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REVIEW

Artificial Intelligence in Language Acquisition: A Balancing Act of Potential and Challenges

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ABSTRACT

The rapid integration of Artificial Intelligence (AI) into educational systems has prompted an exploration of its efficacy in language acquisition. This study aims to evaluate the role of AI in enhancing language learning processes, focusing on its capability to support personalized and adaptive learning experiences. Utilizing a systematic content analysis coupled with quantitative methods, including the chi-square test, this research synthesizes findings from scholarly articles published between 1985 and 2023. The content analysis examined the deployment of AI tools in language learning, while quantitative measures assessed the distribution and impact of these technologies. Results from the chi-square test indicated no significant differences in the frequency of studies advocating for or against the use of AI, suggesting a balanced academic perspective. The findings highlight AI's potential to enrich language learning through customized educational experiences. However, they also underscore the necessity for careful implementation, considering ethical concerns and potential biases. Conclusively, AI presents valuable opportunities for language education but requires strategic management to mitigate associated risks. Implications of this study stress the importance of ongoing research to optimize AI applications in language learning, ensuring they are equitable and effective across diverse educational settings. Furthermore, the use of AI for data analysis based on instructed frameworks for large language models could play a major role in helping researchers analyze large datasets collected about language acquisition if the AI tools are used skillfully and responsibly.

Keywords: Artificial Intelligence; Language Acquisition; Content Analysis; Adaptive Learning; Educational Technology

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1. Introduction

1.1. Language Acquisition and Artificial Intelligence

Artificial Intelligence (AI) known as the ability to perform tasks affiliated with a high level of intelligence through the use of science and engineering to create systems [1] and has been incorporated into different areas and resulted in transformative force in various sectors and industries, and education is not an exception [2]. The emergence of AI in the field of language education and language learning is one of the game-changer innovations that challenged the traditional methodologies and proposed new routes and models of teaching, and different outcomes. The expanding domain of the presence of AI technologies increasingly tends to lead toward a new era of educational practices, particularly in language learning, where AI tools not only promise to assist but promise to change the very aspects of approaches toward linguistic education [3].

More specifically, the discussion has revolved around the employment of AI to allow the delivery of tailor-made individual learning experiences by adaptive intelligent tutoring systems to the learners, varying from AI-supported delivery to learner-adaptive systems that adjust to the individual differences of the learners [4]. The incorporation of AI in language learning, however, is not without its challenges. This includes understanding and implementing ethical considerations, the digital divide, and the capabilities of AI to perpetuate biases very sensitively, and its applications with various groups of learners including neurodiverse populations [1, 5]. For neurodiverse populations, AI in language learning presents both opportunities and challenges. On the other side, the customized learning experience that AI would give to different learning styles and, importantly, to needs would surely produce an increased involvement in education and, most importantly, better outcomes [6, 7].

The existing reviews of AI and language learning contain the poles of extremities: from strong advocacy on one side to cautious optimism and critical appraisals of limits and potential ethical concerns on the other [8, 9]. These wide spectrums of views simply reflect the very nascent stage at which AI has been integrated into language education and succeeded only in driving home the point that a lot needs to be done based on a comprehensive understanding of AI's potential and shortcomings. Recent studies highlight the significant impact of AI on language acquisition, particularly through AI-powered tools such as chatbots. Zhang and Huang found that AI chatbots based on Large Language Models (LLMs) significantly enhance both receptive and productive vocabulary knowledge for foreign language learners, contributing to long-term retention and incidental vocabulary learning [10]. Alam and Asmawi discussed the potential of Generative AI in teaching legal vocabulary, emphasizing an interactive approach grounded in constructivist pedagogy, despite challenges related to educator proficiency and resource limitations [11]. Özçelik and Ekşi explored the role of Generative AI in acquiring register knowledge during English writing tasks, noting its effectiveness in formal contexts but questioning its utility for informal writing [12]. Krajka and Olszak investigated the use of AI-enhanced word processors in academic writing instruction, showing that students could distinguish between AI-generated and human-written texts, highlighting AI's benefits for bilingual language learners [13]. Ongoro and Fanjiang provided a systematic review of digital game-based learning (DGBL) for young learners, finding that DGBL enhances motivation, creativity, and problem-solving but also presents design and development challenges [14]. Tang and Ma demonstrated that integrating computational thinking (CT) with AI tools improves vocabulary richness in English essay writing for non-English majors in China [15]. Fatima analyzed AI's role in pronunciation improvement, finding that accurate AI models can enhance pronunciation accuracy, though cost remains a significant barrier [16]. As AI becomes increasingly integrated into education, raising issues about its effects on teaching, learning outcomes, and ethical data use, recent studies—such as those employing the UTAUT2 model—explore factors like performance expectations, habit, and facilitating conditions that influence students' intentions and actual use of AI tools in higher education [17, 18]. These studies collectively underscore the transformative potential of AI in diverse language learning contexts.

AI has significantly transformed the landscape of language acquisition, offering innovative tools and methodologies that enhance both the efficiency and effectiveness of learning. AI technologies such as adaptive learning systems, intelligent tutoring systems, and natural language processing (NLP) tools have revolutionized traditional language

learning paradigms by providing personalized learning experiences tailored to individual needs, learning styles, and paces [19]. Studies comparing AI-based training with conventional instruction have highlighted the advantages of AI in improving language learning outcomes, although challenges such as generalizability and potential biases remain [20]. The integration of AI in language learning is not without its complexities; for instance, while neural machine translation (MT) offers high-quality outputs, it still requires careful interaction to ensure accuracy and effectiveness [21]. AI-driven applications like Bully Scan and hybrid teaching approaches that combine AI-powered translation tools with traditional classroom methods have shown promise in enhancing language proficiency and engagement [22]. The evolution of AI in NLP, from rule-based systems to dynamic models capable of understanding human language complexities, has facilitated advancements in machine translation, chatbots, and virtual assistants, thereby revolutionizing human-technology interaction in language learning [23]. The use of AI, particularly chatbots, in educational settings has demonstrated potential to improve the quality of teaching and stimulate student engagement, although limitations such as language barriers and content interpretation issues persist [24]. The partnership between AI developers and educators is crucial for overcoming obstacles and ensuring ethical considerations, such as bias mitigation and privacy, are addressed, thus fostering an inclusive and customized educational experience [25]. Technological innovations like Virtual Reality (VR) and AI, including chatbots and agents, have been shown to enhance connectivity between language faculties and cognitive functions, thereby supporting more immersive and effective language learning experiences [26]. Practical applications of AI, such as the English Language Speech Assistant (ELSA), have received positive feedback from students for their effectiveness in vocabulary acquisition and pronunciation, indicating a promising future for AI in language education [27]. The adoption of AI in educational practices, particularly in language acquisition, underscores the importance of continuous research and development to harness its full potential while addressing inherent challenges and risks [28]. To conclude, AI's integration into language learning signifies a paradigm shift towards more personalized, efficient, and engaging educational experiences, paving the way for future advancements in this field.

