10.22633/rpge.v29iesp2.20665

Revista on line de Política e Gestão Educacional
Online Journal of Policy and Educational Management

SHAPING THE DIGITAL LANDSCAPE OF LANGUAGE TRAINING CURRICULA FOR STUDENT TEACHERS: IMPLICATIONS FOR CONFLICT-AFFECTED AREAS

MOLDANDO O CENÁRIO DIGITAL DOS CURRÍCULOS DE TREINAMENTO DE IDIOMAS PARA PROFESSORES EM FORMAÇÃO: IMPLICAÇÕES PARA ÁREAS AFETADAS POR CONFLITOS

CONFIGURACIÓN DEL PANORAMA DIGITAL DE LOS PLANES DE ESTUDIO DE FORMACIÓN LINGÜÍSTICA PARA ESTUDIANTES DE PROFESORADO: IMPLICACIONES PARA LAS ZONAS AFECTADAS POR CONFLICTOS

Lada PETRYK[1]
l.petryk@kubg.edu.ua
Yuliya TRETYAK[2]
Karaguina.tretyak@gmail.com
Natalia KOSHARNA[1]
n.kosharna@kubg.edu.ua
Xu PEI[3]
asp23-p.xu@nubip.edu.ua
Hanna HLUSHCHENKO[4]
glushchenko@khnnra.edu.ua

[1] Foreign Languages and Methodology Department, Borys Grinchenko Kyiv Metropolitan University, Kyiv, Ukraine.

[2] Department of Romance Philology and Translation, Zaporizhzhia National University, Zaporizhzhia, Ukraine.

[3] Faculty of Humanities and Pedagogy, National University of Life and Environmental Sciences of Ukraine, Kyiv, Ukraine; School of Arts, Pingdingshan Polytechnic College, Pingdingshan, China.

[4] Department of Social and Humanitarian Disciplines and Language Training, Khortytsia National Academy, Zaporizhzhia, Ukraine.

How to reference this paper:

Petryk, L., Tretyak, Y., Kosharna, N., PEI, X., & Hlushchenko, H. (2025). Shaping the digital landscape of language training curricula for student teachers: implications for conflict-affected areas. *Revista on line de Política e Gestão Educacional, 29*(esp2), e025062. https:doi.org/10.22633/rpge.v29iesp2.20665

Submitted: 13/08/2025
Revisions required: 05/09/2025
Approved: 17/11/2025
Published: 25/11/2025

ABSTRACT: In recent decades, calls for increased use of technology in teacher training have intensified, given that digital competency has become indispensable to the educational process. Future teachers are expected to be prepared to develop these skills in their students. At the same time, proficiency in foreign languages has established itself as an essential requirement for contemporary teachers, driving professional growth and continuous learning. Thus, training programs face the challenge of integrating digital and linguistic preparation, especially in contexts of geopolitical tensions and armed conflicts. In these regions, creating resilient digital environments for teacher training is imperative. This article reviews theoretical and practical approaches to digital technologies in foreign language training, presenting achievements, challenges, and a digital environment model based on Artificial General Intelligence (AGI) that integrates teaching,

linguistic proficiency, and digital competencies in a flexible and sustainable manner, even in crisis situations.

KEYWORDS: Digital technologies. AI. Martial law. Language training of specialized faculties students. FL digital competence.

RESUMO: *Nas últimas décadas, intensificaram-se os apelos para reforçar o uso de tecnologias na formação de professores, dado que a competência digital se tornou indispensável ao processo educativo. Espera-se que futuros docentes estejam preparados para desenvolver essas habilidades em seus alunos. Paralelamente, a proficiência em línguas estrangeiras consolidou-se como requisito essencial do professor contemporâneo, impulsionando o crescimento profissional e a aprendizagem contínua. Assim, os programas de formação enfrentam o desafio de integrar preparação digital e linguística, especialmente em contextos de tensões geopolíticas e conflitos armados. Nessas regiões, criar ambientes digitais resilientes para a formação docente é imperativo. O artigo revisa abordagens teóricas e práticas das tecnologias digitais na formação em línguas estrangeiras, apresentando conquistas, desafios e um modelo de ambiente digital baseado na Inteligência Artificial Geral (AGI), que integra ensino, proficiência linguística e competências digitais de modo flexível e sustentável, mesmo em situações de crise.*

PALAVRAS-CHAVE: *Tecnologias digitais. IA. Lei marcial. Formação linguística de estudantes de faculdades especializadas. Competência digital em FL.*

