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Personalized Language Education in the Age of AI: Opportunities and Challenges

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ABSTRACT

Artificial Intelligence (AI) has significantly impacted education, particularly language education, by enabling personalized learning experiences through advanced algorithms and machine learning. This paper explores the integration of AI in language learning, focusing on adaptive learning systems that tailor educational content to individual learners' needs. By examining the historical evolution of AI in education, current applications, and future trends, this review highlights the potential benefits of AI-enhanced personalized language education, including improved learning outcomes and increased accessibility. It also addresses the challenges associated with AI implementation, such as technological barriers and the need for effective teacher training. The findings underscore the importance of a balanced approach where AI complements human teachers, providing personalized support while maintaining the essential human elements of empathy and contextual understanding.

Keywords: Personalized Language Education, Artificial Intelligence (AI), Adaptive Learning Systems, Machine Learning, Language Proficiency, Educational Technology and Natural Language Processing (NLP)

INTRODUCTION

As well as these applications of technology to support human teachers or human tutors in their work, AI has had a major impact on education, dating back to the earliest machines that were developed to provide tutorial help to students [1, 2, 3]. These aids used simple rule-based decision-making algorithms and were referred to as AI systems guiding students towards discovery learning, or individual tutoring systems [2]. Since then, AI has developed into a field that has made rapid advances [3]. Errors of previous generations of AI application in education are not always repeated because today's machines and deep learning algorithms are achieving never before seen accuracy in capturing complex patterns [4, 5, 6, 7]. Consequently, there is a growing risk that AI will soon replace the teacher in the classroom [6, 7, 8]. The concept of 'moocs' created by Coursera, Udacity, edX, and Khan Academy is so appealing to thousands of students online because they signify the first signs of a new generation of AI impacting teaching practices in an unlimited number of minds around the world [8, 9]. There is no doubt that, in the not-too-distant future, cutting-edge AI based digital technologies will make high quality, affordable education almost universally available, provided for by an inanimate intelligent machine, in real time [9,10]. With this even in mind, the role of the human teacher will not disappear, but it will need to change, providing a more personalized tutoring experience, shaping the context in which the new, more advanced technology will be the conductor of education [11, 12, 13]. As educational innovation increases

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so, and perhaps even more quickly, the need for improving teacher education in language and pedagogy, and research guidelines in the field of artificial intelligence in technology-mediated language teaching for better coexistence among the different types of learning and teaching agents within the digital ecosystem of education [14]. Language education, like all education, is about individuals. Language teaching requires the establishment of a connection between the teacher and the individual student and empathy on the part of the teacher, if the student is to successfully communicate in another language [15]. Every student's difficulties and challenges are unique, and progress is very dependent on the teaching activities being highly centered on the student [10, 11]. This is the reason that language classes in school are often large or are divided into large classes and the language teacher can find it difficult to teach in ways that are personalized, allowing the student to learn according to his or her individual learning style and pass through teaching material at the pace that is exactly right for him or her [13, 14, 15]. In all teaching, and particularly in language teaching, it is important that personalized attention is given to each student, adapting the teaching to the way each student is learning [16, 17]. This is particularly important in the case of language learners because learning a language is all about having a conversation, and just as the same teaching methods do not work for every student, neither do the same voice, accent, or pronunciation in communication work for every student [18]. Studies have identified many ways in which technology can be used to support personalized language education [19].

Importance of Personalized Language Education

When the personalization focus is on the language, in both cases, typically, one encounters situations where the interest goes beyond supporting the learning process of the language itself [20]. In the first case, the language is not the main target but the tool, at any level, for teaching and learning something else [12, 13, 14]. In the second case, both the languages and what is interested in learning using the language are equally important. In the first scenario, where one may have referred to the method as a "content and language integrated learning method," personal inference is explanatory so to select the content as well as its organization to best fit every learner and so contribute to improving results obtained using a single-language method [15,16]. One of the inevitable consequences of the improvement in education quality and access, especially at the school and undergraduate levels in the second half of the 20th century, is that the standardized mass education programs started to be questioned more and more [15, 16, 17]. In particular, it has become widely accepted that individuals differ in many aspects, such as how they learn, what they want to learn, and the rhythm at which they wish to do so. As a result, personalized education practices that provide learners with the tools, environments, and contents that may best fit their individual needs and expectations became quite popular and demanded [18]. The fact that these can be made available to a great extent online (at any time, anywhere) increased the attractiveness of this type of education, attracting, in general, both the supply and the demand.

