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The New Revolution in Language Learning: The Power of Artificial Intelligence and Education 4.0

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Abstract

This article explores the connection between artificial intelligence (AI) and language learning in the context of Education 4.0, highlighting how the former revolutionizes the latter with the introduction of emerging technologies and innovations in education. The article discusses how AI improves the processes of language learning through personalized learning experiences, interactive practice, and automated assessment. AI can be used to create diverse learning materials and immersive experiences that align with the principles of Education 4.0. When used correctly, AI can bring numerous benefits to language learning, such as increased efficiency, greater student engagement in the teaching-learning process, and the accessibility of content from anywhere and on any device. Additionally, it emphasizes the need to adopt Education 4.0 accompanied by the development of content that equips students with the necessary skills in the digital age. The article also highlights the importance of integrating AI and Education 4.0 in language learning to promote critical thinking, problem-solving skills, and digital literacy.

Keywords:
artificial intelligence; education 4.0; language learning; chatbots; machine learning.

Education 4.0 marks a paradigm shift in the field of education driven by the impact of emerging technologies and innovative approaches on the learning process. In the digital age, Education 4.0 plays a vital role in preparing students for the increasingly complex environment of the 21st century, due to its ability to foster the development of critical skills required by a workforce that must respond to the demands of an ever-changing job market. As automation and artificial intelligence reshape industries, Education 4.0 emphasizes the cultivation of specific skills, including the 4Cs: critical thinking, communication, collaboration, creativity, as well as problem-solving, and digital literacy (Marietta College 2016, 3). These skills are highly important for individuals who wish to adapt to the rapid changes in the job market and thrive in a technology-based world.

To modernize education, traditional learning models are being replaced with personalized learning experiences. Through the use of technology, students can access educational content tailored to their needs and learning styles, to enhance the efficiency of the teaching-learning process and make a notable leap forward from traditional eLearning programs.

In recent years, the partnership established between artificial intelligence (AI) and language learning has emerged as a promising frontier in education. As AI technologies continue to develop and refine at a rapid pace, they are making their way into education, significantly impacting how foreign languages are taught and learned. This article provides a brief overview of this partnership while highlighting the importance of AI in transforming language learning experiences.

Industry and Education 4.0

The term "Industry 4.0" was announced at the Hannover Fair event in 2011 (Qina, Liua, and Grosvenora 2016, 173) and originated from a strategic plan developed by the German government in collaboration with the Industry Science Research Alliance and Acatech in 2013 (Ellahi, Khan, and Shah 2019, 700). The concept of Industry 4.0, which refers to the integration of digital and physical systems in various industries, emphasizes the need for a corresponding transformation in education, known as Education 4.0. As the Fourth Industrial Revolution brings about rapid advancements in technology and automation, traditional educational models must evolve to equip learners with the skills and competencies required in the digital age.

Education 4.0 is an innovative educational framework designed to strategically integrate a range of competencies into the learning experience, aligning with the demands of Industry 4.0 (I.D. 4.0). This approach includes essential areas such as artificial intelligence (AI), the Internet of Things (IoT), simulation, among others. By incorporating these elements, Education 4.0 aims to equip students with the necessary skills and knowledge to thrive in a rapidly evolving technological landscape

(Chakraborty, et al. 2023, 2). It recognizes the importance of adapting education to meet the current requirements and challenges presented by Industry 4.0.

According to Bartolomé (Bartolomé, Castañeda, and Adell 2018, 2-3), two fundamental characteristics of Education 4.0 are personalization and flexibility, both of which offer numerous educational benefits. Digital tools and platforms provide learners with access to vast amounts of information, interactive and personalized learning materials, enabling students to tailor their educational experiences to their individual needs and learning styles. Online learning platforms, virtual classrooms, and educational apps further enhance flexibility by allowing individuals to engage in self-paced learning and break free from the constraints of time and location. Additionally, the incorporation of technologies like virtual reality, augmented reality, and artificial intelligence promotes engagement, creating immersive and interactive learning environments that deepen understanding and enhance creativity.