RESUMEN: *En las últimas décadas, se ha intensificado la demanda de un mayor uso de la tecnología en la formación docente, dado que la competencia digital se ha vuelto indispensable en el proceso educativo. Se espera que los futuros docentes estén preparados para desarrollar estas habilidades en sus estudiantes. Al mismo tiempo, el dominio de lenguas extranjeras se ha consolidado como un requisito esencial para los docentes contemporáneos, impulsando el crecimiento profesional y el aprendizaje continuo. Por ello, los programas de formación se enfrentan al reto de integrar la preparación digital y lingüística, especialmente en contextos de tensiones geopolíticas y conflictos armados. En estas regiones, la creación de entornos digitales resilientes para la formación docente es imperativa. Este artículo revisa los enfoques teóricos y prácticos de las tecnologías digitales en la formación de lenguas extranjeras, presentando logros, desafíos y un modelo de entorno digital basado en la Inteligencia Artificial General (IAG) que integra la docencia, la competencia lingüística y las competencias digitales de forma flexible y sostenible, incluso en situaciones de crisis.*

PALABRAS CLAVE: *Tecnologías digitales. IA. Ley marcial. Formación lingüística de estudiantes de facultades especializadas. Competencia digital en lenguas extranjeras.*

Article submitted to the similarity system

iThenticate

INTRODUÇÃO

In the twenty-first century, a teacher facilitates learning by encouraging students' critical thinking, teamwork, and communication abilities. They adapt to new technologies, value lifelong learning, and tailor instruction to the requirements of each student. Essentially, they help students become active, engaged learners in a fast-changing world (Hasan, 2022).

Students should now be at the center of education rather than teachers, as is the case with traditional teaching. As students take responsibility for their own education, teachers should assume the role of mentor and support. In addition to encouraging students' interest and drive to create a product, teachers are supposed to actively assist students by offering various solutions when necessary (Soylemez, 2023).

Moreover, in today's educational scene, foreign language teachers provide substantial advantages in terms of global connectivity, information access, and improved communication skills. While proficiency in a foreign language is not required for all teaching positions, it can increase career opportunities, foster international understanding, and contribute to a more dynamic and globally conscious learning environment. Teachers with foreign language skills might engage in continuing self-education by reading the most recent articles in specialist scientific journals, attending international professional meetings, and so on.

Future teachers should get foreign language training that emphasizes strong communication skills, pedagogical expertise, and the ability to incorporate technology into language instruction. This includes gaining practical experience in a variety of teaching settings and promoting a student-centered approach to language acquisition. Furthermore, training should focus on the development of critical thinking and problem-solving abilities relevant to language education.

Moreover, one of the crucial factors for teacher' professionalism today is digital skills. This is even more important bearing in mind that the current generation of students are 'digital natives'—it is Generation Z, for whom digital technologies in all spheres of life, including learning, became indispensable element of everyday activities.

Thus, for teacher, within this new landscape of education, both FL skills and digital skills are necessary components of professional competence, and the optimal and fastest way to shape this competence is the use of digital technologies in FL training of future teachers.

Meanwhile, in conflict-affected countries (especially those under martial law) training of future teachers face specific problems. Civilians, educational institutions, and teachers are increasingly targets of attack as international norms on warfare are disregarded, which is evident, in particular, in case of war in Ukraine. During the war, many higher education institutions in Ukraine, including pedagogical institutions, suffered significant damage or were completely destroyed as a result of shelling and bombing. Some of them were completely destroyed,

while others received varying degrees of damage. In addition, the war caused a transition to distance learning, which became the main form of acquiring knowledge for many students. In addition, the war led to migration and emigration of teachers abroad, which creates a shortage of qualified personnel in the educational sector.

Thus, in conflict-affected areas, ensuring the quality of foreign language training of pedagogical specialties students appears to be a challenging task. But namely digital technologies can become a foundation to build a strong system of FL training for future teachers, effective even in turbulent environment.

LITERATURE REVIEW

The Digital classrooms are distinguished by the use of electronic devices or platforms such as social media, multimedia, and mobile phones to instruct pupils. The use of digital technology in education has changed the educational landscape for the better. Digital learning is a learning technique that uses technology to cover the complete curriculum and allows students to learn fast and efficiently (Pacheco et al., 2018; Turgut & Aslan, 2021).

In order to integrate digital technology into teacher education, Rodrigues (2020) sought to identify the theoretical and practical underpinnings that would allow for the adoption of a novel teaching-learning paradigm. Based on recognized pedagogical trends, this teacher training model stood out for its adaptable approach to the training process, which incorporated active training strategies that promoted the development of a variety of abilities, including digital ones.

The author claims that this approach can also assist students in gaining the skills required to take control of their education and produce their own knowledge. The two research methods used were action research in the development of training workshops in an in-service research training project and a case study in a pre-service teacher education study in Portugal. According to the study's findings, the participating teachers were able to modify their teaching methods and acquire new abilities while using digital technology into their own teaching-learning process. This will help online education grow in the future.

Studies show that by offering interactive, easily available, and captivating learning opportunities, digital tools greatly improve andragogy in FL training (Schmidt & Strassner, 2022). These resources can be combined to help with vocabulary development, grammatical drills, listening comprehension, and speaking fluency, among other language learning objectives.

