Computer Assisted Language Learning Electronic Journal (CALL-EJ), 25(3), 1-22, 2024

Navigating the Future of Language Learning: A Conceptual Review of AI's Role in Personalized Learning

Saieed Moslemi Nezhad Arani (Saieed91@yahoo.com)
Department of English Language Teaching, Farhangian Teacher Education University, Zahedan, Iran

Abstract

Language pedagogy is increasingly tailored to meet individual learning needs through the use of Artificial Intelligence. Informed by Hart's (2018) framework, this concept paper explores the potential role of AI in revolutionizing educational practices, with a particular focus on personalized learning pathways in language education. The integration of AI is envisioned as a transformative tool that could fundamentally alter conventional pedagogy, yielding both promising opportunities and significant challenges. This exploration includes a structured synthesis of the literature that underscores the development of digital literacy, robust infrastructure, and teacher training as critical components for effective AI integration. In the midst of examining opportunities, this paper also confronts potential threats and ethical concerns like data bias. Through an in-depth discussion, the paper advocates for a balanced approach that harnesses AI's strengths while preserving the essential human element and inclusivity, thereby proposing a blueprint for an adaptable educational system fit for the digital era. The contemplation herein contributes to the ongoing discourse on AI's influence in education, providing pivotal insights for educators, policymakers, and AI developers.

Keywords: Artificial Intelligence, Conceptual review, Language learning future, Personalized learning,

Introduction

With the evolution of technology, Artificial Intelligence is increasingly being recognized as an instrumental force in reshaping the educational paradigm, particularly in the realm of language pedagogy. As global interconnectedness deepens, the need for effective language instruction that caters to diverse learners has become more apparent. In traditional educational models, which often employ a uniform curriculum and pace, individual learner differences can be overlooked, leading to suboptimal learning outcomes.

This paper identifies the problem rooted in these monolithic teaching strategies and suggests AI as a transformative solution. AI's capabilities for customizing instruction and assessing learner needs promise a departure from the status quo, potentially revolutionizing how we approach language learning. Despite a growing body of research on AI in various educational contexts, there remains a lack of synthesis examining the comprehensive role and intricacies of AI in personalized language learning pathways. Notably, earlier studies have not fully explored the ramifications of AI integration on existing pedagogical frameworks, nor have they systematically addressed the ethical considerations and potential for data bias that AI implementation may entail.

This conceptual paper aims to fill this gap by offering a cohesive synthesis of the current literature, drawing upon theoretical frameworks and empirical findings to illuminate the multifaceted consequences of AI adoption in language education. The contribution lies in threading together the promise of AI for bespoke learning experiences with the nuanced challenges it presents, both technologically and ethically. By engaging in this discourse, the paper not only navigates the complexities of AI's integration but also proposes a way forward that balances innovation with critical human values. Ultimately, this investigation paves the way towards a more refined application of AI in education, where informed strategies lead to equitable, effective, and ethical language learning environments.

Literature review

The concept of 'personalized learning' has its roots in the traditional instruction paradigm, where teaching was primarily a one-way process. Historically, education was designed as a 'one-size-fits-all' model, with a uniform curriculum, instructional method, and pace of learning, providing little room for individual differences among learners. However, as the understanding of cognitive science and learning theories evolved, the emphasis shifted towards a more accommodative and learner-centered model of education (Jordan et al., 2020; Orina et al., 2021). This shift has led to an educational approach that emphasizes tailoring the learning experience to individual students' strengths, needs, skills, and interests (Lu et al., 2023; Reich, 2022).

In the realm of language teaching, personalized learning takes shape by customizing instruction, materials, and assessments to cater to individual learners' needs (Smorodinova et al., 2022; Vuong & Wong, 2019). Each language learner's cognitive abilities, linguistic heritage, cultural background, and learning preferences uniquely influence their language learning process. To accommodate these differences, personalized language learning focuses on tailoring instruction methods (Kupchyk & Litvinchuk, 2021; Šimonová & Poulova, 2014). For instance, certain learners may grasp new languages quicker through visual aids, while others might excel in an auditory or kinesthetic learning environment.

Materials and content employed for language teaching are also customized in a personalized learning setup. Such tailoring aligns with learner's current linguistic competence and gradually progresses as per their pace of learning, giving a truly learner-centered experience. As stated by Lutskovskaia et al. (2019); Mageira et al. (2022); Woo and Choi (2021); Zunaidah et al. (2023), AI-based language learning tools have the capability to offer differentiated content, varying in difficulty level, grammar structure or vocabulary, depending on the learner's proficiency. Therefore, integrating personalized learning in language instruction leverages individual differences, enhances learner engagement, and boosts language acquisition.

Personalized learning in language teaching has been emphasized for promoting numerous advantages. Increased learner engagement is one of the significant benefits, as this approach allows learners to engage with the learning material that suits their style and pace, leading to higher motivation and active learning (Kardaş, 2016; Wang, 2023). Additionally, personalized learning has demonstrated higher efficacy in mastering language skills. By aligning instruction and content with individual capabilities, it allows learners to grasp the language more effectively, enhancing

outcomes like vocabulary acquisition, reading comprehension, and listening skills (Cheung, 2013; Li et al., 2018).

Despite the clear benefits, personalized learning is also associated with some potential drawbacks. One significant challenge is its difficulty to be implemented at large scale. Tailoring instruction to individual needs requires considerable resources, such as time, sophisticated AI technology, and especially-trained teachers (Baimakhanova & Ibrayeva, 2022; Lăpădat, 2023; Rüdian & Pinkwart, 2021; Schulz et al., 2020). Given these demands, applying personalized learning extensively, especially in resource-poor contexts, becomes problematic. Furthermore, this tailored approach relies heavily on data collection and AI algorithms, raising privacy and ethical concerns. In sum, while personalized learning in language instruction indeed holds promise in enhancing teaching and learning, it also incites certain challenges that need to be acknowledged and addressed.

Automated personalized learning powered by AI revolutionizes the traditional education paradigm by offering effective and efficient learner-centric instruction. AI in personalized learning involves sophisticated AI systems capturing learners' data, including their learning pace, styles, and skill levels (Liu & Quan, 2022; Lydia et al., 2023; Pataranutaporn et al., 2021). Using machine learning algorithms, these platforms continuously analyze learners' progress by comparing their performance with their past records or with other learners who share similar traits (Chen et al., 2022; Hocutt et al., 2022; Sayed et al., 2022). Based on the insights gained from this data analysis, AI platforms adapt instruction accordingly. For instance, if a learner is struggling with a particular language concept, the system might revise the content, adjust the complexity level, or change the learning mode to visual, auditory or kinesthetic depending on the learners' preference. In addition, AI platforms provide real-time feedback, identifying areas of strength and improvement (Porter & Grippa, 2020; Wijewickrema et al., 2018). This instantaneous feedback mechanism enables learners to improve their language skills more quickly and efficiently than through traditional feedback methods. The use of AI, therefore, provides a highly targeted, responsive, and effective approach to personalized learning, revolutionizing the way we view education and instruction.

Traditional and AI-based personalized learning offer contrasting paradigms for education. According to Porter and Grippa (2020), traditional personalized learning ensures instruction tailored to individual needs but struggles to deliver this at scale due to constraints on teacher time and resources. Conversely, AI-driven personalized learning has the advantage of scalability (Yu, 2023). Complex algorithms allow for individual instruction adapted to countless learners simultaneously, something unachievable in a traditional setup. Moreover, AI can provide real-time, adaptive feedback that contributes to an immediate and effective learning process (Al Gharbi et al., 2021; Gupta et al., 2022). By contrast, traditional teaching models may not offer immediate feedback, delaying learning progress. Objectivity in assessment is another notable strength of AI-based personalized learning (Anuyahong et al., 2023; Murtaza et al., 2022). It eliminates human biases and variability, offering a more consistent and accurate appraisal of learning. On the flip side, AI-integrated personalized learning brings its share of challenges. Data privacy is a key concern, as learners' sensitive information is constantly collected and analyzed (Fu et al., 2023). Furthermore, unequal access to technology could perpetuate existing educational inequalities, with

students lacking requisite tech access potentially being left behind (Murtaza et al., 2022). Consequently, while AI offers unprecedented opportunities for personalized learning, it also presents complex challenges on the equity and privacy fronts.

