceived efficacy and satisfaction toward the integration of AI technology in children's L2 learning, while also highlighting a few pedagogical, technological and moral implications for AI. The qualitative data was then organized by themes, searching for similarities and differences in the participants' responses. The quantitative and qualitative mixed methodologies included comparing and joining numbers (quantitative) with narrative (qualitative) to corroborate the role of AI in L2 learning and cross validating the accuracy of the findings between the quantitative and qualitative findings.

## Findings

### Quantitative Findings

**RQ1.** How do AI-based language learning tools influence vocabulary acquisition, grammar proficiency, and pronunciation in children aged 6 to 10 who are learning a second language L2?

**Table (1):** Pre- and post-tests Scores of Children's L2

| Metric | Pre-Test Mean | Post-Test Mean | Mean Improvement | p-value (Paired t-test) |
|---|---|---|---|---|
| Vocabulary Acquisition | 55.3 | 74.6 | 19.3 | <0.001 |
| Grammar Proficiency | 60.2 | 78.1 | 17.9 | <0.001 |
| Pronunciation | 52.8 | 71.4 | 18.6 | <0.001 |

AI-enabled tools and applications also resulted in substantial increases in all aspects of language acquisition. Vocabulary acquisition demonstrated a mean improvement of 19.3, with scores of 55.3 to 74.6 and a p-value of less than 0.001. Grammar proficiency advanced by 17.9, from 60.2 to 78.1, with the exact statistically significant p-value. The improvements in pronunciation scores from 52.8 to 71.4 were 18.6 points larger, with a p-value of less than 0.001, which is also significant. Hence, this finding demonstrates how AI-based technologies have helped shape children's L2 learning and their progress toward developing language proficiency.

### Qualitative Findings

**RQ2.** What are the perceptions of educators, AI application developers, and parents regarding the integration of AI tools in children's L2 learning?

**Table (2):** Educators' and Developers' Perspectives on (AI) Tools and Applications.

| Theme | Summary of Findings | Frequency of Mention |
|---|---|---|
| Effectiveness | "Educators and developers generally agree that AI tools provide valuable personalized feedback and support". | 30 times |
| Ethical Concerns | "Issues include data privacy concerns, the risk of over-reliance on technology, and reduced human interaction". | 25 times |
| Pedagogical Challenges | "Challenges include integrating AI with traditional teaching methods and ensuring equitable for all students". | 20 times |

**Effectiveness:** Many teachers and developers of applications that include (AI) thought that merging (AI) technologies helped offer immediate suggestions and feedback to (Second Language) learning. One teacher said, "*I am addicted to these apps. ... They provide feedback at the moment, and my students perceive it with less shame*." Another teacher noted, "*They save time and effort.*" Moreover, a curriculum developer added, *"We designed these apps to be user-friendly…. When a child makes a mistake, the apps will allow self-correction."*

**Ethical Concerns:** Though the participant educators stressed the improvement in the

children's learning, there was a conspicuous disagreement between most educators and AI application developers regarding the ethical concerns of integrating AI tools in children's L2 learning. Some of the discussed drawbacks were linked with miscellaneous privacy concerns, the possible preoccupation of children with the tech facilities, lack of teachers' mediation, and possible decline of face-to-face communication. One teacher said, *"My students are always tinkering with their phones…it makes me angry…so I ask them to turn them off."* Another teacher stated, *"I feel more of a technician than a teacher…the students over-depend on such tools and do not ask questions like before."*

**Pedagogical Challenges:** The educators and AI application developers reached a consensus that there were issues to be solved concerning integrating AI-supported tools and applications in children's L2 learning, including the optimal use of AI and other conventional approaches and equity in the distribution of the two. For example, one teacher stated, *"We are neither fully equipped with the necessary facilities nor do we have the proper knowledge to carry on our teaching using the AI apps."* Another teacher claimed his students were more familiar with some AI applications than he was. He said, *"I feel embarrassed when I cannot deal with some apps….and my kids wake me up through them."* On the other hand, some AI application developers expressed their willingness to communicate with the school districts to provide the teachers with the necessary workshops on the proper integration of such AI applications and tools. One AI developer stated, *"We have been communicating with the in-charge personnel on how and when to provide teachers with the training needed."*

**Table (3):** Parents' Perspectives on AI-Supported Tools.

| Aspect | Positive Feedback | Negative Feedback |
|---|---|---|
| Real-time Feedback | Parents appreciate the immediate corrections and tailored guidance provided by (AI) tools. | Some parents are concerned about the accuracy and appropriateness of the feedback. |
| Customization | High satisfaction with personalized learning experiences and tailored learning paths. | Concerns about children's engagement and the potential for decreased motivation. |
| Integration with Traditional Learning | (AI) tools complement existing educational methods well and add value. | Difficulty in integrating (AI) with traditional methods and ensuring sufficient human interaction. |

**Real-time Feedback:** Parents were grateful for AI-mediated learning tools that were timely, personalized, and helpful. They considered the immediacy of feedback beneficial for their children's progress. Still, their reflections unveiled some basic doubts about the cultural appropriateness and accuracy of some of the content. One parent explained encountering inappropriate visuals as she said, *"I really like these apps… I mean they lighten my burden, in some respects they've helped, but I've at one point encountered indecent, even culturally irrelevant."* Another parent was uncomfortable about introducing new ideas: *"I didn't know how to explain beer to my son."* This type of account shows that even though parents acknowledge AI aid, their appreciation of the benefit to children by these is sensitive to culture and the cultural and contextual factors of how kids learn.