The delivery of education is being drastically altered by artificial intelligence, and sophisticated AI tools are being progressively included in language instruction. Based on the AI-TPACK framework, Zhou and Hou's (2025) study investigated how teachers might employ AI tools in

language instruction in an efficient manner. The study identified a number of uses for AI tools in language instruction through semi-structured interviews with 24 EFL teachers and thematic analysis with MAXQDA software. According to the findings, artificial intelligence (further – AI) tools are crucial for creating instructional materials, assigning and grading homework, translating text, directing student practice, and promoting class discussions and interactions.

But when it comes to employing AI tools, teachers also have to deal with issues like insufficient technical support and training requirements. This study offers techniques for EFL teachers to use AI tools effectively based on these findings. These strategies give teachers useful references for integrating AI technology and provide insights into the creation of pertinent instructional policies.

According to Adarkwah (2024), the andragogical model encourages educators and instructional technologists to customize GenAI tools to adult learning approaches. In this GenAI-infused digital age, the author suggests a "GenAI adult learning ecology" paradigm (GenAI-ALE) for institutions of higher learning. Eight fundamental principles are examined by the GenAI-ALE and are divided into two primary themes: interpersonal aspects (GenAI human-centered andragogy, GenAI literacy, GenAI interest, and GenAI virtual learning) and institutional factors (GenAI curriculum design, GenAI divide, GenAI policy, and GenAI ethics). GenAI integration into adult education is contextualized using Malcolm Knowles' andragogical approach.

Four iterative systematic steps—pre-perception and perception, GenAI preparedness, assessment, and outcome—are involved in putting the concept into practice in a real-world setting. Higher education institutions must create educational systems that have a synergy between humans (adult learners) and GenAI in order to reimagine new forms of adult learning in the context of the GenAI revolution.

The study by Hazaimeh et al. (2024) sought to investigate the viewpoints of EFL teachers working in a variety of UAE colleges on the effectiveness of AI applications in the EFL classrooms. EFL teachers must employ AI apps in ways that are consistent with teaching objectives and promote student learning. A quantitative approach was taken, with data collected from a survey of 46 EFL instructors. The findings revealed that instructors heavily depended on AI tools to streamline work, provide data-driven insights to improve instructional tactics, and personalize the learning experience for each student. Additionally, they placed a high importance on the advantages AI technologies offer their classrooms in terms of enhancing the instructional process.

Notably, the findings demonstrated that the means of EFL instructors' opinions about the advantages of implementing AI apps in EFL classrooms were statistically significantly influenced by the number of years of teaching experience. The findings also demonstrated that opinions about the difficulties of using AI apps did not significantly differ based on prior teaching experience.

10.22633/rpge.v29iesp2.20665

GenAI tools offer the ability to accelerate the quick generation of high-quality, individualized, and engaging materials for instruction and evaluation in any given learning situation, which is particularly useful in adult education where teacher capacity and resources are constrained (Cacicio & Riggs, 2023). Nevertheless, despite the excitement around the revolutionary possibilities of GenAI technologies (such as ChatGPT, Claude, Bard, and Bing Chat) in the realm of education, there have been dire forecasts regarding their application by educators and learners (Rudolph et al., 2023).

Regarding the effects of GenAI tools on teacher practice, teacher education, and student learning, educators have been given conflicting information and are quite unsure (Mishra et al., 2023). Therefore, it is advised to deploy GenAI technologies for teaching and learning with caution because of a number of aspects, including their accuracy, response quality, perceived utility, ethical concerns, etc. (Tlili et al., 2023).

Moreover, AR, VR, and MR technologies offer promising tools for future teachers to enhance FL learning experiences. Through the use of dynamic and interactive simulations, these immersive technologies can enhance student motivation, engagement, and comprehension of difficult ideas. Better language acquisition may result from the tailored and interesting learning experiences that VR, AR, and MR may provide, which can accommodate various learning requirements and styles.

Yan and Lowell (2025) note that virtual reality has been used in FL education for over 50 years and has progressed through four stages: two-dimensional (2D) text-based VR, three--dimensional (3D) desktop-based VR, 3D HMD-based VR, and AI-enhanced 3D HMD-based VR. Using pertinent research and examples, this article examines the significant advancements in VR technology, shows some frequently used VR applications, and discusses their implications for language instruction at each level. From early text-based MUDs to AI-enhanced HMD-based VR, the evolution of VR technology demonstrates its growing ability to build immersive, interactive, and personalized language learning environments.

For virtual reality (VR) study, language instructors and students can use desktop PCs or head-mounted displays (HMD) (Makransky & Petersen, 2021). Since desktop-based VR does not require a headgear (also known as an HMD) that encloses the user's field of vision and includes other capabilities that enhance the possibility of immersion (such as head tracking and stereoscopic 3D vision), it is often considered non-immersive.