AI has transformative potential in language acquisition, offering diverse applications that enhance learning efficiency and effectiveness. One significant application is to integrate AI-powered NLP tools into educational platforms, which can provide real-time translation support and improve the accuracy of language learning, as demonstrated by hybrid teaching approaches combining AI with traditional classroom methods [22]. AI systems like ChatGPT can assist educators in creating academic content and simulation scenarios, thereby reducing their workload and facilitating student learning [29]. Additionally, AI-driven pronunciation evaluation systems using deep learning algorithms can offer precise assessments, aiding learners in improving their spoken language skills [22]. The use of generative AI models, such as those that create human-like text or translate descriptions into video clips, can also be employed to generate engaging and contextually relevant language learning materials [30]. In the context of foreign language teaching, AI chatbots can simulate conversational practice, providing learners with interactive and immersive experiences that enhance their language proficiency [24]. Moreover, AI applications in language acquisition are not limited to English; they can also enrich the teaching and learning of other languages, such as Arabic, by addressing specific challenges and proposing tailored scenarios for effective AI integration [31]. The potential of AI in language acquisition extends to addressing social issues, such as identifying and mitigating cyberbullying through NLP-based frameworks, which can create safer online environments for language learners [22]. Furthermore, the advancements in generative AI and large language models (LLMs) like GPT-4 and PaLM2 highlight the capability of these technologies to revolutionize natural language processing tasks, making them invaluable tools in language education [32]. AI's ability to learn and adapt from vast amounts of unstructured data, including text and speech, enables it to provide personalized learning experiences that cater to individual learner needs [33, 34]. The integration of AI in language acquisition is part of a broader digital transformation in education, where traditional paradigms are evolving to incorporate advanced technological solutions, thereby enhancing the overall learning process [24]. Despite the promising applications, it is crucial to address challenges such as data privacy, ethical considerations, and the need for responsible AI governance to ensure that these technologies benefit

humanity without unintended consequences [32, 35]. Overall, AI's role in language acquisition is multifaceted, offering innovative solutions that can significantly improve language learning outcomes across various educational contexts.

1.2. Purpose of the Present Study

The purpose of the study is to comprehensively evaluate and synthesize the existing literature at the intersection of AI and language acquisition. By conducting a systematic content analysis, the study seeks to identify prevalent themes, methodologies, findings, and discussions related to the use of AI in language acquisition. The overarching purpose is to provide a balanced understanding of AI's potential role in language acquisition, emphasising ethical considerations, quality assurance, and the necessity for continued research to optimise the integration of AI tools in language learning.

The scope of the study encompasses a content analysis of scholarly work from 1985 to 2023, investigating the utilization of AI tools in language acquisition. The content analysis aims to uncover prevalent themes, methodologies, findings, and discussions related to the use of AI in language acquisition, providing insights into the advantages and challenges associated with the integration of AI tools in language acquisition. Additionally, the study quantitatively analyses the distribution of scholarly work investigating the utilization of AI tools in language acquisition, emphasizing the need for balanced discourse and cautious policymaking in the absence of a prevailing consensus. The research also explores the relationship between the position on the use of AI tools in language acquisition and the frequency of studies, seeking to understand the current landscape of research at the nexus of AI and language acquisition while identifying potential avenues for future inquiry. Ultimately, the study aims to provide a comprehensive overview of the current research and identify potential areas for continued investigation and development of AI tools in language acquisition. Overall, the present study seeks to answer the following questions:

1. What are the primary arguments presented in favour of and against the integration of AI tools in language acquisition, and how do these arguments reflect broader ethical and quality control considerations?
2. How does the current academic stance on the use of AI in language learning, as indicated by the inferential statistical analyses, impact the direction of future research and policy-making in this field?

2. Method

2.1. Sample

The sample for this content analysis comprised peer-reviewed articles sourced from several academic databases. The articles were retrieved using a combination of search terms relevant to the fields of AI and language acquisition, applied on December 26, 2023. The search terms were constructed to encapsulate the broad spectrum of research exploring the intersection of AI and language development in various populations. We used the Web of Science, Scopus, and Lens databases for our search terms including 'language acquisition and AI'.

The search strategy yielded a preliminary result of 90 documents. After the elimination of duplicates using the Mendeley reference management software, the total was reduced to 62. Inclusion criteria mandated that studies must be empirical articles focusing on AI's role in language acquisition or development. Exclusion criteria involved the removal of editorials, correspondents, book reviews, and any study not providing sufficient data in English, or for which the full text was unavailable. The abstract screening process further reduced the sample size to 48. A subsequent full-text screening for eligibility based on the aforementioned criteria resulted in a final sample of 47 studies included in the content analysis. **Figure 1** below demonstrates the inclusion and exclusion of the studies in this study following PRIMSA guidelines [36]. The PRISMA checklist is also available as a supplementary document with this submission.

2.2. Design

The present study utilized a content analysis design to systematically evaluate and synthesize the literature. This design was selected for its robustness in identifying and understanding patterns and themes within textual data. The content analysis aimed to uncover the prevalent themes, methodologies, findings, and discussions related to the use of AI in language acquisition. Content analysis is a fundamental qualitative research method utilized extensively for interpreting textual data. Hsieh and Shannon explain that it encompasses

three approaches: conventional, directed, and summative, each with unique coding schemes and purposes [37]. Elo and Kyngäs further categorize content analysis into inductive and deductive processes, depending on the research context and existing theoretical frameworks [38]. Vaismoradi, Turunen, and Bondas highlight the distinction between content analysis and thematic analysis, noting that content analysis uniquely permits data quantification, providing an additional layer of significance when applied cautiously [39].