Methodology

The methodological approach for this conceptual review is inspired by the framework proposed by Hart (2018), which is designed to facilitate a comprehensive exploration and synthesis of the literature on AI's role in personalized language learning. We engage in a thorough literature exploration and critical appraisal, alongside a thematic analysis, to develop a scholarly narrative that encompasses the present scope and prospective direction of the domain. The theoretical foundation of this review is grounded in principles drawn from educational psychology and models of technology adoption, which serve to deepen comprehension of both personalized learning and the integration of AI in educational frameworks. By applying Hart's methodological structure, this paper seeks to expand upon existing scholarship and highlight areas for future research and innovation.

Methodological Approach

Present study's methodological design is tailored to a conceptual examination, wherein we systematically identify, select, and analyze scholarly texts related to the role of AI in personalized language learning. This design follows a thematic structure that allows for the identification of patterns, frameworks, and theories discussed across various sources.

Literature Synthesis Strategy

The procedure for the present study's literature synthesis involved a multi-phase approach. Initially, relevant academic databases were queried using a defined set of keywords encompassing aspects of AI and language learning. Following this, we employed a critical appraisal technique to evaluate the quality and relevance of identified articles. Finally, we synthesized the core concepts and discussions to construct the narrative and arguments presented in this paper.

Scope and Delimitation

Guided by Chris Hart's framework for conducting rigorous literature reviews, this paper systematically examines the burgeoning intersection of Artificial Intelligence and personalized language learning. Prsent study's approach adopts Hart's methodologies for literature mapping, critical analysis, and synthesis, ensuring that the literature included is scrutinized through multiple lenses to construct a rich conceptual landscape.

The scope of this paper is carefully defined to focus on primary scholarly works that explicitly explore the use of AI in language education, while secondary sources are used to contextualize and support the researcher's interpretations. Sources are selected based on their relevance to the field, their contribution to foundational knowledge, and their recent implications for the future trajectory of language learning and pedagogy. In keeping with Hart's guidelines, the literature is

mapped to identify key themes and patterns, with particular attention to the evolution of thought within the discipline and emerging areas of consensus and debate.

While the present study's review is extensive, there are delimitations intrinsic to the approach. Consistent with Hart's framework, the emphasis is placed on academic and peer-reviewed sources, potentially excluding grey literature or non-peer-reviewed material that may also hold valuable insights. Furthermore, in aligning with the structure of a conceptual paper, the reasercher's focus is on developing thematic narratives rather than empirical generalizability. This includes an acknowledgement of the predominant focus on literature published in English, with the understanding that significant contributions may exist in other languages.

The paper's lens is further narrowed to the implications of AI in language learning environments, which may omit broader educational technologies and applications from the discussion. The rapid pace of technological advancement in AI also means that while the present analysis is representative of the state of the field at the moment of writing, subsequent innovations may not be covered within this review.

This paper presents a synthesized perspective on the integration of AI in language teaching, shaped by a structured and critical engagement with the literature as outlined by Chris Hart's theoretical approach. Yet, it also recognizes the dynamic nature of AI research and the importance of ongoing inquiry to encapsulate its evolving impact on education." Using this framework, you clarify the methodological rigor of your review process and explicitly define the breadth and limits of your analysis, helping to set accurate expectations for your readers.

Key Findings

Drawing on a diverse array of literature, this section will explore the sophisticated algorithms that enable personalized language learning experiences, highlight the adaptive capabilities of AI in real-time settings, and examine various systems and tools that exemplify the practical application of AI in language education. We will also consider the reported effectiveness of these AI tools in shaping language learning.

In personalized language learning, AI algorithms play a pivotal role in delivering tailored instruction that can significantly enhance the learning outcomes. These algorithms are primarily designed to interpret and analyze large volumes of learner data systematically to discern patterns and create adaptive learning paths (Jeong & Park, 2019; Rizvi, 2023). Machine learning algorithms can identify a learner's language proficiency level, preferred learning style, common errors, and pace of learning. For instance, an algorithm can recognize a learner's difficulty in understanding a particular tense in a new language and can accordingly adapt its instructions to provide more practice or explain differently. Furthermore, according to (Ng et al., 2020; Zhaxybayev & Mizamova, 2022), natural language processing algorithms, a branch of AI, enable the system to understand, interpret, generate, and contextualize human language in a meaningful way. This technology can provide immediate feedback on learners' written and spoken language, marking a disruptive shift from traditional language learning methods.

The process of data gathering and analysis is integral to AI's transformative role in personalized language learning. Using sophisticated algorithms, AI systems are capable of collecting and analyzing real-time data on learner performance, helping to inform instructional adaptations (Godwin-Jones, 2017). For instance, these AI platforms can monitor a learner's pace of study, the complexity of language they can handle, their mastery over specific language aspects such as syntax, pronunciation or vocabulary, and their interactions with the learning platform. This information not only paints a comprehensive picture of a learner's current proficiency level, but it also offers deep insights into their learning patterns. By analyzing this voluminous data, AI can tailor instruction to the specific needs of the learner, providing content that matches their language proficiency level, suggesting exercises to overcome specific weaknesses, or adjusting the pace of instruction (Chen et al., 2022). Accordingly, the importance of data analysis in AI language learning allows for a highly responsive system that constantly adapts and improves its instruction based on the individual learner's demonstrated needs and progress (Demmans Epp, 2021).

The crucial advantage of AI systems in personal language learning is their real-time adaptive capability. Based on the learner's analyzed data, these systems instantaneously adjust their instruction to suit the learner's current proficiency and requirements. Incorporation of personalized language learning systems with AI and cognitive-based personalization can further enhance language personalization systems (Lydia et al., 2023). These dynamic adjustments span from altering content difficulty according to the learner's language proficiency, presenting relatively simpler content to beginners and, progressively more complex content as the learner advances. AI also identifies learning difficulties through factors such as time spent on specific exercises or recurring mistakes and ensures additional practice or explanations are provided (Chen et al., 2021). Furthermore, an AI system may pace the instruction depending on the learner's speed of learning, ensuring the learner is neither overwhelmed nor under-stimulated (Cui & Sachan, 2023).

Several language learning platforms effectively apply the capabilities of AI to offer personalized instruction in languages. Duolingo, a well-known AI-empowered language learning platform, demonstrates the dynamic role of AI in language services by using machine learning algorithms for data analysis to understand users' proficiency levels, aptitudes, and learning patterns. Then, it personalizes language pathways in real-time to focus on weaknesses and reinforce strengths. Further, Duolingo's language bot employs natural language processing algorithms to generate interactive dialogues, thereby improving learners' conversational skills in the target language. Similarly, the AI platform Rosetta Stone applies proprietary speech recognition algorithms offering immediate feedback on pronunciation, assisting learners in refining their spoken language skills. This ability to provide customizable and interactive user experiences is a testament to AI's potential in language learning. However, ongoing challenges like data privacy and algorithm bias should still be addressed. Woo and Choi (2021) corroborate these advantages, showing improvements in language skills and knowledge in learners after they utilize AI tools for error spotting, receiving feedback, and language evaluation. Vall and González Araya (2023) discuss the beneficial aspects of AI language learning tools including reduced learning times, personalized learning experiences, and exposure to different cultures which signifies the role AI plays in personalizing instruction and enhancing language learning outcomes.