When using desktop-based virtual reality, language instructors and students engage with the virtual world using a computer screen, conventional keyboard, and mouse (Lowell & Yan, 2023). On the other hand, because the headgear obscures the physical surroundings and immerses language learners in sounds, images, and other sensory inputs, HMD-based VR is referred to as fully immersive (IVR) (Lowell & Tagare, 2023). Language learners may feel as though they have been taken to a virtual environment that closely mimics reality thanks to the

tactile, visual, and aural experiences that IVR offers (Lowell & Yan, 2024). Language instructors and students can move about physically or operate an IVR environment using a joystick (Lee & Wong, 2014).

According to studies, students' sense of presence is improved by complete immersion in HMD-based VR, which enables them to participate in virtual settings that mimic language use in real life. This strengthens practical abilities and improves learning outcomes (Lai et al., 2021). Through contextualized application and problem-solving, the embodied experience also promotes improved memory of vocabulary and complicated language structures (Ou et al., 2021). Furthermore, the multisensory involvement of HMD-based VR increases learner pleasure, improves communication and teamwork, and encourages positive attitudes toward language acquisition (Enkin, 2022).

As AI has developed, VR applications have been greatly improved by incorporating AI, creating immersive, interactive, personalized, and adaptable language learning environments that take advantage of both AI's intelligence and VR's immersive features (Godwin-Jones, 2023). AI has been used into the platforms of Immerse and ImmerseMe to offer individualized and interactive language learning. By simulating real-world language exchanges, these AI-powered apps enable learners to converse contextually with virtual characters or actual users in a dynamic and genuine environment (Chen et al., 2022).

Despite the existence of huge array of literature devoted to digital technologies application in FL teaching, as well as some studies considering FL instruction for future teachers, the role of digital technologies in enhancing quality of future teachers FL learning actually was not a subject of scientific investigation. In attempt to fill this gap, we see the objective of our research in reviewing and systematizing theoretical provisions and practical implications in the domain of digital technologies usage namely within FL training for pedagogical departments students, as well as outlining promising vectors of further development in this domain.

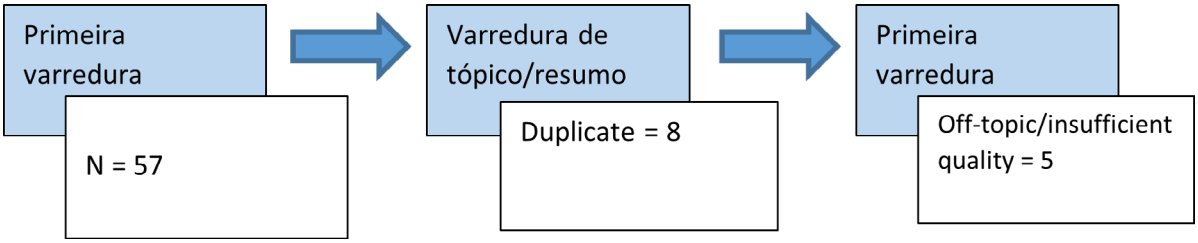
METHODS

A qualitative methodology within constructivist paradigm of research was applied in this study. Narrative review was used as a method, and the results of narrative review allowed further application of modelling method.

The search for publications to compile a sample for narrative review was carried out within the following databases: ScienceDirect, MDPI, Wiley, ResearchGate, ERIC, IEEE. Since the topic is broad, and manual searching based on keywords could lead to incomplete sample for analysis and missing some important patterns, perspective, and concepts, we employed AI-powered research tool Semantic Scholar.

This allows us to reveal core patterns and keywords (based on 963 entries), which we then used for manual search. The final array of keywords included: teaching FL in digital environment; pre-service teachers FL training; FL teaching in conflict-affected territories; digital cognitive models of FL learning; XR in FL teaching and learning. Flowchart of searching the publications to include in the final sample is depicted in Figure 1 below.

Figure 1
Flowchart of searching the publications to include in the final sample



Note. Compiled by the authors.

RESULTS AND DISCUSSION

More involvement, quicker assessments, and an instant learning environment are all things that traditional classroom training cannot offer. On the other hand, technology and digital learning resources cover this gap. Traditional teaching methods just cannot match some of the efficiency that these technologies offer.

Since smartphones and other wireless technology devices are becoming increasingly common in society, it makes sense for educational institutions like schools to use them effectively by integrating technology into the classroom. Indeed, the next generation finds learning more interesting due to the adaptability and non-intrusive nature of today's technology (Haleem et al., 2022).

In FL training, digital technologies are becoming more and more important since they improve students' learning experiences and teachers' ability to teach. From developing interactive classes to giving users access to real language resources and promoting cooperation and communication, these tools can be utilized for many different things.