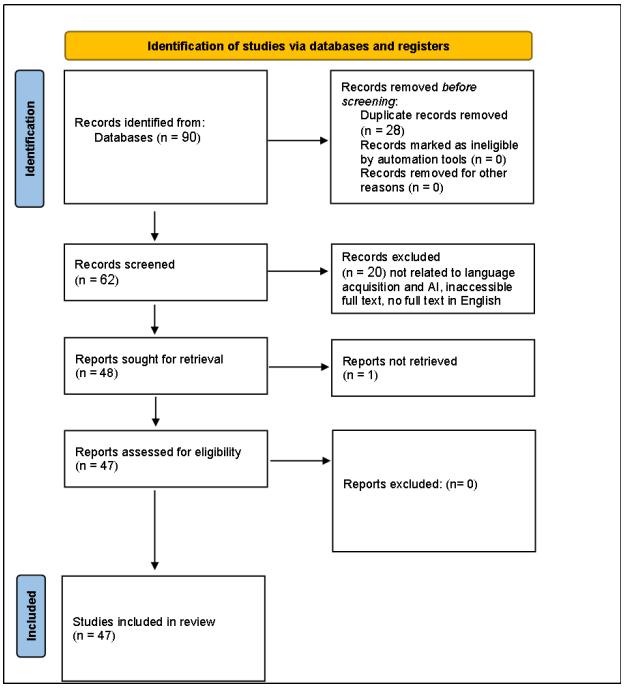

Figure 1. PRISMA Flowchart for the Inclusion and Exclusion of the Studies.

2.3. Measures

The primary measure for the content analysis was the coding framework developed to categorize the findings of the included studies. The framework was constructed to capture dimensions such as study aims, main findings, positions on AI (supportive, neutral, or critical), and the AI applications or software used. This framework facilitated the extraction of relevant information and the determination of overarching narratives within the field.

2.4. Procedures

The content analysis began with the identification of relevant studies through a structured search strategy. The identified studies underwent a rigorous screening process to ensure compliance with the inclusion and exclusion criteria. Each selected study was then subjected to a detailed coding process using the predefined coding framework. Data extracted from these studies included the aim of the study, main findings, position on the use of AI in language acquisition, and the specific AI technologies examined.

The coding framework used for content analysis was developed to capture dimensions such as study aims, main findings, positions on AI, and AI applications or software used. The framework facilitated the extraction of relevant information and the determination of overarching narratives within the field. The coding framework consisted of the following categories:

1. Aim of the study: This category captured the primary objective or purpose of each selected study. For example, a study might aim to explore the effectiveness of AI-based language learning tools or assess learner perceptions and challenges.
2. Main findings: This category summarized the key results or outcomes of each study. For instance, a study might find that AI tools significantly enhance language acquisition or identify potential concerns such as ethical implications.
3. Position on the use of AI in language acquisition: This category classified each study's stance on the integration of AI for language learning. Studies were categorized as supportive, neutral, or critical based on their position.
4. AI technologies examined: This category identified the specific AI technologies or software used in each study. Examples might include AI-powered language learning apps, chatbots, or natural language processing tools.

Two independent reviewers conducted the coding to enhance the reliability of the data extraction process. Any discrepancies between coders were discussed and resolved through consensus. The coded data were then analysed to identify patterns, trends, and gaps in the existing literature. This analysis was used to construct a narrative synthesis that summarized the collective understanding of AI's role in language development.

The non-parametric Kruskal-Wallis test was selected as it does not require normality assumptions and allows comparing measures of central tendency across three or more independent groups, fitting the categorical position variable (support, neutral, mixed) and numerical study frequency

data. The chi-square test examined the association between these two categorical variables. Pairwise comparisons using Dwass-Steel-Critchlow-Fligner followed up on overall group differences. These non-parametric methods accounted for the data's categorical and numerical variables without requiring distributional assumptions.

Through this methodical approach, the study aimed to provide an overview of the current research related to AI and language acquisition, while also identifying potential avenues for future inquiry. Finally, since this study is totally based on secondary data analysis, and there was no direct contact with humans or non-humans, no ethical considerations were raised in this study.

3. Results

3.1. Results Overview

The results present a qualitative and quantitative analyses of studies spanning from 1985 to 2023—decided by existing relevant literature in the search databases. The studies focus on the integration of AI in language acquisition and development. The findings highlight a diverse spectrum of support and opposition regarding the integration of AI tools for language learning. While some studies unequivocally advocate for the implementation of AI tools, emphasizing their capacity to foster engagement, motivation, and learning autonomy, others adopt a more cautious stance, acknowledging potential concerns such as ethical implications, quality control, and the limitations of AI in replicating human context understanding. This array of studies not only contributes to the growing literature on AI and language learning but also underscores the need for a balanced understanding of AI's potential, emphasizing the importance of ethical considerations, quality assurance, and the necessity for continued research to optimize the integration of AI tools in language learning.

The quantitative analysis, depicted in **Figure 1**, suggests a prevalent trend favouring the advantages of employing AI-assisted methodologies, indicating a favourable view of AI's role in language education. The non-parametric one-way ANOVA (Kruskal-Wallis test) and subsequent analyses reveal no statistically significant differences in the frequency of studies across supportive, neutral, and mixed categories regarding the use of AI in language acquisition, suggesting an evenly distributed academic stance and no prevailing consensus, indicative of the field's nascent stage. This uniformity fosters balanced discourse, necessitates cautious policy-making without clear evidence to prefer one perspective over another, and highlights the need for more detailed research to delineate conditions under which AI tools may be effective. The relationship between the position on the use of AI tools in language acquisition/child language development and the study frequency was further investigated using a chi-square test, showing no significant association between the position on using AI tools and the frequency of studies. The findings underscore the need for additional research with larger sample sizes and more varied study frequencies to accurately assess the relationship between the position on the use of AI in language acquisition and the frequency of studies.

3.2. Qualitative Analysis

Table 1 encapsulates a comprehensive array of academic studies, spanning from 1985 to 2023, focusing on the integration of AI in the domain of language acquisition and development. The studies encompass a variety of aims, ranging from exploring the effectiveness of AI-based language learning tools to assessing learner perceptions and challenges and discussing the ethical implications of AI implementation. The findings underscore the multifaceted role of AI in language learning, indicating its potential to significantly enhance language acquisition across diverse learner groups.