Numerous studies attest to the effectiveness of AI in personalized language learning. In a study conducted by Moulieswaran and Prasantha (2023), it was found that the ability of AI to provide immediate feedback, address individual learning needs, and offer customized practice tasks resulted in a favorable learning environment, conducive to improved language proficiency. Addressing the same issue, Zhou et al. (2022) examined the effectiveness of Duolingo, a well-known AI language learning platform. The research revealed that the platform's algorithm-driven personalization provided learners with a flexible, engaging, and efficient language learning pathway, leading to significant improvement in reading, writing, listening, and speaking skills in the target language. This evidence reinforces the argument that AI-driven personalized language learning can effectively support learners to develop their language skills and proficiency. However, it is crucial to mitigate potential downsides highlighting the potential difficulties and challenges of AI-driven language learning platforms. Zhu (2020) points out that AI-assisted language education can advance learning efficiency and foster education equity by supplying individualized content and personalized assistance.

Meanwhile, Fulton et al. (2021) warns of the datafication and personalized learning trends, arguing an over-dependence on AI systems might decrease learner autonomy and critical thinking abilities. In the same regard, given AI systems' adaptability to the learner's pace and content, an overreliance could result in a lack of learner autonomy and critical thinking skills, essentials in language learning. Haristiani (2019) investigates the application of AI chatbots as language learning mediums, concluding that they could serve as effective tutors and autonomous learning tools. However, if these systems provide all the answers, learners might get used to being spoon-fed and face difficulties when having to use the language in unforeseen or innovative scenarios. Woo and Choi (2021) examined AI-based language learning tools, touching on their positive impact on language skills and knowledge. Yet, their study also concedes the need for teacher preparation and identifies concerns about insufficient information. Moreover, as paralleled by Mah et al. (2022), there could potentially be among different learner groups, which could unintentionally widen the digital divide, favoring learners with more accessibility to technology. However, granting the positive side, the need for large volumes of data for these AI systems to work effectively raises important concerns. Such data includes specifics about an individual learner's behavior, patterns, and preferences, potentially posing considerable data privacy and security risks.

Table 1
Real-World AI Applications in Language Learning: Platform Categorization

Type of AI		Main features	Relevant Popular Apps/Platforms	Relevant studies
Intelligent Tutoring Systems	These systems provide personalized instructions and feedback to learners, adapting to their	• Interactive Instruction • Personalized Feedback • Adaptive Content • Knowledge Modeling • Scaffolding and Hints	• Duolingo • Rosetta Stone • Babbel • Busuu • Memrise • Mondly • ALEKS	(Kang, 2021) (Sakalauskė & Leonavičiūtė, 2022) (Namaziandost et al., 2021) (Arifin & Hikmah, 2023) (Sporn et al., 2020)

	individual needs.	• Error Analysis and Correction • Progress Tracking and Reporting		(Loewen et al., 2020) (Winans, 2019) (Lubis et al., 2023) (Putri & Simanjuntak, 2022) (Nushi et al., 2024) (Harous et al., 2017)
Adaptive Learning Platforms	Platforms that adjust the learning content based on the learner's performance.	• Real-Time Adaptation: • Customized Learning Paths • Data-Driven Insights • Feedback and Assessment • Predictive Analytics • Engagement Tools • Accessibility and Flexibility • Comprehensive Content Libraries	• Smart Sparrow • Knewton (now part of Pearson) • DreamBox Learning • ScootPad • ALEKS	(Mezin et al., 2022) (S. Liu et al., 2021) (Zhang et al., 2023) (Aprilinda et al., 2022) (Nosenko, 2020) (Gayathri et al., 2018)
Conversational Agents and Chatbots	AI-driven chat interfaces that can engage learners in natural language conversations	• Natural Language Interaction • Immediate Response • Language Practice • Personalization • Scalability • Error Detection and Correction • Availability • Sentiment Analysis • Progress Tracking	• Duolingo Bots • Mondly Chatbot • Andy - English Speaking Bot • HelloTalk • Rosetta Stone Chatbot • Speaky	(Ruan et al., 2021) (Wu et al., 2023) (Najima et al., 2021)
Speech Recognition Tools	These tools focus on developing speaking and pronunciation skills by giving instant feedback.	• Pronunciation Assessment • Real-Time Corrective Feedback • Interactive Speaking Practice • Accent Reduction • Speech-to-Text Conversion • Listening Comprehension • Phonetic Visualization • Voice Command and Control • Contextual Recognition	• Rosetta Stone • Duolingo • Babbel • Pronunciator • Speechling • HelloTalk	(Floyd, 2016) (Cavus, 2016) (Yang, 2022) (Febriani et al., 2023) (Nugroho et al., 2021)

Virtual Reality and Augmented Reality Applications	Some language learning platforms use VR/AR to create immersive experiences.	• Immersive Environments • Interactivity • Contextual Learning • Engagement and Motivation • Visual Aids • Cultural Immersion • Gesture Recognition • Real-world Integration • Multi-sensory Learning • Safe Practice Environment	• MondlyVR • ImmerseMe • Language Learning with Virtual Reality • AR Flashcards • Quiver • Google Translate	(Pan et al., 2021) (Jing et al., 2022) (Tschanz & Baerlocher, 2022) (Soto et al., 2020)

Studies evidenced that AI-based language learning platforms have the potential to enhance language acquisition and provide personalized and engaging learning experiences (Jia et al., 2022; Y. Liu et al., 2021; Tan et al., 2022). A host of AI-based language learning platforms are reshaping the educational landscape as detailed in Table 1, each delivering unique advantages driven by artificial intelligence. Intelligent Tutoring Systems like Duolingo, Rosetta Stone, Babbel, Busuu, Memrise, Mondly, and ALEKS personalize the learning path for users, adapting to their individual progress and areas of difficulty. Adaptive Learning Platforms, including Smart Sparrow, Knewton, DreamBox Learning, ScootPad, and once more ALEKS, tailor educational content and exercises to a student's specific needs, optimizing the learning experience. Conversational Agents and Chatbots, such as Duolingo Bots, Mondly Chatbot, Andy - the English Speaking Bot, HelloTalk, Rosetta Stone Chatbot, and Speaky, engage learners in dialogues to practice language skills in an interactive context. Speech Recognition Tools provided by platforms like Rosetta Stone, Duolingo, Babbel, Pronunciator, Speechling, and HelloTalk assist in perfecting pronunciation through immediate feedback. Lastly, Virtual and Augmented Reality Applications including MondlyVR, ImmerseMe, various VR offerings for language learning, AR Flashcards, Quiver, and Google Translate immerse users in contextual learning environments with interactive 3D models and real-time language translation. Collectively, these platforms exemplify the transformative potential of AI to create dynamic, personalized language learning experiences. Nevertheless, challenges such as data privacy, technological over-reliance, and access inequality must be continually addressed to ensure the responsible evolution of these educational tools.

Available scholarly literature (Divekar et al., 2021; Ji et al., 2022; Lee & An, 2021; Rebolledo Font de la Vall & González Araya, 2023; Woo & Choi, 2021) highlights the AI-driven applications and AI-platforms' success in enhancing language proficiency, reporting significantly higher engagement and satisfaction rates compared to traditional language learning methods, concluding that comprehensive, personalized learning pathways and feedback mechanisms resulted in considerable improvements in individuals' language skills. This reveals that the personalized, interactive nature of these AI platforms can foster sustained engagement, which is a critical factor in successful language learning. The researchers in the above-mentioned studies found that the

intelligent combination of human teaching and AI tools effectively increased students' language learning efficiency and proficiency. These studies, among others, provide robust evidence of the transformative impact of AI tools in engaging learners, enhancing their language proficiency, and boosting learning outcomes. Yet, it is important to remember that these platforms need to continue addressing concerns related to data privacy, equity of access, and the potential of over-reliance on technology.

Discussion

This section weaves together the implications of AI's role in language pedagogy, reflecting on how it affects student engagement and overall educational quality. We will delve into both the individual and societal benefits that AI integration promises, while also addressing the potential barriers and drawbacks. The future impact of AI on language education, as well as pressing concerns over data privacy, access inequality, and ethical considerations, will be critically examined.