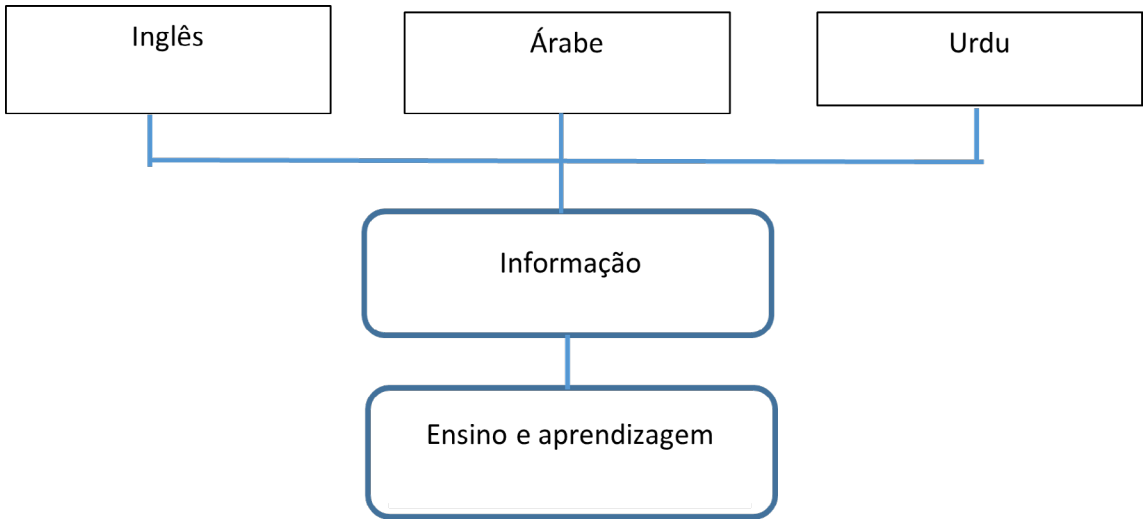
As was already indicated, it is particularly pertinent to areas affected by conflict, where safety conditions and a shortage of trained personnel frequently impede the regular teaching process. In the meantime, companies who provide educational technology are always trying to come up with new ways to give people who can't afford proper educational facilities more access to education. The use of social media as a teaching tool has advanced significantly. Social media is a vital component of the entire e-learning experience for many educators and learners.

At the same time, FL training of pedagogical specialties students has its specifics, since acquired FL skills should be strongly in line with pedagogy (teaching) skills, and in this domain, new space opens for enhancing training of future teachers. In particular, digital technologies in FL training of future teachers can simultaneously be used for shaping their digital skills, which also are necessary element in teachers' competence.

According to Khairon et al. (2022), instructors who possess multicompetence are better able to attain excellence in the classroom. Teachers maintain their effectiveness when they use a variety of teaching techniques to spark students' attention and help them learn new abilities. The purpose of their paper was to investigate how foreign languages play a part in effective instruction among secondary school teachers who are highly skilled in Islamic teaching. Data for the case study was gathered from eight Malaysian secondary schools using a qualitative methodology. The findings indicate that teachers are proficient in Arabic, English, and Urdu.

Additionally, during teaching and learning sessions in Islamic Education classes, proficiency in other languages enhances the quality of instruction, draws students' attention, boosts motivation to learn, and gets them excited about learning, according to the study. A new model, the model of language as one of the characteristics influencing good instructors of Islamic education, was produced by the researchers based on the findings. Figure 2 provides a visual description of the model.

Figure 2
Model of the relationship between foreign language skills and teaching and learning process



Note. Khairon et al. (2022).

We suggest to modify this model and include digital technologies component in it, bearing in mind the above-mentioned dual role of digital technologies in FL instruction for future teachers (see Figure 3).