The included studies showcase a nuanced spectrum of support and opposition regarding AI's integration for language learning. While some studies unequivocally advocate for the implementation of AI tools, emphasizing their capacity to foster engagement, motivation, and learning autonomy, others adopt a more cautious stance, acknowledging potential concerns such as ethical implications, quality control, and the limitations of AI in replicating human context understanding. Moreover, several studies propose theoretical frameworks, discuss the educational affordances of AI, and offer critical evaluations of its application, reflecting an evolving discourse on the subject.

This compilation of studies not only contributes to the burgeoning literature on AI and language learning but also reflects the growing significance of AI in educational con-

texts, particularly concerning language acquisition and development. The findings underscore the need for a balanced understanding of AI's potential, emphasizing the importance of ethical considerations, quality assurance, and the necessity for continued research to optimize the integration of AI tools in language learning.

Table 1. Characteristics of Included Studies.

No.	Citation	Aim of the Study	Main Findings on Using AI	Position	AI Application/Software Used
1	[4]	To analyse the role of AI in aiding second language learners master pronunciation	AI algorithms can substantially advance language learning in various dialects and are beneficial for diverse stakeholders	Supports	Not specified; general AI technology in second-language learning
2	[7]	To propose a method for testing if large language models can be seen as input-driven theories of language acquisition	Suggests that processing pressures in language development may override input, necessitating a new understanding of both human language and AI models	Neutral	Not specified; discussion of large language models in the context of a thought experiment
3	[40]	To explore ESL learners' perceptions and challenges towards AI-Assisted English Language Learning and Teaching	Most students view AI-powered tools favourably for learning English; however, there is a noted lack of quality in AI-powered language-learning apps	Supports	AI-powered language learning apps; specific apps not detailed
4	[41]	To provide an overview of AI robot use in language learning and its impact on learner autonomy and learning strategies	Temi robot introduction at CILL has been effective in fostering learner autonomy and rethinking service delivery during staff shortages	Supports	Temi (Robot as a Service) used in the Centre for Independent Language Learning
5	[42]	To develop a comprehensive mobile app for English language learning using AI, reinforcement learning, and augmented reality	PEM mobile app acts as a full-fledged English teacher, offering personalized curriculum and interactive learning activities	Supports	Pocket English Master (PEM) mobile app incorporating AI, reinforcement learning, and augmented reality
6	[43]	To explore behavioural intentions of junior and senior high school students to use AI in L2 learning	The AILL-Motivation-UTAUT model showed high predictive power for students' intentions to use AILL, indicating positive perceptions and motivational factors influencing acceptance	Supports	Not specified; survey-based study on AILL
7	[44]	To examine the adaptability and mental health of college students in AI-supported foreign language learning	AI-supported learning environments show higher adaptability in students majoring in foreign languages; psychological issues affect learning outcomes	Supports	Not specified; general discussion of AI in learning environments
8	[45]	To investigate the role of Applied Translation (AT) in L2 learning with AI technologies	AI-based chatbots and machine translation can enhance critical thinking and digital literacy in L2 classrooms when integrated through the IMI+ framework	Supports	AI-based chatbots and machine translation tools
9	[46]	To study the effect of social network-based interaction on English speaking practice with AI apps	Social network-based interaction significantly improves speaking skills when using AI apps, highlighting the importance of interactive activities	Supports	AI speaking apps paired with social networking platforms like WeChat
10	[47]	To review the impact of AI in foreign language learning via learning management systems	AI technology enhances learning experiences and language skills when integrated with learning management systems, offering personalized learning	Supports	Learning management systems with AI capabilities
11	[48]	To investigate the impact of AI-based language learning on Chinese EFL students' speaking skills and self-regulation	AI-based instruction led to significant improvement in speaking skills and self-regulation over traditional methods	Supports	Duolingo with natural language processing and speech recognition
12	[49]	To explore the benefits of gamification in English language learning through ChatGBT	ChatGBT can enhance engagement and motivation in language learning through gamification, though challenges exist	Supports	ChatGBT for gamified language learning
13	[50]	To discuss the future of language learning with AI, focusing on ChatGPT, and demystify AI for educational use	Emphasizes the need for clarity and understanding of AI in education, including ethical considerations	Neutral	Discussion of ChatGPT and AI in education

Table 1. *Cont.*

No.	Citation	Aim of the Study	Main Findings on Using AI	Position	AI Application/Software Used
14	[51]	To develop a framework for understanding chatbots in language learning and review their educational affordances	Proposes a framework with goal-orientation, embodiment, and multimodality, identifies chatbot types, and discusses future research directions	Supports	Various speech-recognition chatbots
15	[52]	To research the use of AR glasses integrated with ChatGPT for contextual language learning	VisionARy system using AR glasses with ChatGPT shows positive results for improving oral language skills and immersion	Supports	VisionARy system with AR glasses and ChatGPT
16	[53]	To discuss the prospects and challenges of LLMs in language learning and cognition	LLMs show promise but differ from human cognition in grounding, action, pragmatics, bias, and individuality	Neutral	General discussion on Large Language Models
17	[54]	To explore auto-generation of language learning courses using generative AI	The use of GPT-3.5 to create language learning content is feasible, but quality control is a concern	Supports	GPT-3.5 for generating learning materials
18	[55]	To compare ChatGPT and traditional mentoring in programming language learning	Integration of ChatGPT with traditional mentoring can enhance learning efficiency and understanding	Supports	ChatGPT integrated with a mentoring system
19	[8]	To evaluate Generative AI as a tool in language learning	Generative AI is valuable for language learning when used alongside traditional methods	Supports	Generative AI as a conversational AI
20	[56]	To assess the usability of Generative AI for formal English language learning	Generative AI is effective for various English learning tasks and is well-received by a diverse range of students	Supports	Generative AI for formal English language learning tasks
21	[57]	To explore the ethical implications of using Generative AI in language learning and education	Ethical concerns such as privacy, bias, reliability, accessibility, authenticity, and academic integrity must be addressed in using Generative AI	Neutral	Generative AI in language education
22	[58]	To examine factors influencing learner attitudes towards Generative AI-assisted language learning	Information system quality and hedonic motivation greatly affect learner satisfaction and performance expectancy; behavioural intention predicts learning effectiveness	Supports	ChatGPT-3 or ChatGPT-3.5 for language learning
23	[59]	To establish a model for Generative AI research on English language learning	Generative AI aids in developing language skills, scaffolding learning, and providing feedback; a five-dimension model for AI-assisted language learning is proposed	Supports	Generative AI for English language learning
24	[60]	To explore the educational affordances of Generative AI across multiple languages	Generative AI is valuable for language teaching but can't replace teachers; identifies learning optimization gap and knowledge comprehension gap	Supports	Generative AI for multilingual applications
25	[61]	To investigate EFL special education teachers' attitudes towards Generative AI for language learning	Teachers perceive Generative AI as moderately effective with moderate barriers; gender differences in willingness to use Generative AI were noted	Supports	Generative AI for EFL special education
26	[62]	To review research on speech-recognition chatbots for language learning and discuss implications for future research with LLM-powered chatbots	Speech-recognition chatbots are under-researched but show a growing trend in studies and potential for language learning; English is the primary target language, with college students as common participants	Supports	Speech-recognition chatbots
27	[63]	To explore EFL learners' use of Generative AI for language learning tasks and their perceptions	Generative AI is seen as a valuable learning partner by students, who use critical judgment to evaluate and improve Generative AI's outputs, hinting at its educational potential	Supports	Generative AI
28	[64]	To investigate the potential of Generative AI in generating dialogue for EFL learning	Generative AI-generated dialogues are suitable for elementary level students and can help intermediate learners with new vocabulary, showing promise for EFL learning resources	Supports	OpenAI's Generative AI