Fundamentals of Artificial Intelligence (AI)

Recent progress in AI has been accelerated by the increased availability of information, developments in software and machine learning algorithms, and greater access to supercomputing hardware to perform increasingly complex tasks [17]. Examples of AI activities include reading and understanding natural language texts, problem-solving through logical reasoning, perception of visual patterns, learning from observations and data, and motion and manipulation control in robots [18]. These types of capabilities lead to machines that enhance human productivity, improve human understanding and decision-making, and assist in making clinical diagnoses [18, 19]. Artificial intelligence (AI) supports the ability of a digital computer or a computer-controlled robot to perform tasks characteristic of a human being, such as decision-making, perception, language translation, and artistic creativity [20]. These digital representations of real-world objects, concepts, and entities are assembled or constructed to achieve an intelligent machine representation that helps people interpret and reason within that representation [21]. The components of intelligent machine learning fall into the categories of knowledge representation and machine reasoning [20].

Machine Learning and Natural Language Processing

In supervised learning, models are trained from labeled data. Labeled data is almost impossible to obtain. To address this, unsupervised learning aims to learn a general representation of structured data from unlabeled data [20]. People then take advantage of the unsupervised properties of learned representations. Reinforcement learning considers a learning agent interacting with an environment. The learning problem is posed as a mapping problem from sensory perception of the environment to actions to be performed within the environment [21]. The learning agent is trying to maximize a certain notion of cumulative rewards received from the environment. Machine learning has emerged as the leading family

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of algorithms for solving numerous natural language processing problems. Machine learning refers to creating a model or mappings by learning from data [20]. Machine learning is so pervasive that people are no longer conscious of how much everyday life is driven by it. From automatically tagging family photos to speeding through carpool lanes, the prevalence of machine learning and its impact on day-to-day living is impressive [21]. Many tasks in NLP can be posed as either supervised learning or reinforcement learning problems. In other cases, machine learning is used to optimize the performance or identify the most useful parameters for task-independent predetermined algorithms.

Integration of AI in Language Learning Platforms

With the rise in technological innovations in personalizing language learning, the paper aims to offer academia and education practitioners an overview of language learning platforms and reviews the literature on the integration of AI in language learning [20]. This paper also explores the solutions developed by language learning platforms and explains the core technology behind the platform, including AI techniques used [21]. Finally, the author highlights the future research focus on the development of language learning platforms [22]. The integration of AI into the language learning platforms in devising their solutions, developers of language learning platforms have used technology as a tool to augment language teaching [23]. And with the ability to analyze and evaluate each individual language learner, platforms have used technology to turn the language learning experience into a more personalized, efficient, and effective practice. However, current language learning platforms are not able to provide holistic and intensive practices purely based on traditional teaching and learning methods [20, 21]. Consequently, developers are increasingly turning to integrating machine learning into their personalization of language learning platforms through the use of algorithms and models [12]. Machine learning (ML), especially supervised learning, and deep learning algorithms are becoming popular modeling approaches chosen by developers of language learning platforms due to their capability in learning complex mapping from data and identifying latent patterns [20,21].

Adaptive Learning Systems

As the digital age progresses, learning complexity and coverage become higher and wider. Specifically, big data analytics and data infrastructure solution dominate the design, implementation, and deployment of large scale personalized learning systems. Consequently, educational researchers have leveraged various technologies and methodologies toward both system-ready and characteristic-ready solutions [22].As we navigate from historical deep belief networks (DBNs) to present deep scheduling networks (DSNs), model-based adaptive learning theory illustrates the three associated learning styles: traditional computer-assisted instruction (CAI), rat-based learning, and model learning [23]. The evolution tracks from classical training-time pedagogy and real-time pedagogy developed from reinforcement learning. In addition to expert knowledge and student test results, knowledge discovery in learning data (KDL) depicts great opportunity to extract instructional content from Web 2.0, learning object repositories, and peer student learning history data for adaptive learning. Furthermore, KDL could benefit the personalized content development and delivery of the future learning model [24]. Historical Perspective Most of the early adaptive learning research was built upon intelligent tutoring systems (ITSs) and incorporated the domain knowledge model. The domain knowledge model is a flexible curriculum with topic-level concepts and the associated inter-concept relationships [25]. Combined with the model-based diagnosis, adaptive learning systems are able to simulate interactions with human experts for the learner's questions at the concept level. The underlying identity-based diagnostic approach is the classic started-Bayesian-network model, where arc probabilities between nodes are computed through training and learning data. When collaboration with multi-topic impacted student knowledge data is taken into account, the dynamic belief network framework develops [26]. In the education setting, students' demographic data (i.e., age, language culture, and language proficiency) and their learning history (i.e., search and review, examination, and testing styles) could provide beneficial information for personalized system design, implementation, and evaluation. Several AI technologies have been used to build adaptive learning systems, such as expert systems, fuzzy logic, Bayesian networks, decision trees and rule sets, support vector machines, genetic algorithms, and artificial neural networks. With the development of deep learning, deep feedforward networks, convolutional and recurrent networks, and customized deep learning models have been invented for the personalized learning systems. In addition, cloud computing in the Web Services, PaaS and SaaS models provide computation, storage, and deployment support for AI applications [27]. Adaptive learning systems in computer-aided language learning (CALL) refer to the technological solutions that personalize learning content to individual learners. Adaptive systems are frequently driven by artificial intelligence (AI) algorithms, which enable them to make decisions about

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students' existing learning knowledge states and predict their future performance. In this way, an adaptive system is able to determine a student's required instructional content and presentation method, as well as the learning assistance and guidance, thereby providing a tailored instructional experience [28].