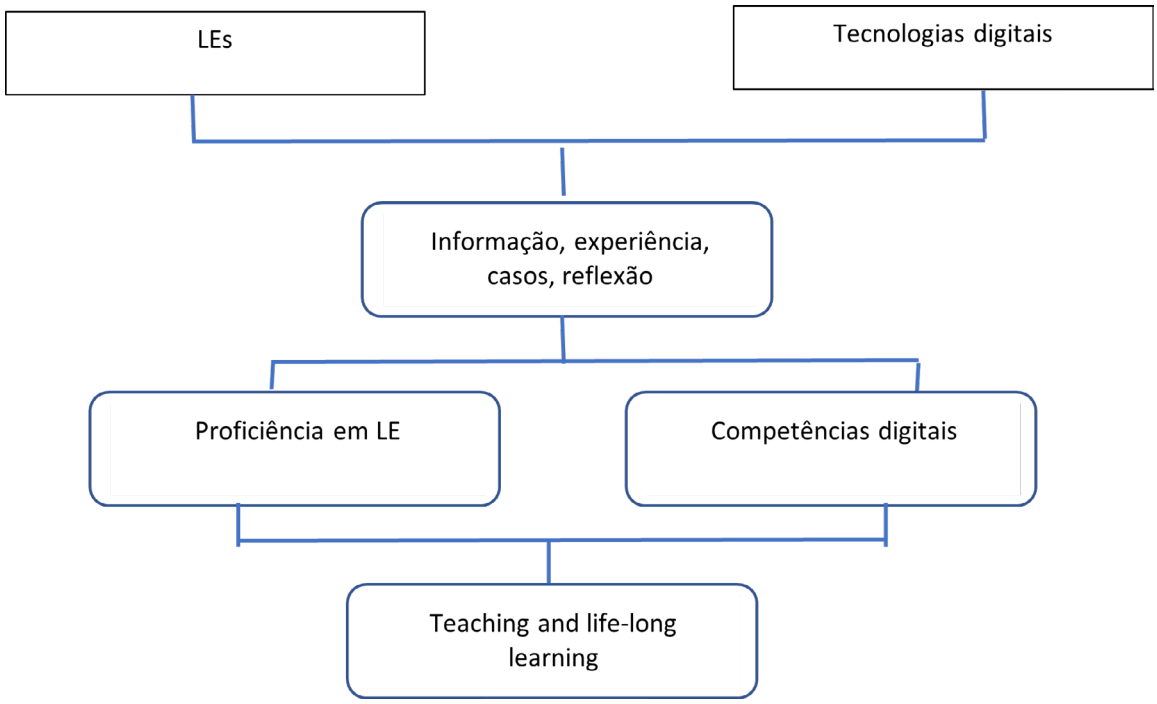
The 2019 New Media Alliance (futher – NMC) higher education panel agreed that six technological developments have the potential to significantly impact education, particularly in the areas of pedagogical and learning approaches, teacher work organization, and instructional design, arrangement, and delivery. Mobile learning, analytics, mixed reality, artificial intelligence, blockchains, and virtual assistants are among the six technological advancements. In other words, AI and mixed reality have entered the mainstream and are now important components of modern education (Chen et al., 2022).

Many studies have stressed the need of tailoring English courses to the actual communication needs of workers in a certain workplace (Malicka et al., 2019; Hazaymeh et al., 2024). As previously said, VR is a simulated environment, and the interactive nature of robotics enables language development and conversation to occur. Learners can interact with robots and experience simulated scenarios.

However, because only a few research studies have included programmed AI robots in language learning (Hui, 2019), there are more recent studies on robot-assisted language learning (RALL) that provide various insights into how application systems and learning content can be designed to motivate and engage students in learning.

Figure 3

The conceptual role of digital technologies for enhancing the quality of FL teaching for pedagogy students



Note. Developed by the authors.

Chen et al. (2022) created an extremely creative technique for FL learning. The goal of their action research study was to develop an application system for educating English-language tour guides utilizing robotics, AI, and VR technologies. The two students taking part in the study volunteered for the interviews. They were identified under the pseudonyms Jeffrey and Amanda, and their English skill level was intermediately high.

These two students were enrolled in a university of science and technology in Taiwan's Department of Applied Foreign Languages' Master of Arts program in International Tourism and Meetings, Incentives, Conferences, Exhibitions (M.I.C.E.) Industry. The goal of this program's practice-based curriculum paradigm is to develop linguistically competent planning and management executives. The teaching methodology for all of the courses is "learning by doing".

The interactive robot as a learning companion (a learner must interact with Robot Robert) was the design concept for Chen et al.'s (2022) study. Robot Robert provided more input the more the learner interacted with him. The system's language-learning mechanism was created with social interaction in mind. As a result, the application system's content was centered on conducting English-language tours using interactive conversations designed to give students chances to practice speaking the language.

Each of the ten modules (destinations) included multiple scenes. That is, there were multiple dialogues for each location. Each chat included a scenario outlining the plot (for example, a discussion about the history of an architectural attraction, route planning, or preparing for the next stop) as well as individual scenes that mirrored the appropriate real-life event. Robot Robert led the conversations during the exercise, and both the students and the robot pretended to be either travelers or tour guides.

Simple activities including sentence construction (i.e., grammar and syntax) and multiple choice (i.e., suitable wording, matching words, and collocation) were also included. After each response was given, the robot supplied feedback. It was anticipated that by practicing conversations with the robot, students would increase their speaking ability and vocabulary.

Students are motivated and active when they are involved in the learning process. To put it another way, they use cognitive techniques to improve and facilitate their comprehension (Mollen & Wilson, 2010). Being involved, enthusiastic, and active are characteristics of engagement, which goes beyond simply completing a task. People work hard and use their brains to the fullest extent possible. Jacobi et al. (as cited in Blaz, 2018) argued in 1962 that the amount of time and physical effort devoted to learning activities was correlated with student engagement.

According to Kuh (2003), engagement is the work a student does to learn, practice, and get feedback on problem-solving and analysis. According to Parsons and Taylor's (2011) research, there has been an increase in studies on student engagement, and the biggest shift among them has been from concentrating on disengaged students to engaged learners.

It should be noted that more research has lately been done on the use of simulation environments in teacher training. Yilmaz and Hebebci (2022) reviewed research on the use of simulation programs and virtual environments in teacher training programs. The findings of the study demonstrated that virtual environments and simulations, which are extensively and successfully employed in a variety of fields, also have significant promise for training and instruction.