Table 1. *Cont.*

No.	Citation	Aim of the Study	Main Findings on Using AI	Position	AI Application/Software Used
29	[65]	To review the use of Google Assistant for second language learning and teaching	Google Assistant is effectively used for language learning and teaching; identifies four distinct patterns of its use in second language acquisition	Supports	Google Assistant
30	[66]	To examine AI's role in enhancing language learning experiences and discuss its potential in education	AI, including chatbots and voice assistants, can enhance language learning and teaching; emphasizes AI's role in fostering learner autonomy and fluency	Supports	Various AI tools, including Generative AI and Google Assistant
31	[67]	To review the implementation of AI in second language learning and highlight the possibilities of AI in this context	Finds AI to be a promising tool for increasing interest and effectiveness in foreign language learning	Supports	Various AI systems and implementations
32	[68]	To evaluate the application of AI in Chinese college students' English learning	Suggests that AI can serve as an intelligent teacher, emotional soother, and a rater, thus aiding in the development of multiple intelligences	Supports	Not specified
33	[69]	To present and evaluate the Cognitive Immersive Language Learning Environment (CILLE) for Chinese language education	Shows significant improvement in CFL vocabulary, comprehension, and conversation skills using CILLE, an AI and XR integrated system	Supports	Cognitive Immersive Language Learning Environment (CILLE)
34	[70]	To examine the role of AI in English language learning among Ukrainian university students and address their fears	Indicates a high level of understanding of AI among students, but highlights concern about cyber-attacks, loss of personal interaction, and the impact on learners' spontaneity and creativity	Supports	Not specified
35	[71]	To create and evaluate a Robot-Assisted Language Learning (RALL) system for English-language tour guide training	Reports positive attitudes towards RALL and its effectiveness in improving engagement, motivation, and learning autonomy	Supports	AI Unity plug-in, Robot-Assisted Language Learning (RALL) system
36	[5]	To review and analyse empirical research on AI-supported language learning using activity theory	Found AI as effective in language learning but needing improvement for communication and collaborative design; teacher intervention is crucial for learning effectiveness	Supports	Not specified
37	[1]	To systematically review AI-assisted personalized language learning and conduct co-citation analysis	Reported Taiwanese institutions' leading role, the effectiveness of intelligent tutoring systems, and positive student perceptions; emphasized the need for learner profiling and learning resource adaptation	Supports	Intelligent Tutoring Systems, Natural Language Processing, Artificial Neural Networks
38	[72]	To investigate the enhancement of English language learning effectiveness through AI information technology	Demonstrates that AI technology enables interactive learning and self-correction, improving learning effectiveness and student engagement	Supports	Not specified
39	[73]	To analyse AI applications in modern foreign language learning	Suggests designing comprehensive AI technologies for multilingual learning to improve efficiency and interest	Supports	Not specified
40	[74]	To examine the use of AI in language learning apps and propose improvements	Finds that most language learning apps do not use AI to its full potential and suggests implementing AI for sustainable and competitive education	Supports	Not specified
41	[75]	To explore chatbots as a medium for language learning	Determined chatbots have high potential as both tutors and independent learning media for language practice; learners prefer chatbots for the convenience and confidence they offer	Supports	Chatbots
42	[6]	To develop an English class model using AI through Flipped Learning	Found that AI-based Flipped Learning had a positive impact on students' self-efficacy and language skills; however, the study had limitations in generalizing results	Supports	Not specified

Table 1. *Cont.*

No.	Citation	Aim of the Study	Main Findings on Using AI	Position	AI Application/Software Used
43	[9]	To discuss human vs. artificial intelligence in language learning	Argued that human intelligence is essential as AI cannot fully replicate human context understanding; highlighted limitations of AI in language learning	Mixed	AI, Pattern Recognition, Image Analysis
44	[76]	To discuss reverse-engineering the language learning process of infants using AI	Emphasized the need for comprehensive, privacy-conscious data and testing to compare human and machine language learning	Supports	Machine Learning, Wearable Sensors
45	[77]	To examine the impact of ICT, networked learning, and AI on second language learning and teaching	Highlighted the importance of ICT and AI in revolutionizing CALL and creating new trends in language education	Supports	ICT, Networked Learning, AI
46	[78]	To argue for AI's role in adult second language learning	Presented original research showing that systematic correction of errors via AI can aid in language learning	Supports	AI-based language learning systems
47	[79]	To inform about AI and its implications on language and learning	Aimed to demystify AI for the public and ponder its effects on intelligence and society, providing a foundational view on AI and language learning	Supports	Not specified

Note: The included studies are visually categorised using a triadic colour scheme: green denotes studies supporting the use of AI tools in language acquisition/child language development, orange signifies studies that maintain a neutral position on this matter, and yellow indicates studies presenting a balanced perspective. It is crucial to understand that these classifications are not absolute, but rather relative. For example, a study classified as neutral may still acknowledge potential benefits or provide suggestions regarding AI utilization, although its primary focus leans towards the limitations or challenges.