Furthermore, Education 4.0 places a special emphasis on the development of lifelong learning skills. In an era when new technologies and industries emerge at a rapid pace, individuals must continuously update their skills and knowledge throughout their careers. Education 4.0 promotes a culture of lifelong learning, encouraging individuals to focus on continuous skill development to adapt to changes. Equally important is the promotion of critical thinking skills, which are essential for academic success and the transition to the job market (Almeida and Simoes 2019, 130). Education 4.0 aims to develop individuals' capacity to analyze, evaluate, and solve problems independently. By promoting critical thinking skills, Education 4.0 equips students with the tools necessary to navigate the complexities of the modern world and succeed in their academic pursuits and future careers (Marietta College 2016, 6).

Therefore, the emergence of Industry 4.0 would require a corresponding change in education towards an approach that focuses on developing skills and attitudes (Rus 2019, 338). Education 4.0 provides students with certain competencies needed in the society of the future through the integration of technology, the development of critical skills, and the promotion of lifelong learning. It prepares individuals to tackle the challenges and opportunities of Industry 4.0 and ensures their continued success in a constantly changing job market.

The Role of AI in Language Learning

The potential of artificial intelligence to replace humans in certain professions has raised concerns about job displacement (Lewis 2019, 32). To address this issue, individuals and education systems need to focus on lifelong learning because, in an ever-evolving job market, continuous learning is of paramount importance. Individuals should seek opportunities to acquire new skills and knowledge to adapt to the constantly changing job requirements and avoid becoming redundant. In this

context, teachers should use AI to assist people in achieving their learning goals, transforming it from an enemy to a partner, as in the not-too-distant future, almost everyone will be working with AI (Gleason 2018, 5).

The integration of artificial intelligence in language learning has immense potential to revolutionize the educational landscape for both learners and teachers. The emergence of AI-powered tools and platforms has opened up great possibilities in foreign language instruction. One significant advantage of AI in this context is its ability to analyze large amounts of data, enabling its algorithms to understand patterns of language usage, identify common errors, and provide detailed and tailored feedback to students. By using AI, students learning a foreign language can receive personalized information that meets their specific needs and preferences. This personalized approach offers a more efficient learning experience as students can focus on areas where they need more practice, receiving specific guidance designed for their needs (Redecker and Punie 2013, 8).

AI bears immense potential in language learning by offering innovative approaches that cater to the diverse needs and learning styles of individuals. Through AI, experiences in learning foreign languages can become more interactive, captivating, and aligned with how the new generation relates to technology and learns. AI-powered chatbots and virtual tutors can simulate real-life conversations and provide language practice anytime, on any device, and in the absence of a teacher. For example, they can assist in a persuasive writing exercise (Wambsganß, et al. 2021, 1) as well as in dialogues on various topics, correcting errors and offering translation support.

By using AI, language learners can access a multitude of resources, including online language courses, specialized platforms, and artificial intelligence programmed to provide support in a specific foreign language. These developments allow learners to take control of their learning and manage their linguistic skills on their own. With the help of AI technologies, educational platforms, and systems can better meet the needs of learners, offering personalized and adaptive learning experiences that align with their expectations and requirements (Pikhart 2021, 95-96).

AI holds great potential in transforming experiences in learning foreign languages as it can make them more personalized, interactive, and efficient, a characteristic that will certainly be refined in the future with the further development of AI. In the following sections, we will delve into more details on the various ways in which AI is revolutionizing language learning and explore their benefits and implications. This enables a more efficient and effective learning experience, as learners receive personalized instruction tailored to their individual needs and preferences a feature that was not supported by conventional learning (Mansor, Abdullah, and Rahman 2020, 443-444). AI can adapt to learners' progress by dynamically adjusting the difficulty level of exercises and providing relevant content to facilitate continuous improvement. Personalized and adaptive learning is a key feature facilitated by AI algorithms.

With the use of the AI, language learning platforms can deliver tailored content and experiences based on learners' proficiency levels, interests, and learning styles (Clarizia, et al. 2018, 291). As AI algorithms analyze learner data, they can adapt the learning materials and activities to optimize engagement and outcomes (Wambsganß, et al. 2021, 4). This personalized approach fosters greater learner motivation and increases the likelihood of successful language acquisition.