The individualized experience that these settings must offer must be genuine enough for each instructor to suspend his or her disbelief. The teacher must simultaneously have a sense of personal accountability for enhancing their practice, which is based on a critical self-reflection process. According to Dieker et al. (2014), these individualized learning environments are necessary for teachers to engage in self-directed professional development, wherein content and pedagogy experts and mentors/coaches collaborate with teacher candidates in a secure, technologically advanced setting "to produce effective teachers".

In the analysis of the benefits and drawbacks of augmented reality (futher – AR) in second language acquisition, Belda-Medina (2022) highlights AR's potential as a transformative tool rather than a delivery system for teacher preparation programs. In order to effectively incorporate AR-based projects that teach English using a Computer-Supported Collaborative Learning approach, the study looks at the attitudes and innovative abilities of pre-service teachers. 229 University of Alicante (Spain) education students made up the sample size.

They used various authoring tools to produce 47 vision-based and location-based projects that were used to teach English to young learners. Videos of teaching experiences, class discussions, and a pre-post test were used to collect both quantitative and qualitative data. The study's conclusions showed that although the teacher candidates lacked technical and pedagogical experience in creating and implementing AR content, they had very positive attitudes toward AR integration as a transformative technology, especially when it came to student focus, teamwork, and enjoyment. Additionally, a correlation between participants' perceptions of the degree of difficulty and their positive sentiments regarding AR integration in EFL was shown by Spearman's Rho correlation coefficient.

Thus, for effective integration of digital technologies in the didactics of FL teaching for pre-service teachers implies that learning digital skills is no less important than 'targeted' — FL skills. We believe expedient to create integrative digital environments, enabling simultaneous formation of teaching skills, FL skills, and digital skills in pre-service teachers. Virtual and augmented reality-based digital technologies are most frequently employed in the training of professionals, especially aspiring educators, to develop their digital abilities (Tzima et al., 2019).

The first category consists of fundamental functional (core) digital abilities. It can involve using digital gadgets (like cellphones) for practical purposes, scanning images from textbooks to create application labels, and using the Internet to look for information. The second category is the general level of digital skills. It can be exemplified by abilities like labeling

textbook images, designing applications using software, and finding and organizing data on different processes and occurrences. The third category consists of advanced professional digital skills. It may include fundamental programming abilities (at the user level).

Similar to the difference between a pre-service teacher reading about behavior management and actually seeing real pupils and classrooms, virtual settings must have a sense of "real presence" in order to be effective. The secret to a successful simulator is this "presence" phenomenon (Dieker et al., 2014).

Since they allow for integrative instruction in any setting without requiring physical presence, these simulation environments are a useful tool for teacher training in conflict-affected areas. The ability to use suitable platforms and tools on smartphones is a significant concern at the same time. In this scenario, the teaching and learning process is truly independent of security conditions. Future developments in cloud computing, 5G, and AI will improve AR/VR apps even more, increasing their scalability and adaptability (Thangavel, 2025).

Teachers have long used simulations to help students develop their abilities and prepare them for the workforce, especially in fields like medicine and health care. Simulation use in teacher education has been sluggish, but this is beginning to change as digital simulation technologies have advanced and become more widely available.

Simulation as a teaching method has mostly been analyzed from the perspectives of cognitive psychology and human-computer interface (further – HCI). Nonetheless, other and useful viewpoints on the creation and application of simulations, particularly for teacher education, are provided by educational theories. The intricacies of classroom practice are acknowledged by social practice theories, which place special emphasis on focusing on certain areas for skill development and facilitating chances for deconstruction, reflection, and feedback.

Bradley (2020) categorizes teacher education simulation platforms into three types: "virtual puppetry simulations", in which individual preservice teachers (PSTs) engage in what Sweeney et al. (2018) refer to as «virtual field experiences» within a classroom; MUVEs, in which multiple PSTs interact within a virtual environment; and "single user simulations", in which a single PST interacts with a virtual student programmed to respond in specific ways to prompts. SimSchool is one of the most well-known and well-established "virtual puppetry simulations" for teacher education.

It is driven by an artificial intelligence model that simulates how learners modify and adapt themselves to fit the cognitive, emotional, and physical demands of a task using a hill-climbing algorithm (Bush & Hall, 2013). Although reviews on SimSchool's efficacy are conflicting, it is said to be affordable, scalable, and a safe approach for children to practice and learn in a variety of scenarios (Badiee & Kaufman, 2015). Bush and Hall (2013) argue that SimSchool (and digital simulations in general) cannot entirely mimic the target environment, with simplifying resulting in the loss of a critical factor in a complicated situation.