Studies suggest that while AI has potential benefits in language learning, there are considerable challenges that need to be addressed, such as the limitations of AI in replicating human intelligence and the need for more research on skills development and pedagogy (Kukulska-Hulme & Lee, 2020; Vall & González Araya, 2023). One of the primary concerns is privacy, given the substantial amount of data collected by these AI tools (Foulds et al., 2022; Nazaretsky et al., 2022). Such data includes not only language learners' personal information, but also their learning patterns and academic progress (Hockly, 2023). Effective measures are needed to ensure the privacy and security of such user data. Accessibility also poses a significant challenge. Despite technological advancements, not all learners, especially those situated in remote or socio-economically disadvantaged areas, have access to the necessary technology or internet connectivity to leverage these AI tools. Besides, the integration of AI in language learning also raises concerns related to the deepening of digital divide. The varied access to and quality of technology among different learner populations could inadvertently result in disparities in language learning outcomes. Additionally, while the functional capabilities of AI tools are impressive and continually improving, they still fall short of replicating the holistic and intuitive nature of human instruction. Human language teachers can provide nuanced cultural context, foster emotional connections, and adapt to the learner's needs in a dynamic and empathetic manner. While AI-based tools can effectively supplement human instruction by allowing personalized learning paths and offering immediate feedback, it remains questionable whether they can fully replace the human element of language teaching.

The future of language learning through AI tools promises transformative potentials with the currently burgeoning AI-based language-learning market poised to revolutionize language teaching through more responsive, personalized, and learner-centric solutions. Continuous advancements in machine learning and voice recognition are set to improve the quality and efficacy of AI language tools, which could be adapted for broader academic areas. Disciplines integrating substantial language components, like literature or history, could particularly benefit from the personalization and interactivity provided by AI. However, realizing these potentials necessitates navigating associated challenges, such as ensuring data privacy and security and bridging the

digital divide for equitable access to technology. If these challenges can be effectively managed, AI could potentially democratize education, granting learners across the socio-economic spectrum access to quality language learning resources.

AI-enabled personalized learning has been found to significantly improve student engagement and motivation in language learning by tailoring teaching techniques to each student's abilities, preferences, and interests, making learning more engaging and thereby encouraging sustained motivation (Alsobeh & Woodward, 2023). These AI tools encourage active participation by addressing individual needs and goals, leading to increased intrinsic motivation and a more positive attitude towards language learning due to the meaningful and rewarding learning experience offered.

The impact of student engagement through these tools extends beyond motivation, with several studies outlining how this engagement facilitates more extensive language practice and exploration, thereby enhancing language acquisition. The persistence shown by engaged learners when faced with challenging language concepts or skills, further emphasizes the effectiveness of this approach in language education (Campenhout et al., 2023; Hiromori, 2023). The interactivity offered by many AI tools promotes hands-on language learning, forcing constant active responses and adjustments that reinforce understanding and retention of the language (Yang & Kyun, 2022). This underlines a positive correlation between sustained engagement and effective language outcomes, with the stimulation of learners' curiosity and interest fostering a more engaging and rewarding language learning environment.

The use of AI-enhanced personalized learning techniques holds significant potential to boost the overall quality of education, primarily due to their learner-centric approach (Liyanage et al., 2022; Lydia et al., 2023). Instruction catered to individual learners' unique abilities, needs, and interests fosters a more responsive and effective teaching environment. Notably, these personalized learning methods also prioritize fostering critical thinking skills by encouraging a more interactive, inquiry-based approach to learning, prompting students to question, analyze, and synthesize information. Additionally, the utilization of sophisticated AI computing technologies should be closely linked with educational theories in order to optimize learning efficiency and effectiveness. Numerous studies also highlight the changing roles and economies of degrees as well as increasingly scalable personal learning experiences resulting from automated technology, showing how AI can improve opportunities for all students (Harry, 2023; Kohli et al., 2021). AI-based personalized learning pathways in education have the potential to revolutionize traditional teaching methods by tailoring instruction to individual learners' specific needs, abilities, and interests.

The transformative potential of personalized learning to enhance language skills and its consequence on both personal and societal scales cannot be understated. As Chen and Wang (2020) elucidate, personalized learning accounts for individual differences such as learning styles, prior knowledge, preferences, and ability levels, which can significantly enrich personal, academic, and professional lives of individuals. This tailored approach to learning, as Wozniak (2020) argues, can exceptionally support adult learners, fostering their particular needs, motivations, and resources. Therefore, the proficiency earned in multiple languages in this way, not only expands cultural understanding and personal perspectives, but also offers an edge in the professional milieu.

Samah et al. (2011) echo this sentiment, asserting that recognizing individual differences in personalized learning settings leads to boosted learning outcomes, satisfaction, and engagement. Consequently, the societal implications of these individual enhancements are substantial. Greater prevalence of multilingual individuals breaks down socio-cultural barriers, thus facilitating mutual respect and understanding in diverse communities. Furthermore, it stimulates economic growth by potentially attracting global businesses and fostering innovation.

While personalized learning offers promising benefits, acknowledging potential barriers and drawbacks is crucial. Principal among these challenges is the resource intensiveness of such methods (Maghsudi et al., 2021). Implementing personalized learning, particularly when supplemented by AI, requires significant investments in technological infrastructure, ongoing maintenance, and educators' professional development (Tapalova et al., 2022). This brings into question the feasibility and sustainability of such approaches, particularly in resource-limited situations. Additionally, concerns exist regarding the potential of personalized learning to inadvertently widen existing educational disparities. As argued by Montez et al. (2019) and Teasley and Homer (2020), students from socio-economically disadvantaged backgrounds may lack equal access to necessary technological resources, resulting in unequal chances for personalized learning. Hence, instead of equalizing opportunities, personalized learning might unintentionally exacerbate existing inequities. Another salient issue is the possible isolation implicit in such an educational approach. Gurba (2022) reported that with learners overly reliant on individual learning pathways, the opportunities for collaborative learning might be substantially reduced. While personalized learning is designed to cater to individual needs, it is essential to ensure it does not isolate learners or impede their social skills development. In conclusion, while AI-aided personalized learning can significantly enhance language education, these potential obstacles and disadvantages need careful consideration and preemptive management for successful and fair implementation.

The future implications of integrating AI into personalized learning could profoundly impact language education. Foremost among these implications is the potential for AI advancements to increase the accuracy of speech recognition. As speech recognition software becomes more sophisticated, it can provide more detailed feedback to learners regarding their pronunciation, intonation, and speech patterns, thereby enhancing their spoken language skills and communication confidence in a target language. According to Alhawiti (2015) and Sathya et al. (2017), the efficacy and satisfaction derived from employing artificial neural networks for isolated speech recognition affirm its potential in this field. This is further bolstered by the progressive models of artificial intelligence methodologies, notably for decoding speech patterns, underlining the prospect of extensive applications across diverse disciplines. Ultimately, it is postulated that the trajectory of artificial intelligence will ultimately help overcome the prevalent challenges inherent to speech recognition. In addition to improved speech recognition, the increased adaptivity of AI could enable more personalization in language learning. With machine learning algorithms becoming more advanced, they may anticipate individual learners' needs more effectively by adapting content delivery or learning pathways at a more granular level (Chen et al., 2021; Woo & Choi, 2021). This adaptability will provide personalized support that aligns with learners' current abilities, goals, and projected learning trajectory.

Strong arguments can be made for AI advancements' potential to widen access to language learning resources. The groundbreaking research by Vall and González Araya (2023) emphasizes that AI language tools can tailor learning experiences, quicken the pace of learning, and expose learners to diverse cultures. Similarly, Almelhes (2023) substantiates this standpoint with the proposition of implementing AI technology in second-language learning, to refine learners' pronunciation and diversify learning opportunities. Na-young et al's (2019) study involving chatbots powered by AI clearly showcases the positive impact on students' communication skills and motivation in language learning. Further strengthening the case, Kannan and Munday (2018) praise the convergence of AI, ICT, and networked learning for transforming language learning. By promoting global connections, facilitating access to open educational resources, and promoting self-regulated learning, this integration can revolutionize language education. These substantial findings overwhelmingly suggest that innovations in AI can augment accessibility and effectiveness in language learning. While current AI integration in personalized language learning extends numerous benefits, the possibilities are exciting to envision even more meaningful enhancements to language education quality, accessibility, and personalization with future advancements.