Categories of Studies on the Use of AI Tools in Language Acquisition

Table 2 presents data exploring the intersection of AI and language acquisition. The discussion is organized into five categories: AI in Language Learning and Teaching, AI-Powered Language Learning Applications, Implications and Challenges of AI in Language Learning, Language Learning and Large Language Models, and AI and Child Language Development.

The integration of AI in language acquisition presents promising opportunities and challenges, particularly for individuals with special education needs. This essay delves into five distinct categories that explore the implications of AI tools in language acquisition for these populations, providing a nuanced understanding of the potential benefits and challenges associated with this intersection. Each category is examined in detail, drawing from recent research to support its implications.

The category of AI in language learning and teaching focuses on the use of AI in language learning and teaching contexts. Studies within this category, such as those by Barrot et al.[8, 40, 46], have investigated the efficacy of AI tools in language learning and explored their impact on speaking practice. Additionally, research by Jeon et al.[51, 52, 62] has assessed the perceptions of both students and educators regarding AI in language instruction.

Studies within the category of AI-powered language learning applications, such as those by Har et al.[41, 42, 45], have focused on the development and assessment of AI-powered applications, including chatbots, language learning apps, and virtual reality applications. These applications have the potential to offer adaptive and individualized learning experiences. However, as highlighted by Chen et al.[1, 43], challenges related to accessibility, inclusivity, and customization for diverse populations warrant careful consideration.

The category of implications and challenges of AI in language learning encompasses studies that have explored the ethical, usability, and practical implications of integrating AI tools in language learning, as well as potential challenges and concerns associated with AI implementation. Studies by Wu et al.[44, 48] have delved into the ethical and practical implications of AI in language learning, while research by Vaccino-Salvadore[57] has highlighted potential concerns associated with AI integration.

Research within the category of language learning and large language models, as seen in studies by Saville et al.[50, 51, 62], has focused on exploring the potential applications of large language models, such as ChatGPT, in language learning. These studies have examined how large language models and speech-recognition chatbots can provide tailored

language learning experiences. However, considerations regarding the adaptability of these models and their effectiveness in addressing individual learning challenges remain essential areas of inquiry.

Studies within the category of AI and child language development, including research by O'Grady et al. [7, 40] have investigated the role of AI in child language development, including AI applications for second language learning, AI-based language learning systems, and the role of AI in cognitive development. Understanding the role of AI in child language development is critical for providing tailored and inclusive learning.

Table 2. Five Categories for the 47 Studies on Using AI Tools in Language Acquisition.

No.	Category	Elaboration	How Studies Accounted for the Category	Sample Studies
1	AI in Language Learning and Teaching	This category focuses on the use of AI in language learning and teaching, including AI-assisted language learning, AI-supported speaking practice, and the impact of AI technology on language instruction.	These studies investigated the efficacy of AI tools in language learning, explored the impact of AI on speaking practice, and assessed the perceptions of both students and educators regarding AI in language instruction.	[1, 8, 40, 44, 46, 50, 51, 55, 56, 62, 73, 78]
2	AI-Powered Language Learning Applications	This category encompasses studies involving AI-powered applications, including chatbots, language learning apps, and virtual reality applications, for personalized and contextual language learning experiences.	These studies focused on the development and assessment of AI-powered language learning applications, exploring their impact on personalized and contextual language learning experiences.	[41, 42, 44, 45, 51, 56, 74, 78]
3	Implications and Challenges of AI in Language Learning	This category covers studies exploring the ethical, usability, and practical implications of using AI tools in language learning, as well as the potential challenges and concerns associated with AI integration.	These studies investigated the ethical, usability, and practical implications of integrating AI in language learning, as well as potential challenges and concerns associated with AI implementation.	[9, 44, 57]
4	Language Learning and Large Language Models	This category focuses on the exploration and potential applications of large language models such as Generative AI in language learning, including speech-recognition chatbots, contextual learning, and multilingual applications.	These studies explored the potential applications of large language models in language learning, focusing on speech-recognition chatbots, contextual learning, and multilingual applications.	[42, 50, 51, 55, 62]
5	AI and Child Language Development	This category involves studies that explore the use of AI in child language development, including AI applications for second language learning, AI-based language learning systems, and the role of AI in cognitive development.	These studies investigated the use of AI in child language development, focusing on AI applications for second language learning, AI-based language learning systems, and the role of AI in cognitive development.	[1, 7, 40, 47, 63, 69, 75]

3.3. Quantitative Analysis

Figure 2 presents a graphical representation of the distribution of scholarly work investigating the utilization of AI tools in the context of language acquisition and child language development. The data visualized in the figure indicates a propensity for most of the included studies to advocate for the advantages of employing AI-assisted methodologies in this domain. This observed trend suggests an initial impression that the academic discourse might be skewed toward a favourable view of AI's role in language education. Nevertheless, the mere numerical preponderance of studies supporting the use of AI tools does not suffice to conclusively assert their dominance over neutral or critical perspectives within the scholarly community. The quantity of supportive studies, while suggestive, is not in itself dispositive of the overarching narrative in the field. Consequently, to ascertain whether the observed distribution reflects a statistically significant preference among researchers, it is necessary to employ inferential statistical testing.

The execution of such inferential tests is designed to determine if the apparent predominance of supportive studies reflects a genuine underlying trend or merely an artefact of sampling variability. Through these analysis, we seek to establish whether the distribution of positive endorsements of AI tools in language acquisition and child language devel-

opment research is statistically significant when compared to more neutral or mixed viewpoints. This statistical validation is crucial to ensure that any conclusions drawn from the data are not merely the result of chance but rather indicative of a meaningful pattern within the corpus of existing literature.

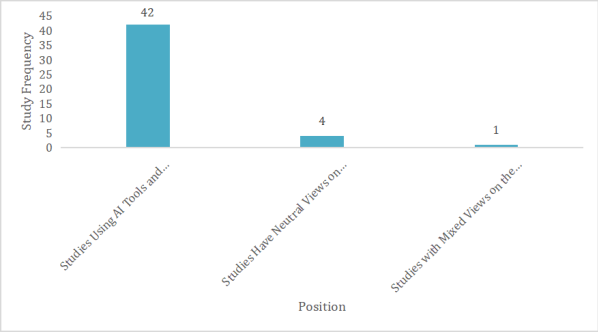

Figure 2. Distribution of Studies on AI and Language Acquisition by Position and Frequency.