AI-based tutors and chatbots have brought a change in foreign language practice by allowing students to engage in conversation with AI tutors that simulate real-life scenarios, thus providing them with new opportunities to practice their written and oral communication skills. According to Haristiani (Haristiani 2019, 5), AI chatbots offer instant language practice and feedback with several advantages:

- Students feel more relaxed in conversations with a computer than with a person, and chatbots can repeat the same material endlessly with them without getting bored or being constrained by a location or a specific timeframe;
- AIs offer both text and synthesized speech, allowing students to practice their listening and reading skills, and providing them with a fresh and interesting experience;
- AIs also enable students to use a wide range of language structures and vocabulary that they would not typically have access to while providing quick and efficient feedback on spelling and grammar;
- AI tools such as chatbots provide a safe environment for students as they can practice without the fear of being judged; this type of interaction contributes to their confidence and fluency in the foreign language.

In addition, automated assessment and feedback on foreign language use are other important roles that AI can play in learning. AI technology can objectively assess learners' linguistic competence and provide automated feedback on grammar, pronunciation, and vocabulary usage. This instantaneous feedback allows learners to promptly identify and correct their mistakes, accelerating their progress in language learning (Wambsganss, et al. 2020, 4). AI-powered assessment systems that facilitate the evaluation process save time and resources for teachers while providing accurate evaluations of structures. However, some voices raise various concerns about the use of AI, particularly regarding the impact it can have on students' creativity through a number of limitations caused by the algorithms that govern it (Seo, et al. 2021, 14).

Conversational agents (CAs), such as Amazon Alexa or Google Assistant, can also provide significant support to students in their learning process, even though they were not specifically created for this purpose. One way in which teachers can use CAs is by implementing them as evaluation tools throughout a course. These CAs are widely accessible and user-friendly, even for teachers who do not have programming expertise, and by integrating CAs as evaluation tools during a course, teachers can gather valuable feedback on students' performance, particularly regarding speaking skills (Wambsganss, et al. 2020, 3).

Therefore, AI has become increasingly important in foreign language learning, offering access to personalized and adaptive learning, interactive practice through AI tutors and chatbots, and automated evaluation of grammar structures, pronunciation, etc. The integration of AI technologies into foreign language learning processes has a significant potential to improve both teaching efficiency and student engagement in the learning process. Importantly, students themselves show interest in using AI for learning, as they are already familiar with smart environments. Therefore, the incorporation of AI into various learning applications should not be ignored or neglected (Pikhart 2021, 95). As AI continues to advance, its role in foreign language learning is likely to expand, further transforming the educational landscape.

Benefits of AI in Language Learning

The integration of artificial intelligence in foreign language learning can bring numerous benefits, changing the way students develop language skills. Here are some key advantages of AI in foreign language learning:

- Personalized and adaptive instruction: Personalized learning encompasses four core elements: individual characteristics, individual performance, personal development, and adaptive adjustment. These elements are essential in tailoring the learning experience to the unique needs, abilities, and progress of each learner, providing a more efficient and personalized learning experience (Peng, Ma, and Spector 2019).
- Enhanced efficiency and accessibility: AI enables learners to access foreign language learning resources anytime and anywhere, at their own pace. Online platforms and mobile applications equipped with AI technologies offer a flexible and convenient learning experience, eliminating barriers of time and location.
- Intelligent language assessment: AI algorithms can accurately and objectively assess certain aspects of students' language proficiency. Through automated assessments, AI can evaluate their speaking, writing, listening, and reading skills, providing instant feedback on areas that need improvement. For example, automated essay scoring (AES) is a technology-driven process that uses AI algorithms to evaluate and assign scores to essays written by students. However, despite saving time and being reasonably accurate, AES still faces challenges in evaluating creativity, nuanced arguments, and contextual understanding. Despite these obvious challenges, researchers are actively working to improve AES by developing more sophisticated algorithms that capture subtleties and enhance contextual understanding (Ramesh and Sanampudi 2021, 2521-2522).
- Interactive language practice: AI-powered chatbots and virtual language tutors offer learners opportunities for interactive language practice. One of the advantages of chatbots as language-learning partners is their availability for continuous practice (Fryer, et al. 2020, 10). Unlike human conversation partners who may have limited availability, chatbots are available at any time,

providing learners with flexible and extended practice sessions. Students can confidently practice new language skills, experiment with different expressions, and strengthen their vocabulary and grammar (Fryer, et al. 2020, 12-13). This repetitive and interactive practice with a chatbot can significantly enhance language acquisition and proficiency, allowing learners to gain confidence and fluency in an accessible and user-friendly learning environment.