In leveraging AI for personalized learning in language education, the necessity for comprehensive data consumption cannot be understated. AI relies heavily on encompassing learner data, including progress tracking, strengths, weaknesses, and preferences, to accurately individualize and adapt the educational experience (Fulton et al., 2021). This prominent data requirement, however, ushers in concerns of privacy and security. If mishandled or exploited, learner data could potentially infringe on privacy rights or be used in non-consensual ways. This worry amplifies when dealing with minors or other vulnerable demographics, necessitating robust security measures to protect privacy rights. Best practices may include anonymizing student data, using aggregated data for decision-making, and regularly auditing data usage and access (Fu et al., 2023). Clear and comprehensible transparency norms should also be established. Learners and their families must be informed about how and why their data is being used and protected, and they should provide clear consent to this data collection and use. So, while AI's extensive data usage is crucial for delivering personalized learning, students' privacy concerns require strict regulations, adherence to best practices, and transparency to guarantee ethical and secure data handling.

The introduction of AI to personalized language learning presents considerable potential, but also highlights potential disparities brought about by the digital divide. This disparity risks students without sufficient technological access falling further behind, leading to widened educational inequalities due to socio-economic status, geography, or age (Banerjee, 2022; Hampton et al., 2020). To counteract this, simultaneous investment in digital literacy programs and technological infrastructure is vital. These initiatives should aim to empower learners to engage efficiently with technology, possibly through tech skill workshops, online safety education, and teacher training sessions which equip educators with the necessary skills for employing AI technologies in education. In addition, investments in technological infrastructure, encompassing reliable internet access in schools, homes, and community centers along, and the hardware required for AI applications, should not be overlooked. Public-private partnerships and government policies can

aid this area, ensuring equitable access to advanced educational technology. Therefore, although the application of AI in personalized language learning could intensify the digital divide, through digital literacy initiatives and concerted investments in technological infrastructure, these potential inequities can be reduced, creating opportunities for all learners to reap the benefits of AI-enabled personalized language learning.

The integration of AI in language learning might pose a significant shift to traditional education systems, spawning concerns ranging from job displacement fears to concerns about the loss of the human touch in education. AI-related challenges in education may be caused by AI with regard to inappropriate use of AI techniques, changing roles of teachers and students, as well as social and ethical issues (Zhai et al., 2021). However, it is vital to note that AI should not be seen as a threat, but as a tool that can aid teachers by taking over routine tasks and offering helpful insights. Research showed that despite AI's efficiency and adaptiveness, it lacks the empathetic understanding, creativity and nuanced decision-making that human teachers provide (Zhai et al., 2021).

A potentially effective way forward could involve integrating AI with traditional teaching methods. According to Eaton (2017), this would create a best-of-both-worlds scenario, merging AI's adaptability and data-driven findings with a teacher's interpersonal skills and expertise. This idea reinforced by Goel and Joyner (2017) believing that it is equally important to empower educators with AI competency by providing training on how to use AI-based tools, interpret the generated data, and integrating these tools within their teaching strategies. This would make teachers active participants in AI-driven education, preserving their current roles and offering them new digital skills (Lee & Perret, 2022). Even though the widespread adoption of AI in language learning may shake traditional education systems, with deliberate integration of AI with standard methods and investment in teacher training, the transformation of language education can remain teacher-centric with AI acting as a valuable support tool.

The adoption of AI in language teaching brings along significant ethical considerations, the most concerning being the potential for bias in AI algorithms, stemming from the nature of the data they are trained on. Emphasized and concluded by Ntoutsi et al. (2020), there is a need to embed ethical and legal principles in AI's design and deployment, it becomes crucial to recognize that if AI draws on biased data, its recommendations may inadvertently perpetuate these biases, leading to unfair outcomes in language education. To tackle these biases, developers should employ diverse and representative data sets, meticulously test their algorithms for potential bias, and make necessary adjustments for fair performance (Hwang, 2022; Prediger, 2017). Regular audits and evaluations should also be conducted to spot any bias in functioning AI applications. Furthermore, it is worth stressing that AI-generated recommendations should not be followed without question. Educators need to complement AI suggestions with their professional discretion, and students should have some autonomy in their education. Rothenberger et al. (2019) and Ryan and Stahl (2020) state that clear policy guidelines are necessary to manage ethical AI applications, stipulating how AI should be utilized in language education, and putting measures in place to penalize misuse or unethical practices. In sum, ethical factors, including fairness, prevention of bias, and education values, are paramount when incorporating AI in language teaching. Adherence

to measures like diligent AI use and development, regular audits, and explicit policy guidelines could mitigate associated concerns.

Conclusion

The rapidly evolving technological landscape and the subsequent rise of AI are fundamentally transforming the field of language teaching. This trend has the potential to foster personalized learning, enhance interactivity, and provide valuable data-driven insights, all contributing to a more dynamic and effective learning environment. However, the transition to such AI-enabled education is not without its challenges, with potential threats to traditional education systems and ethical implications to consider, particularly concerning data bias. The successful integration of AI into language teaching will thus require careful planning and substantial development in digital literacy, infrastructure, and teacher training. By combining the versatility of AI and the irreplaceable human touch of teachers, language education can navigate this digital shift effectively, creating a balanced, innovative, and inclusive learning atmosphere for all students.

Implications of this study extend to educational policy-makers, technology developers, and educators who must collaborate to ensure that AI tools are seamlessly and ethically incorporated into language teaching frameworks. It is essential to develop strategies that maintain a learner-centric approach, adaptable to diverse educational contexts and sensitive to the socio-cultural dimensions of language learning. Moreover, investing in teacher education to include AI literacy and pedagogical strategies for technology integration will be imperative to leverage AI's benefits effectively.

However, the limitations of this conceptual exploration must also be acknowledged. While the paper provides a broad overview of AI's potential role in language learning, empirical studies are needed to validate the hypotheses and suggestions made herein. The current review is based on available literature, which may not fully represent the rapidly changing AI landscape. Furthermore, the long-term implications of AI in education, which are still unfolding, could not be addressed in depth. Future research should aim to provide longitudinal data on the efficacy and impact of AI integration in language teaching and learning, contributing to an adaptive educational framework that responds to technological advancements and evolving learning needs.

References

Al Gharbi, S., Al-Majed, A.-A., Abdulraheem, A., Patil, S., & Elkatatny, S. (2021). Improving Real-Time Drilling Data Quality Using Artificial Intelligence and Machine Learning Techniques. *Day 2 Mon, November 29, 2021*.

Alhawiti, K. M. (2015). Advances in Artificial intelligence Using Speech Recognition. *World Academy of Science, Engineering and Technology, International Journal of Computer and Information Engineering*, *9*, 1439-1442.

Almelhes, S. (2023). A Review of Artificial Intelligence Adoption in Second-Language Learning. *Theory and Practice in Language Studies*.

Alsobeh, A. M. R., & Woodward, B. (2023). AI as a Partner in Learning: A Novel Student-in-the-Loop Framework for Enhanced Student Engagement and Outcomes in Higher Education. *Proceedings of the 24th Annual Conference on Information Technology Education*.

Anuyahong, B., Rattanapong, C., & Patcha, I. (2023). Analyzing the Impact of Artificial Intelligence in Personalized Learning and Adaptive Assessment in Higher Education. *International Journal of Research and Scientific Innovation*.

Aprilinda, Y., Martavia, T., Erlangga, E., Afandi, F. N., & Rizal, U. (2022). Chatbot Menggunakan Natural Language Processing untuk Pembelajaran Bahasa Inggris Berbasis Android. *EXPERT: Jurnal Manajemen Sistem Informasi dan Teknologi*.

Arifin, F. J., & Hikmah, K. (2023). Enhancing Arabic Vocabulary Acquisition: Evaluating Rosetta Stone Application for College Students. *Indonesian Journal of Islamic Studies*.