The conducted analysis explored the distribution of study frequencies across three distinct positions regarding the use of AI tools in language acquisition and child language development. The positions were categorized as supportive, neutral, or mixed. A non-parametric one-way analysis of variance (ANOVA), specifically the Kruskal-Wallis test, was employed to assess the differences in frequencies among these categories (**Table 3**). The chi-square (χ^2) value of 2.0000 with 2 degrees of freedom (df) yielded a p-value of 0.368. The effect size (ε^2) was calculated to be 1.0000. The p-value exceeds the conventional alpha level of 0.05, indicating that there are no statistically significant differences in the frequency of studies across the three categories of positions concerning the use of AI tools in language acquisition.

Table 3. ANOVA Non-Parametric Test Results.

Variable	χ^2	df	p
Study Frequency	2.0000	2	0.368

Further pairwise comparisons were conducted using the Dwass-Steel-Critchlow-Fligner method to examine the specific differences between each pair of categories (**Table 4**). In each pairwise comparison, the statistic W indicates the test statistic for the pairwise comparison, and p represents the p-value for that comparison. The W values are all identical (−1.4142), and the p-values are equal (0.577) for each of the comparisons between the categories. These results suggest that there are no significant differences in the study frequencies when comparing the categories pairwise. Overall, the analysis did not reveal any statistically significant differences in the frequency of studies across the categories of support, neutral, or mixed positions regarding the use of AI in language acquisition and child language development. The consistent p-values in the pairwise comparisons corroborate the overall Kruskal-Wallis test finding, indicating homogeneity among the categories in terms of study frequencies.

Table 4. Kruskal-Wallis Test.

Pairwise Comparisons - Study Frequency	W	p
Support vs. Neutral	−1.4142	0.577
Support vs. Mixed	−1.4142	0.577
Neutral vs. Mixed	−1.4142	0.577

The non-parametric one-way ANOVA (Kruskal-Wallis test) and subsequent analyses reveal no statistically significant differences in the frequency of studies across support, neutral, and mixed categories regarding AI use in language acquisition, suggesting an evenly distributed academic stance and no prevailing consensus, indicative of the field's nascent stage. This uniformity fosters balanced discourse, necessitates cautious policy-making without clear evidence to prefer one perspective over another, and highlights the need for more detailed research to delineate conditions under which AI tools may be effective. The methodological diversity reflected in the non-parametric nature of the analysis underscores the potential benefits of interdisciplinary approaches and the value of heterogeneous study designs to enrich our understanding of AI's potential role in language development.

The relationship between the position on the use of AI tools in language acquisition/child language development (categorical variable with levels: supportive, neutral, and mixed) and the study frequency (numerical variable) was further investigated using a chi-square test. The outcomes are presented in contingency tables and chi-square test results. The observed and expected frequencies for each category of study position are displayed in **Table 5**. The table lists the observed frequencies of studies in each category across three different frequencies of studies (1, 4, and 42). The expected frequencies were calculated based on the assumption that there is no association between study position and study frequency. As the total number of studies is quite low (n = 3), the validity of the chi-square test may be questionable due to the small sample size and the expected counts being less than 5.

Table 5. Contingency Values.

Study Position	1	4	42	Total
Studies Using AI Tools and Endorsing Them in Language Acquisition				
Observed	0	0	1	1
Expected	0.33333	0.33333	0.33333	1.0000
Studies Have Neutral Views on Using AI Tools in Language Acquisition				
Observed	0	1	0	1
Expected	0.33333	0.33333	0.33333	1.0000
Studies with Mixed Views on the Use of AI in Language Acquisition				
Observed	1	0	0	1
Expected	0.33333	0.33333	0.33333	1.0000
Total				
Observed	1	1	1	3
Expected	1.00000	1.00000	1.00000	3.0000

A chi-square value (χ^2) of 6.0000 with 4 degrees of freedom (df) resulted in a p-value of 0.199 (**Table 6**). This p-value is greater than the conventional significance threshold of 0.05, suggesting that there is no statistically significant association between the position on using AI tools and the frequency of studies. The contingency coefficient is a measure of association for nominal data. The value of 0.81650 suggests a high degree of association between the two variables. However, given the small sample size and the limitations of the contingency coefficient (which can be affected by the number of categories and the distribution of cases), this result should be interpreted with caution.

Table 6. Chi-Square Test Result.

Value	df	p
χ^2	6.0000	4

The chi-square test indicates that there is no significant association between study position and study frequency. This is consistent with the previous Kruskal-Wallis test findings. The small number of studies included in the analysis could limit the power of the statistical test to detect an association if one exists. The high value of the contingency coefficient suggests a possible association but given the small sample size and the nature of the coefficient, this result should be interpreted with caution and cannot be taken as conclusive evidence of a relationship between the variables. Additional research with larger sample sizes and more varied study frequencies is needed to more accurately assess the relationship between the position on the use of AI in language acquisition and the frequency of studies.

4. Discussion

The aim of this content analysis research paper is to assess and analyse the existing literature on the utilization of AI tools in language acquisition studies. The sample included 47 articles covering the period from 1985 to 2023, the content analysis aimed to scrutinize prevalent themes, methodologies, findings, and discussions related to the use of AI in language acquisition, with a particular focus on addressing the diverse range of support and opposition regarding the integration of AI tools in language acquisition and learning. The study also explored the balanced attitudes and studies that highlight the benefits and disadvantages of using Al tools in language acquisition and learning in this study.

The qualitative and quantitative analyses of this research reported that the majority of researchers explored the potential benefits of using AI tools in language acquisition and language learning [4, 72, 78]. On the other hand, the content analysis research on the existing literature found that there are still some concerns about using AI tools in language acquisition and learning fields. Privacy, bias, reliability, accessibility, authenticity, and academic integrity in using AI tools including ChatGPT are among the common concerns reported in this research [57]. Highlighting the need for clarity and understanding of AI in education including language learning and teaching is highly recommended and ethical considerations should be greatly considered [50].

The data analysis of the existing literature on the relationship between AI and language acquisition and language learning found five categories that highlight the use of AI in language acquisition including (a) AI in Language Learning

and Teaching, (b) AI-Powered Language Learning Applications, (c) Implications and Challenges of AI in Language Learning, (d) Language Learning and Large Language Models, (e) AI and children Language Development. There are some studies that explored the efficacy of AI tools in language learning, discovering the impact of AI on language skills, and assessed the perceptions of both students and educators regarding AI in language instruction [40, 44, 50, 51, 55, 56]. There are also studies that focused on the development and assessment of AI-powered language learning applications, exploring their impact on personalized and contextual language learning experiences and catering to diverse learning styles, contexts, and needs [42, 45, 51].