- Continuous learning and progress tracking: AI can track learners' progress over time and provide personalized recommendations for further study. By monitoring performance, AI algorithms can suggest learning materials and activities that help learners continuously improve their language skills. Effectively monitoring students' academic progress and identifying those in need of additional support are primary objectives for educational institutions. At the beginning of a course, it can be challenging for teachers to assess the individual capabilities and needs of their students (Khan, et al. 2021, 1). However, by utilizing artificial intelligence and other means, struggling students can be identified, and teachers can develop preventive or remedial measures tailored to their specific needs (Khan, et al. 2021, 2).
- Natural language processing and translation: AI-based natural language processing enables speech recognition and translation services. However, automatic analysis in foreign language learning can also be used to identify correctly formed linguistic structures, allowing for positive or negative feedback. To detect and diagnose learner errors, all approaches must include models that encompass the full range of variations, both correct and incorrect, that can occur within a specific activity and for a particular learner (Meurers 2021, 2). Thus, learners can benefit from real-time translation, pronunciation analysis, and language comprehension tools, in order to improve their language skills.

These advantages of artificial intelligence in foreign language learning provide students with personalized, efficient, and accessible instruction, enabling them to achieve their language learning goals. By harnessing the power of artificial intelligence, students can access interactive and tailored learning experiences that accommodate their individual needs and preferences.

AI-Driven Language Instruction and Resources

The use of AI in foreign language learning has allowed for the development of highly diverse materials that provide the interactivity that new generations are accustomed to. The advantage lies in the fact that AI algorithms can analyze a vast amount of linguistic data, enabling the creation of content that is more tailored to the needs and proficiency levels of students. These AI-powered resources offer interactive exercises and tests that promote active student engagement and provide greater control over the content, transforming the foreign language learning experience into a more dynamic and efficient one (Ramesh and Sanampudi 2021, 2521-2522).

The integration of AI tools has revolutionized many aspects of foreign language learning, such as speech recognition, pronunciation practice, and translation. AI-assisted speech recognition technology allows students to practice their speaking skills by providing precise feedback on pronunciation, intonation, and fluency. Students can engage in interactive speaking exercises and receive real-time evaluations, helping them perfect their pronunciation and develop authentic speech patterns (Fryer, et al. 2020, 12). One such AI-based application is Mondly, which offers interactive lessons, AI-powered conversations, vocabulary, and pronunciation development. The platform supports multiple languages, speech recognition, and exercises aimed at improving speaking, listening, reading, and writing skills. Mondly's program includes augmented reality lessons, gamified learning, progress tracking, online and offline access, and a variety of theme-based lessons to expand vocabulary (Mondly 2023).

A very useful tool, which can also be based on AI, is the one that provides text translation in different languages, allowing students to easily understand the provided materials or create new materials themselves. These tools use algorithms to provide the most accurate translations possible, enabling students to translate texts in real-time or correct their own texts using AI-powered models to improve their writing, reading, and comprehension skills.
In addition, another significant role played by AI is in creating immersive language learning environments using virtual and augmented reality technologies, which, together with AI algorithms, provide students with the opportunity to familiarize themselves with simulated contexts in a foreign language. Through virtual scenarios, students can practice their language skills in real-life situations, even if simulated with the help of AI, such as going shopping, having a conversation with a doctor, ordering food at a restaurant, making a hotel reservation, etc., or engaging in guided conversations with a virtual character. Additionally, AI can generate real-time feedback and diverse responses tailored to the conversation, allowing students to improve their language skills. AI algorithms will analyze the students' responses and provide personalized recommendations for additional practice, highlighting areas that need improvement and suggesting ways to achieve it.