Benefits and Challenges of AI in Personalized Language Education

A renowned language learning application that integrates AI and natural language processing technologies is Duolingo. It proposes science-based lessons to teach languages. In particular, there are several applications that use AI quizzes for language learning. Other applications provide text-based English language evaluations, such as verifying grammatical correctness and relevance to a given context [7]. Such evaluations can be used not just on the individual level but also utilized in various classrooms. Automatically generated exercises were employed in the language classrooms by the teacher and also for self-assessment purposes by the students. It should be acknowledged, however, that in the field of language education, AI could do much more than the above-presented examples [9]. One of the notorious projects aiming to introduce robots into the educational process is Morphy, which integrated state-of-the-art education and robotics technologies. Among different applications of cognitive robots in education, Morphy facilitates English lessons. It assists children with the expression of emotions, sensations, and the aim of a character, taking the clown's role, as well as evaluating children's interaction with each other using natural language processing tools. Among the development versions of Morphy, several focused on the English curriculum. The approach of project engineers was to create both a useful tool for current school lessons and demonstrate the power of AI and robots for the future [23].

Enhanced Learning Outcomes

This realistic opportunity to communicate nurtures a contextual long-term memory capacity, important in current language-learning theory. The SILL (Language Learning Inventory) that summarizes many practical FSWT ideas has shown that real communication has a significant correlation with the best language-learning benefits; while other variables, such as memorization of form or word lists, are typically irrelevant [7]. [9], must support communicative success but minimize the opportunities to just chitchat without improving the fluency of content production. The dueling motivators seem to create an optimal condition for much-enhanced acquisition and motivation; the contextual delta rests in carefully balancing tension; intrinsic goal motivation brings learners repeatedly back to negotiate and interact for a real communicative purpose, rather than just reading passages anxiously hoping to reinforce their understanding and memorize more grammar points. Each variable, when significant, corresponds to a different BOK learning objective; they are not reporting the original difference in acquisition changes identified e.g. by Lu et al., but attempting to identify a balance in UGC human factor, which is different in outcome from other learning school surveyed literature[24, 25]. Fully adaptive AI systems can lead to improved language learning outcomes, more closely aligned with the BOK and the individual learners' goals. Adaptive learning AI can ascertain when a learner is challenged and provide on-the-spot scaffolding to support skills improvement [20]. It may also provide challenge and engage retention for more advanced learners who would otherwise be falling asleep in the CityU experience! It is clear that AI will increase motivation, especially in adult EFL learners and in children helped by their supportive human teachers. However, in teenage pocket-money learners, unlimited motivation for successful teaching materials seems to follow real EFL communication goals, offering opportunities to communicate and negotiate meaning in meaningful learning interactions [8]. This opposite motivation changes negative expected values into positive ones; just getting through the language learning materials is not possible if they need to understand or be understood with their discussion partners.

Future Trends and Developments in AI for Language Education

Most importantly, teachers can better understand how students use their learning materials and how successful their learning methods are compared to their peers. Third, AI will be able to make tutoring and technical support even more cost-effective. This is expected to enable language learning in many parts of the world where, at present, access to qualified teachers is difficult for socio-economic or geographic reasons [13]. Yet, it is important for the language education community to recognize the limits of AI. Can AI cause the positive emotion and sociocultural enrichment that students feel in a traditional language classroom? Can AI respond flexibly and effectively to the pace and needs of different learning styles? In the future, it is hoped that AI can cooperate and coordinate with teachers to manage students' language education more personalized, more widely, and more cost-effectively [26, 27, 28]. First, AI will play an even more significant role in language education, not just for practicing language tasks that can be automatically graded, such as reading, translation, and dictation, but also for speaking and writing

[27]. Second, AI can go beyond accuracy in language grading and provide a deeper level of language feedback. It can tell students why a mistake occurred, what they should have done, and how to improve in their next opportunity to practice the same language skill [28]. Feedback about the task success or test score will help teachers understand the learning process.

CONCLUSION

AI has the potential to significantly enhance personalized language education by providing tailored learning experiences, improving engagement, and supporting individual learning needs. Despite the challenges, such as technological barriers and the need for effective teacher training, AI can complement human teachers by offering adaptive learning systems that cater to diverse student requirements. Future developments in AI technology promise further advancements in language education, making high-quality, personalized learning more accessible. By balancing AI's capabilities with human empathy and contextual understanding, the education system can leverage the best of both worlds to improve language proficiency and overall educational outcomes.

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