Baimakhanova, A. Y., & Ibrayeva, Z. K. (2022). Advantages and Disadvantages of Virtual Reality Tools in ESL Classroom. *Bulletin of Toraighyrov University. Philology series*.

Banerjee, M. (2022). The Digital Divide and Smartphone Reliance for Disadvantaged Students in Higher Education. *Journal of Systemics, Cybernetics and Informatics*.

Campenhout, R. V., Clark, M., Dittel, J. S., Brown, N., Benton, R., & Johnson, B. G. (2023). Exploring Student Persistence with Automatically Generated Practice through Interaction Patterns. *2023 International Conference on Software, Telecommunications and Computer Networks (SoftCOM)*, 1-6.

Cavus, N. (2016). Development of an Intellegent Mobile Application for Teaching English Pronunciation. *Procedia Computer Science*, *102*, 365-369.

Chen, S. Y., & Wang, J.-H. (2020). Individual differences and personalized learning: a review and appraisal. *Universal Access in the Information Society*, *20*, 833-849.

Chen, X., Zou, D., Cheng, G., & Xie, H. (2021). Artificial intelligence-assisted personalized language learning: systematic review and co-citation analysis. *2021 International Conference on Advanced Learning Technologies (ICALT)*, 241-245.

Chen, Y.-H., Huang, N.-F., Tzeng, J.-W., Lee, C.-A., Huang, Y.-X., & Huang, H.-H. (2022). A Personalized Learning Path Recommender System with LINE Bot in MOOCs Based on LSTM. *2022 11th International Conference on Educational and Information Technology (ICEIT)*, 40-45.

Cheung, S. K. S. (2013). Hybrid learning and continuing education : 6th international conference, ICHL 2013, Toronto, ON, Canada, August 12-14, 2013 : proceedings.

Cui, P., & Sachan, M. (2023). Adaptive and Personalized Exercise Generation for Online Language Learning. Annual Meeting of the Association for Computational Linguistics,

Demmans Epp, C. (2021). Using Analytics and Artificial Intelligence to Support Language Learner Decision Making.

Divekar, R. R., Drozdal, J., Chabot, S., Zhou, Y., Su, H., Chen, Y., Zhu, H., Hendler, J. A., & Braasch, J. (2021). Foreign language acquisition via artificial intelligence and extended reality: design and evaluation. *Computer Assisted Language Learning*, *35*, 2332 - 2360.

Eaton, E. (2017). Teaching Integrated AI through Interdisciplinary Project-Driven Courses. *AI Mag.*, *38*, 13-21.

Febriani, S. R., Widayanti, R., Saputra, H. Y., Safutri, J. T., & Bedra, K. G. (2023). Hello Talk: An Alternative Media for Improving Writing Skills for Higher Education. *Ta'lim al-'Arabiyyah: Jurnal Pendidikan Bahasa Arab & Kebahasaaraban*.

Floyd, A. (2016). LibGuides: Get to Know the LiLI Tools: Pronunciator.

Foulds, J. R., McDonald, N., Massey, A. K., Hamidi, F., Okeson, A., Caruana, R., Craswell, N., Inkpen, K., Lundberg, S. M., Nori, H., Wallach, H. M., Vaughan, J. W., Patrick, Kelley, G., Yang, Y., Heldreth, C., Moessner, C., Sedley, A., Woodruff, A., . . . Mojsilovic, A. (2022). Special Issue on Responsible AI and Human-AI Interaction.

Fu, D., Bao, W., Maciejewski, R., Tong, H., & He, J. (2023). Privacy-Preserving Graph Machine Learning from Data to Computation: A Survey. *ACM SIGKDD Explorations Newsletter*, *25*, 54 - 72.

Fulton, L., Hoffman, D. L., & Paek, S. (2021). Language learning in an era of datafication and personalized learning. *Educational Technology Research and Development*, *69*(1), 315-318. https://doi.org/10.1007/s11423-020-09903-0

Gayathri, G., Mohana, N., Pal, R., & Murthy, H. A. (2018). Mobile Application for Learning Languages for the Unlettered. Interspeech,

Godwin-Jones, R. (2017). Scaling Up and Zooming In: Big Data and Personalization in Language Learning. *Language Learning & Technology*, *21*, 4-15.

Goel, A. K., & Joyner, D. A. (2017). Using AI to Teach AI: Lessons from an Online AI Class. *AI Mag.*, *38*, 48-59.

Gupta, C., Chandrashekar, P. B., Jin, T., He, C., Khullar, S., Chang, Q., & Wang, D. (2022). Bringing machine learning to research on intellectual and developmental disabilities: taking inspiration from neurological diseases. *Journal of Neurodevelopmental Disorders*, *14*.

Gurba, K. (2022). Individual and Collaborative Online Learning – Reasonable Compromise. *International Journal of Research in E-learning*.

Hampton, K. N., Fernandez, L., Robertson, C. T., & Bauer, J. M. (2020). Broadband and Student Performance Gaps. *Social Science Research Network*.

Haristiani, N. (2019). Artificial Intelligence (AI) Chatbot as Language Learning Medium: An inquiry. *Journal of Physics: Conference Series*, *1387*(1), 012020. https://doi.org/10.1088/1742-6596/1387/1/012020

Harous, S., Alkhoori, F., Alzaabi, A., & Saedi, S. A. (2017). Alturjoman Alsagheer: Basic language app for kids. IEEE Conference on Computer Communications,

Harry, A. (2023). Role of AI in Education. *Interdiciplinary Journal and Hummanity (INJURITY)*.

Hart, C. (2018). *Doing a Literature Review: Releasing the Social Science Research Imagination*. Sage Publications Inc.

Hiromori, T. (2023). Unlocking Effective Language Learning: The Crucial Role of Engagement and its Multifaceted Components. *Current Research in Psychology and Behavioral Science (CRPBS)*.

Hockly, N. (2023). Artificial Intelligence in English Language Teaching: The Good, the Bad and the Ugly. *RELC Journal*, *54*, 445 - 451.

Hocutt, D. L., Ranade, N., & Verhulsdonck, G. (2022). Localizing Content: The Roles of Technical & Professional Communicators and Machine Learning in Personalized Chatbot Responses. *Technical Communication*.

Hwang, J.-Y. (2022). Bridging the Gap Between AI Trustworthiness Guidelines and The Practice Use of AI Service Development. *2022 13th International Conference on Information and Communication Technology Convergence (ICTC)*, 2289-2291.

Jeong, Y.-S., & Park, J. H. (2019). Learning Algorithms in AI System and Services. *J. Inf. Process. Syst.*, *15*, 1029-1035.

Ji, H., Han, I., & Ko, Y. (2022). A systematic review of conversational AI in language education: focusing on the collaboration with human teachers. *Journal of Research on Technology in Education*, *55*, 48 - 63.

Jia, F., Sun, D., Ma, Q., & Looi, C.-k. (2022). Developing an AI-Based Learning System for L2 Learners' Authentic and Ubiquitous Learning in English Language. *Sustainability*.

Jing, Y., Mingfang, Z., & Chen, Y. (2022). Feasibility Analysis of the Application of Virtual Reality Technology in College English Culture Teaching. *J. Inf. Knowl. Manag.*, *21*, 2240020:2240021-2240020:2240022.

Jordan, O., Abiogu, R. F. G. C., & Eneogwe, E. (2020). Analysis of Learner-centered Model of Education as a Condition Precedent for Developing Creativity in a Learner: The Nigerian Perspective.

Kang, J. (2021). Digital Technical Language Teaching: Teaching/Learning Principles of Duolingo. *Learning & Education*.

Kannan, J., & Munday, P. (2018). New Trends in Second Language Learning and Teaching through the lens of ICT, Networked Learning, and Artificial Intelligence. *Círculo de Lingüística Aplicada a la Comunicación*.

Kardaş, D. (2016). The use of personalized texts for teaching Turkish as a second language. *Educational Research Review*, *11*, 252-259.

Kohli, R., Phutela, S., Garg, A., & Viner, M. D. (2021). Artificial Intelligence Technology to Help Students With Disabilities.