In conclusion, AI-based language instruction and resources have already transformed the landscape of language learning by developing interactive learning materials, integrating AI tools for voice recognition, pronunciation practice, and translation, as well as creating immersive language learning environments. As AI continues to advance, its role in language learning will also evolve, providing personalized language instruction and helping students achieve their learning goals.

Ethical Considerations and Challenges

Even if AI-based tools are extremely useful in many fields, ethical problems and challenges may still arise when AI is integrated into foreign language learning.

Addressing potential biases and limitations is crucial to ensure fair and inclusive learning experiences, and language models should be designed to detect and modify biases present in the data used. Data privacy and security are also extremely important in AI-assisted platforms, as students' personal information needs to be protected through the implementation of strict regulations and security measures. Therefore, while AI plays an important role in foreign language learning, maintaining a balance between AI utilization and human interaction is essential, as human teachers are indispensable when it comes to understanding cultural context, and linguistic nuances, assessing creativity, and facilitating real-world communication.

AI-assisted language platforms collect and analyze a large amount of data about students, raising concerns regarding data privacy and security, as well as the policy changes needed in this context (Tuomi 2018, 7). Students should have control over their personal information and be informed about how their data is collected, stored, and used. Foreign language learning platforms must adhere to strict data protection regulations and implement robust security measures to protect students from unauthorized access or misuse. Therefore, transparent privacy policies and user consent mechanisms should be rigorously implemented to protect students from data breaches and other unpleasant incidents associated with working in the virtual environment.

AI is often considered as an unbiased tool for assessing student learning because it can easily rank them based on the input or data obtained from testing. However, sometimes test results may not accurately reflect the students' learning, as they do not take into account numerous aspects that AI cannot handle, such as critical thinking or problem-solving skills. While AI assessment tools provide insights and facilitate the grading process, a comprehensive evaluation framework that includes diverse forms of assessment is crucial because test scores alone may not adequately capture the students' actual level of proficiency (Tuomi 2018, 32). Thus, a holistic approach provides a more comprehensive view of their knowledge and skills.

Although AI can enhance foreign language learning experiences, it is essential to strike a balance between AI-driven instruction and human interaction. Foreign language learning is a complex and social process that benefits from human interaction, cultural nuances, and real-world communication. AI can support and complement language instruction, but it should not replace the role of human teachers and mentors, as it is much more beneficial for both AI and human teachers to work together in close collaboration (Seo, et al. 2021, 2). Incorporating opportunities for authentic human interaction, such as group discussions, human conversation partners, or language exchange programs, allows students to develop real-world communication skills, cultural understanding, and the ability to navigate authentic language contexts.

Educational institutions and foreign language learning platforms should, therefore, consider the pedagogical implications of AI integration, ensuring that students

receive a holistic learning experience that combines the benefits of AI-based resources with the guidance and expertise of human instructors, who are responsible for creating a balanced and effective learning environment.

Conclusion

This article has explored the role of AI in language learning and highlighted its potential to transform the way we teach and learn languages. Through AI-driven language instruction and resources, students can benefit from personalized and interactive learning materials, speech recognition tools, pronunciation practice, translation assistance, and immersive language learning environments. Thus, the advantages of AI in learning seem to be numerous, as this approach offers improved efficiency, instruction tailored to students' needs, and the system's ability to analyze large amounts of language data.

However, it is extremely important to consider the ethical considerations and challenges associated with AI in language learning. Addressing potential biases, ensuring data privacy and security, and maintaining a balance between the role of AI and human interaction and instruction are key factors in creating safe language learning experiences.

Using AI allows students to receive personalized instruction that meets their individual needs, while teachers receive valuable information to help improve their teaching methods. To fully utilize the benefits of AI in language learning, both teachers and policymakers, as well as students, need to adapt to the requirements of the new virtual landscape governed by AI. This involves promoting lifelong learning and intercultural skills and stimulating collaboration between humans and AI. With AI as a tool in language education, we can enhance the learning experience, effectively develop language skills, and prepare students for the challenges of globalization and the technology-based society.

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