**Customization:** Parents also emphasized the advantage of AI in providing personalized, child-specific learning paths that are adjusted to each child's individual pace and abilities. Adaptive learning was an effective mechanism that encouraged higher responsiveness and flexibility, they wrote. But close examination of their narratives revealed an equally

ambiguous problem: the immediacy with which AI-assisted feedback is provided, despite its efficacy, can actually corrode children's natural urge to engage in increasingly intensive and independent learning. One parent said: *"My daughter gets instant suggestions now, so she hardly investigates or asks questions anymore and that scares me."* At the same time, this presents an issue that is part of AI-informed learning, where the aforementioned insight can be seen as one of the guiding paradoxes in AI-driven education: personalization both as easy and accessible, engaging, and motivating, but potentially creating a dependence and a sense of loss of persistence.

**Integration:** In discussing AI's place in traditional education, many parents expressed mixed sentiments. In fact, they often perceived AI more as an adjunct than a replacement for human teachers. One parent explained, *"I would still prefer my children to learn from an actual teacher, not a machine."* Another parent, who recognizes their child has learning challenges, emphasizes the value of human interactions: *"My daughter is slower than others; I think, in her case, more human interactions would facilitate her performance."* As these examples show, while parents understand the benefits of AI-enabled tools, they still regard the relationship between a teacher and student as a central function of effective learning, which is key for engagement, social-emotional development, and equitable educational support.

## Mixed-Methods Integration

**Table (4):** Overall Impact of (AI) on Children's (L2) Learning.

| Dimension | Quantitative Data | Qualitative Insights |
|---|---|---|
| Language Improvement | "Significant improvements in grammar, pronunciation, and vocabulary were observed". | "Report of parents and teacher improved the skills of language due to tools of AI". |
| Ethical and Pedagogical Concerns | "Statistically significant improvements in language skills". | "Notable concerns include privacy, over-reliance on technology, and challenges integrating AI with traditional methods". |

**Language Development:** The quantitative findings show each child improved their language proficiency, corroborated by the qualitative parental and teacher responses.

**Ethical and Pedagogical Considerations:** There has been positive growth and concerns have grown surrounding privacy, technology dependence, and how to combine, or better integrate, traditional teaching methodologies along with technological pedagogical knowledge.

## Discussion and Conclusion

This study investigated advantages of Artificial Intelligence (AI)-enabled tools and applications for children in learning a second language (L2). According to the data, vocabulary, grammatical structures, and pronunciation improved markedly for language learners after AI-enhanced learning opportunities were introduced. These findings are consistent with earlier research (Ghareeb, Ahmed, & Ali, 2020; Li, 2022; Su & Yang, 2022; Zou et al., 2023), and in turn lend further confirmation that AI can promote language education positively. And even more crucially, beyond those tools and apps enhanced by AI, children had several opportunities to use the language in many different meaningful situations via AI-interactive tasks. AI brought language experiences to kids, thus allowing for a flexible, fun, and responsive learning environment meeting and accommodating kids' diverse language needs. In addition to qualitative data describing the children's experiences, they also recorded quantitative

data that corroborated the significance of the findings, in three domains of language processing.

Additionally, the advancements of language processing skills also indicate the effect of language development on the whole. Some of the gains can be attributed to the fact that AI applications are individualized and adaptive, offering instruction tailored to learners' knowledge, progress, and preferences. They provide learners with the proper support to reach their maximum learning potential through individualization and adaptation. In the same way, real-time feedback and interactivity offer learners control, and motivation and control are the two most important elements in advance of any L2 learning process. The findings stated that one of the significant benefits was that AI-supported technology is offered for mobile and connected devices to promote learning beyond the school environment.

Furthermore, the feedback that comes quickly and the flexibility of AI tools that assist children with processing content through technology promote responsibility and independence in children, allowing for greater opportunities for them to take ownership of their learning. It is critical for building early language skills. Several important educational and ethical concerns have been identified by the study, however. Potential dangers were voiced by participants, including fear of cultural insensitivity, failure to explicitly recognize dependency on technology, and a diminution of human participation that could impact the learning process, as well as relevant scientific literature (e.g., Al-Othman, 2024; Ghareeb, 2020). To grow children as individuals with unique needs, context, and emotional requirements that AI cannot meet, human instructors are necessary, as indicated in the recommendations to address concerns about the learning process. In spite of indications of the possible merits to the integration of AI-supported technology in children's L2 learning and teaching, the current research uncovered a fundamental, sizeable necessity for peer moderation and to create trustworthy balance in using this technology. Furthermore, rather than simply replacing conventional methodologies, technology should be perceived more as a supplement of them. Educational organizations need to prepare teachers comprehensively and adhere to ethical guidelines that are first conducive to students' development and health, so that students can reap the benefits of technology that supports learning. The present research contributes to the recent research that argues that AI should be introduced thoughtfully in early childhood language education. The promising effects of AI on language learning are apparent. However, future work needs to identify the ethical implications and practical applications to ensure that AI enhances children's overall learning, rather than detracting from it. However, the study has some limitations. First, the study was undertaken over six months; it would be more beneficial to examine how well AI-supported technologies improve children's L2 learning for a full academic year. In addition, the gender variable was not observed, which could make it helpful to compare L2 learning outcomes by gender regarding the use of AI technologies.

**Disclosure Statement**

- **Ethical approval and consent to participate**. Not applicable. This study does not involve any clinical or medical procedures requiring ethical approval.
- **Availability of data and materials**. The data supporting the findings of this study are available upon request.
- **Author contribution**. The corresponding author and Dr. Khaled Alnajjar jointly conducted the research. Both authors

contributed equally to the study design, data collection, data analysis, and manuscript preparation.

- **Conflict of interest**. The authors declare that there are no conflicts of interest regarding the publication of this paper.
- **Funding**. This research received no external funding.
- **Acknowledgments**. The authors would like to thank all participants who completed the questionnaire and contributed to the success of this study.

**Open Access**



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