Kukulska-Hulme, A., & Lee, H. (2020). Intelligent assistants in language learning: an analysis of features and limitations. *CALL for widening participation: short papers from EUROCALL 2020*.

Kupchyk, L., & Litvinchuk, A. (2021). Constructing personal learning environments through ICT-mediated foreign language instruction. *Journal of Physics: Conference Series*, *1840*.

Lăpădat, M.-M. (2023). Harnessing Technological Transformation: An Exploration of the Impact of Mobile-Assisted Language Learning on English Vocabulary Acquisition. *ANALELE UNIVERSITĂȚII DIN CRAIOVA SERIA ȘTIINȚE FILOLOGICE LIMBI STRĂINE APLICATE*.

Lee, C. L., & An, D.-I. (2021). Reinforcement learning and neural network-based artificial intelligence control algorithm for self-balancing quadruped robot. *Journal of Mechanical Science and Technology*, *35*, 307-322.

Lee, I. A., & Perret, B. (2022). Preparing High School Teachers to Integrate AI Methods into STEM Classrooms. AAAI Conference on Artificial Intelligence,

Li, H., Cui, W., Xu, Z., Zhu, Z., & Feng, M. (2018). Yixue Adaptive Learning System and Its Promise on Improving Student Learning. International Conference on Computer Supported Education,

Liu, S., Zhang, X., Chen, W., & Zhang, W. (2021). Construction of Intelligent Adaptive Learning Platform in Ubiquitous Environment. *2021 10th International Conference on Educational and Information Technology (ICEIT)*, 56-60.

Liu, Y., & Quan, Q. (2022). AI Recognition Method of Pronunciation Errors in Oral English Speech with the Help of Big Data for Personalized Learning. *J. Inf. Knowl. Manag.*, *21*, 2240028:2240021-2240028:2240019.

Liu, Y., Sahagun, J., & Sun, Y. (2021). An Adaptive and Interactive Educational Game Platform for English Learning Enhancement using AI and Chatbot Techniques. *Natural Language Processing*.

Liyanage, M. P. P., Hirimuthugoda, U. J., Liyanage, N. L. T. N., Thammita, D. H. M. M. P., Wedanage, D. K. H. W., Kugathasan, A., & Thelijjagoda, S. (2022). AI Solution to Assist Online Education Productivity via Personalizing Learning Strategies and Analyzing the Student Performance. *2022 IEEE 13th Annual Ubiquitous Computing, Electronics & Mobile Communication Conference (UEMCON)*, 0609-0615.

Loewen, S., Isbell, D. R., & Sporn, Z. (2020). The effectiveness of app-based language instruction for developing receptive linguistic knowledge and oral communicative ability. *Foreign Language Annals*.

Lu, W., Yu, H., Wang, J., Teney, D., Wang, H., Chen, Y., Yang, Q., Xie, X., & Ji, X. (2023). ZooPFL: Exploring Black-box Foundation Models for Personalized Federated Learning. *ArXiv*, *abs/2310.05143*.

Lubis, B. N. A., Husda, A., & Zulhantiar, P. A. (2023). Memrise Application as Digital Media Skill to Enrich Students' English Vocabulary at Junior Highschool in Medan. *Journal Education and Development*.

Lutskovskaia, L. Y., Shoustikova, T., & Udina, N. (2019). AI-based Tools for Foreign Language Training: Opinions from Different Audiences.

Lydia, E. G., Vidhyavathi, P., & Malathi, P. (2023). A Study on "AI in Education: Opportunities and Challenges for Personalized Learning. *Industrial Engineering Journal*.

Mageira, K., Pittou, D., Papasalouros, A., Kotis, K. I., Zangogianni, P., & Daradoumis, A. (2022). Educational AI Chatbots for Content and Language Integrated Learning. *Applied Sciences*.

Maghsudi, S., Lan, A. S., Xu, J., & van der Schaar, M. (2021). Personalized Education in the Artificial Intelligence Era: What to Expect Next. *IEEE Signal Processing Magazine*, *38*, 37-50.

Mah, P. M., Skalna, I., & Muzam, J. (2022). Natural Language Processing and Artificial Intelligence for Enterprise Management in the Era of Industry 4.0. *Applied Sciences*, *12*(18), 9207. https://www.mdpi.com/2076-3417/12/18/9207

Mezin, H., Kharrou, S. Y., & Lahcen, A. A. (2022). Adaptive Learning Algorithms and Platforms: A Concise Overview. *Advances in Information, Communication and Cybersecurity*.

Montez, J. K., Hayward, M. D., & Zajacova, A. (2019). Educational Disparities in Adult Health: U.S. States as Institutional Actors on the Association. *Socius*, *5*.

Moulieswaran, & Prasantha. (2023). Investigating ESL Learners' Perception and Problem towards Artificial Intelligence (AI) -Assisted English Language Learning and Teaching. *World Journal of English Language*.

Murtaza, M., Ahmed, Y., Shamsi, J. A., Sherwani, F., & Usman, M. (2022). AI-Based Personalized E-Learning Systems: Issues, Challenges, and Solutions. *IEEE Access*, *10*, 81323-81342.

Na-young, K., Cha, Y. J., & Kim, H.-S. (2019). Future English Learning: Chatbots and Artificial Intelligence. *Multimedia-Assisted Language Learning*, *22*, 32-53.

Najima, T., Kato, T., Tamura, A., & Yamamoto, S. (2021). Remote Learning of Speaking in Syntactic Forms with Robot-Avatar-Assisted Language Learning System. Workshop on Time-Delay Systems,

Namaziandost, E., Alekasir, S., Dehkordi, E. S., & Tilwani, S. A. (2021). An Account of EFL learners' Vocabulary Learning in a Mobile-Assisted Language Environment: The Case of Rosetta Stone Application.

Nazaretsky, T., Ariely, M., Cukurova, M., & Alexandron, G. (2022). Teachers' trust in AI-powered educational technology and a professional development program to improve it. *Br. J. Educ. Technol.*, *53*, 914-931.

Ng, V., Rees, E. E., Niu, J., & Zaghlool, A. (2020). Application of natural language processing algorithms for extracting information from news articles in event-based surveillance.