Although this was not mainly part of our study's aims this research highlighted the challenges of implementing AI in language learning and language acquisition for individuals with special education needs or neurodiverse populations, addressing potential barriers and concerns that help in ensuring inclusivity and accessibility, and awareness about AI integration with language acquisition [9, 57]. The study presented the potential applications of large language models in language learning in modern research focusing on speech-recognition chatbots, contextual learning, and multilingual applications. This would be useful for individuals with special education needs or neurodiverse populations [51, 55, 62]. This content analysis study presented the significant role of using AI in child language development, focusing on AI applications for second language learning, AI-based language learning systems, and the role of AI in cognitive development and language recognition tools that are AI-based models [7, 47, 63]. While our present study analyzes the diverse perspectives on AI in language acquisition, studies like [80–82] highlight the broader context of technology integration in education. These studies emphasize the positive perceptions of teachers and learners toward technology use, the potential for enhanced engagement and reduced anxiety, and the need for adequate infrastructure and training. This aligns with the present research's focus on the complexities of integrating new tools like AI into language learning, suggesting that successful implementation requires not only addressing practical and logistical hurdles but also considering the varied perspectives and potential impacts on the learning process itself.

Recent studies have further emphasized the transformative potential of AI in diverse language learning contexts. For instance, AI chatbots based on LLMs have been found to significantly enhance both receptive and productive vocabulary knowledge for foreign language learners, contributing to long-term retention and incidental vocabulary learning [10]. Generative AI has shown promise in teaching legal vocabulary through an interactive approach grounded in constructivist pedagogy, despite challenges related to educator proficiency and resource limitations [11]. AI tools have also proven effective in acquiring register knowledge during English writing tasks, particularly in formal contexts [12]. AI-enhanced word processors have been beneficial for bilingual language learners in academic writing instruction [13]. Digital game-based learning (DGBL) using AI has been shown to enhance motivation, creativity, and problem-solving for young learners, although design and development challenges persist [14]. Integrating CT with AI tools has improved vocabulary richness in English essay writing for non-English majors in China [15]. Accurate AI models have been found to enhance pronunciation accuracy, although cost remains a significant barrier [16]. These findings collectively underscore the significant impact of AI on language acquisition and the potential for AI-powered tools to revolutionize language learning.

5. Implications for Practice

The findings of this study hold implications for educators, policymakers, and researchers in the domains of language acquisition and AI integration. The documented array of perspectives on AI tools in language acquisition underscores the necessity for a balanced and informed approach to the implementation of AI technologies in educational settings. First, there is a need to conduct longitudinal studies to understand the long-term effects of AI integration in language learning. These studies should track student progress over several years to provide a comprehensive view of AI's impact. Researchers should collaborate across disciplines, including AI development, education, psychology, and special education, to create AI tools that are both technically robust and pedagogically sound.

6. Limitations

This study is subject to several limitations that warrant consideration. Firstly, the content analysis focused on scholarly work spanning from 1985 to 2023. While this range covers a significant period, it may exclude the most recent developments in AI technologies and their applications in language acquisition. Given the rapid evolution of AI, the exclusion of the latest literature might limit the comprehensiveness of the analysis. Additionally, although the sample size was carefully selected to provide a broad overview, it may not fully capture the entirety of research in this area. The expanding interest and investments in AI and language acquisition suggest that there could be a substantial body of work not included in this study, potentially impacting the representativeness and completeness of the findings.

Another limitation is the study's reliance on English-language articles, which may introduce a language bias. This approach potentially overlooks valuable contributions published in other languages, limiting the global perspective of the analysis. Furthermore, content analysis, despite employing rigorous methodologies, inherently involves a degree of subjectivity. The process of coding and interpreting data can be influenced by the researchers' perspectives, potentially affecting the identification of prevalent themes and the overall understanding of the literature. This subjectivity could introduce biases in the synthesis of findings.

Lastly, the analysis of the distribution of scholarly work investigating AI tools in language acquisition was based on a limited dataset, which may affect the generalizability of the findings. The rapid pace of AI technological evolution means that studies quickly become outdated, and newer technologies and methodologies may not be reflected. Additionally, while the study highlighted ethical considerations and practical implications, it may not have fully explored all dimensions of these complex issues. Future research could provide a more in-depth examination of these aspects, addressing the gaps and expanding the understanding of AI's role in language acquisition.

7. Conclusion

In brief, the study provides an overview of the existing literature on the intersection of AI and language acquisition. The analysis underscores the diverse spectrum of support and opposition regarding the integration of AI tools for language learning, emphasizing the importance of ethical considerations, quality assurance, and the necessity for continued research to optimize the integration of AI tools in language learning. The study's findings indicate a balanced discourse and the absence of a prevailing consensus, highlighting the nascent stage of the field and the need for cautious policy-making without clear evidence to favour one perspective over another. The research underscores the potential benefits of interdisciplinary approaches and the value of heterogeneous study designs to enrich our understanding of AI's potential role in language development. Ultimately, the study serves to guide educators, policymakers, and researchers in navigating the complexities of integrating AI tools in language acquisition, emphasizing the need for inclusivity, ethical considerations, and continued inquiry to optimize the use of AI in language learning.

Author Contributions

Conceptualization, O.A., A.A., M.A. and F.Q.; Formal analysis, A.A.; Funding acquisition, O.A., M.A. and F.Q.; Investigation, O.A., M.A. and F.Q.; Methodology, A.A.; Project administration, O.A., M.A. and F.Q.; Resources, M.A. and F.Q.; Software, A.A.; Supervision, O.A., M.A. and F.Q.; Validation, A.A.; Visualization, A.A.; Writing—original draft, O.A., A.A., M.A. and F.Q.; Writing—review & editing, O.A., A.A., M.A. and F.Q. All authors have read and approved the final work.

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This research did not require IRB approval.

Informed Consent Statement

Neither human nor non-human subjects were involved directly in this research. Therefore, informed consent was not required.

Data Availability Statement

The data that support the findings of this study are available from the corresponding author, [A.A.], upon reasonable request.

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Conflict of Interest

The authors declare no conflicts of interest.

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