Canada communicable disease report = Releve des maladies transmissibles au Canada, *46 6*, 186-191.
Nosenko, Y. (2020). ALTA Solution from Knewton as a Tool of Support for Adaptive Learning in Mathematics. *Educational Discourse: collection of scientific papers*.
Ntoutsi, E., Fafalios, P., Gadiraju, U., Iosifidis, V., Nejdl, W., Vidal, M.-E., Ruggieri, S., Turini, F., Papadopoulos, S., Krasanakis, E., Kompatsiaris, I., Kinder-Kurlanda, K. E., Wagner, C., Karimi, F., Fernández, M., Alani, H., Berendt, B., Kruegel, T., Heinze, C., . . . Staab, S. (2020). Bias in data-driven artificial intelligence systems—An introductory survey. *Wiley Interdisciplinary Reviews: Data Mining and Knowledge Discovery*, *10*.
Nugroho, B., Nafasya, F. D., Nurshanya, N., & Awaliyah, S. (2021). The Implementation of HelloTalk Application in Teaching Vocabulary to Young Learners.
Nushi, M., Fattahi, N., & Ebn-Abbasi, F. (2024). An Evaluative Review of Mondly: A Mobile Language Learning Application. *The EuroCALL Review*.
Orina, W. A., Macharia, S. M., & Okpalaenwe, E. N. (2021). Managing Overcrowded Classrooms to Accommodate Learner Centered Methodologies: An Indispensable Pillar for Teachers' Preparedness in Implementation of Competency-Based Curriculum in Kenya. *International Journal of Innovative Research and Development*.
Pan, Z., Sun, Y., Yao, Z., & Li, M. (2021). Application of Virtual Reality in English Teaching. *2021 3rd World Symposium on Artificial Intelligence (WSAI)*, 64-71.
Pataranutaporn, P., Danry, V., Leong, J. Y. Y., Punpongsanon, P., Novy, D., Maes, P., & Sra, M. (2021). AI-generated characters for supporting personalized learning and well-being. *Nature Machine Intelligence*, *3*, 1013 - 1022.
Porter, B. A., & Grippa, F. (2020). A Platform for AI-Enabled Real-Time Feedback to Promote Digital Collaboration. *Sustainability*.
Prediger, L. (2017). On the importance of monitoring and directing progress in AI. *AI Matters*, *3*, 30-38.
Putri, A. N., & Simanjuntak, M. N. W. (2022). Students' Perception Toward Memrise Application as Media in Learning Vocabulary. *ANGLO-SAXON: Jurnal Ilmiah Program Studi Pendidikan Bahasa Inggris*.
Rebolledo Font de la Vall, R., & González Araya, F. (2023). Exploring the Benefits and Challenges of AI-Language Learning Tools. *International Journal of Social Sciences and Humanities Invention*.
Reich, J. (2022). Audrey Watters. Teaching Machines: The History of Personalized Learning Boston: MIT Press, 2021. 328 pp. *History of Education Quarterly*, *62*, 355 - 358.
Rizvi, M. (2023). Investigating AI-Powered Tutoring Systems that Adapt to Individual Student Needs, Providing Personalized Guidance and Assessments. *The Eurasia Proceedings of Educational and Social Sciences*.
Rothenberger, L., Fabian, B., & Arunov, E. (2019). Relevance of Ethical Guidelines for Artificial Intelligence - a Survey and Evaluation. European Conference on Information Systems,
Ruan, S. S., Jiang, L., Xu, Q., Liu, Z., Davis, G. M., Brunskill, E., & Landay, J. A. (2021). EnglishBot: An AI-Powered Conversational System for Second Language Learning. *26th International Conference on Intelligent User Interfaces*.
Rüdian, S., & Pinkwart, N. (2021). Generating adaptive and personalized language learning online courses in Moodle with individual learning paths using templates. *2021 International Conference on Advanced Learning Technologies (ICALT)*, 53-55.

Ryan, M., & Stahl, B. C. (2020). Artificial intelligence ethics guidelines for developers and users: clarifying their content and normative implications. *J. Inf. Commun. Ethics Soc.*, *19*, 61-86.
Sakalauskė, A., & Leonavičiūtė, V. (2022). Strategic Analysis of Duolingo Language Learning Platform. *Mokslas - Lietuvos ateitis*.
Samah, N. A., Yahaya, N. A., & Ali, M. B. (2011). Individual differences in online personalized learning environment. *Educational Research Review*, *6*, 516-521.
Sathya, R., Pavithra, M. S., & Girubaa, G. (2017). Artificial Intelligence for Speech Recognistion.
Sayed, W. S., Noeman, A. M., Abdellatif, A., Abdelrazek, M., Badawy, M. G., Hamed, A., & El-Tantawy, S. (2022). AI-based adaptive personalized content presentation and exercises navigation for an effective and engaging E-learning platform. *Multimedia Tools and Applications*, *82*, 3303 - 3333.
Schulz, K., Beyer, A., Dreyer, M., & Kipf, S. (2020). A data-driven platform for creating educational content in language learning. Conference on Digital Curation Technologies,
Šimonová, I., & Poulova, P. (2014). Personalized Learning and Assessment. International Conference on Advances in Web-Based Learning,
Smorodinova, M. V., Borodina, M., Tatarintseva, E. N., Ermilova, D. Y., & Sokolova, A. P. (2022). Distance Learning in Language Courses Under the Constraints of the Covid-19 Pandemic: The Impact of Face-To-Face Learning on Student Motivation. *International Journal of Early Childhood Special Education*.
Soto, J. H. B., Ocampo, D.-C., Colón, L. d. C. B., & Oropesa, A. V. (2020). Perceptions of ImmerseMe Virtual Reality Platform to Improve English Communicative Skills in Higher Education. *Int. J. Interact. Mob. Technol.*, *14*, 4-19.
Sporn, Z., Chanter, J., & Meehan, D. (2020). Babbel Language Learning Podcasts.
Tan, K. M., Duan, R., Huang, X., Zou, B., & Do, X. L. (2022). A Deep Learning Platform for Language Education Research and Development. Interspeech,
Tapalova, O. B., Zhiyenbayeva, N., & Gura, D. (2022). Artificial Intelligence in Education: AIEd for Personalised Learning Pathways. *Electronic Journal of e-Learning*.
Teasley, M. L., & Homer, B. (2020). Racial Disparities in the Education System.
Tschanz, N., & Baerlocher, B. (2022). Virtual Reality in Language Teaching. *MedienPädagogik: Zeitschrift für Theorie und Praxis der Medienbildung*.
Vall, R., & González Araya, F. (2023). Exploring the Benefits and Challenges of AI-Language Learning Tools. *International Journal of Social Sciences and Humanities Invention*.
Vuong, L., & Wong, P. C. M. (2019). From Individual Differences in Language Aptitude to Personalized Learning. *Language Aptitude*.
Wang, L. (2023). The Application and Impact of Artificial Intelligence in International Chinese Language Education: A Case Study of ChatGPT. *Education, Language and Sociology Research*.
Wijewickrema, S. N. R., Ma, X., Piromchai, P., Briggs, R., Bailey, J., Kennedy, G. E., & O'Leary, S. J. (2018). Providing Automated Real-Time Technical Feedback for Virtual Reality Based Surgical Training: Is the Simpler the Better? International Conference on Artificial Intelligence in Education,
Winans, M. D. (2019). Busuu: A Social Network Application to Learn Languages. *CALICO journal*.

Woo, J.-H., & Choi, H. (2021). Systematic Review for AI-based Language Learning Tools. *ArXiv*, *abs/2111.04455*.

Wozniak, K. (2020). Personalized Learning for Adults: An Emerging Andragogy.

Wu, C., Lam, H., Kong, A., & Wong, W. (2023). The design and evaluation of a digital learning-based English chatbot as an online self-learning method. *International Journal of Engineering Business Management*.

Yang, H., & Kyun, S. (2022). The current research trend of artificial intelligence in language learning: A systematic empirical literature review from an activity theory perspective. *Australasian Journal of Educational Technology*.

Yang, Z. (2022). The Application of the Intelligent Learning Assistant based on Automatic Speech Recognition in the International Learning Environment. *Highlights in Science, Engineering and Technology*.

Yu, D. (2023). AI-Empowered Metaverse Learning Simulation Technology Application. *2023 International Conference on Intelligent Metaverse Technologies & Applications (iMETA)*, 1-6.

Zhai, X., Chu, X., Chai, C. S., Jong, M. S. Y., Istenič, A., Spector, M., Liu, J.-b., Yuan, J., & Li, Y. (2021). A Review of Artificial Intelligence (AI) in Education from 2010 to 2020. *Complex.*, *2021*, 8812542:8812541-8812542:8812518.

Zhang, C., Doan, K. D., Liao, Q., & Abdul-Mageed, M. (2023). The Skipped Beat: A Study of Sociopragmatic Understanding in LLMs for 64 Languages. Conference on Empirical Methods in Natural Language Processing,

Zhaxybayev, D. O., & Mizamova, G. N. (2022). Natural Language Processing Algorithms for Understanding the Semantics of Text. *Proceedings of the Institute for System Programming of the RAS*.

Zhou, H., Nova, A., Larochelle, H., Courville, A. C., Neyshabur, B., & Sedghi, H. (2022). Teaching Algorithmic Reasoning via In-context Learning. *ArXiv*, *abs/2211.09066*.

Zhu, A. (2020, 17-19 April 2020). Supply and Demand of Ai-Aided Language Education. 2020 International Conference on Computer Information and Big Data Applications (CIBDA),

Zunaidah, A., Wiharja, C. K., & Febriantono, M. A. (2023). Dependency on AI-Based Writing Tools in English Learning: Implications for Human-Computer Interaction. *2023 International Conference on Information Management and Technology (ICIMTech)*, 1-6.