Simulations, on the other hand, do not always aim to duplicate this complexity, but rather to serve as approximations or "metaphors" (Schutt et al., 2022) that allow for learning by trial and error and/or theoretical material conceptual consolidation. Another comparable platform is TeachLivE, which was created by a university in the United States. A participant teacher supervises and interacts with a classroom of avatars capable of engaging in inappropriate behaviors, such as an attention-seeking student who is content to respond repeatedly to more difficult challenges such as aggressive power and revenge-type behaviors, as well as passive fear of failure behaviors (Schutt et al., 2022). Teacher educators can set behavior/challenge levels in advance.

Mursion is an example of an MUVE, which is powered by a combination of human and artificial intelligence and is operated by simulation experts, or «interactors», who are skilled professionals who plan the interactions between trainees and avatar-based characters. The realism required to make experiences involving intense human-to-human connection impactful is provided by this mixed approach (Landon-Hays et al., 2020).

Naturally, simulators cannot answer every query. A few of these restrictions are specific to the simulation tools. For instance, Mursion prevents teachers from moving around the room and students from answering questions on mini-whiteboards. But in the upcoming years, technological advancements might loosen some of these restrictions.

Methods that promote involvement in teacher communities of practice and peer cooperation in small groups are advised for XR's mass teacher onboarding (Mystakidis et al., 2021).

When developing AI-based learning environments for pre-service teachers, a multimodality approach is required. Language, tactile, visual, and auditory learning are all included in multimodality. The Lee et al. (2023) article goes into great depth about this method, which the authors refer to as Artificial General Intelligence (futher – AGI). AGI uses a variety of techniques and tools to try to replicate human intelligence in computers.

The evolution of complex AGI systems is dependent on numerous cognitive processes, learning skills, decision-making abilities, and adaptability techniques, all of which are essential components of AGI. The formation of cognitive frameworks is critical in AGI development. These all-encompassing systems include cognitive functions such as thinking, learning, memory, and perception.

These frameworks replicate the structural and functional principles of the human mind, enabling AGI systems to mimic human cognitive processes. AGI must be able to understand and generate human language in order to analyze data and interact with humans effectively. Natural language processing methods like syntactic, semantic, and discourse analysis are used for this (Lee et al., 2023).

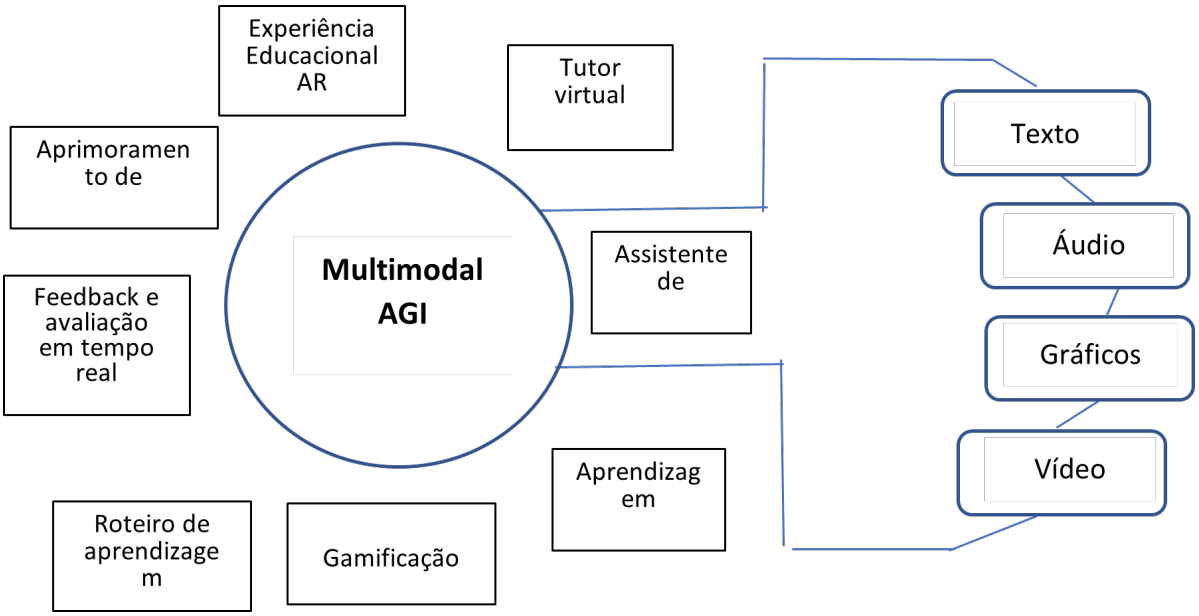
Instead of creating systems that mimic human thought processes, more focus is being placed on creating technologies that improve and augment the educational experience as AGI

in education develops. This modification acknowledges the unique benefits of AGI and leverages them to create more engaging, inclusive, and practical educational materials. A concept of AGI organizing is presented in Figure 4.

The uniting component that teacher education must include in order to embrace the future of simulation in practice is a cyclical process. Simulations are industry standards in commerce, health, and aviation, as well as widely employed in the military, and they all follow a cyclical process. A cyclical process in teacher education is demonstrated by the teacher observation cycle of a pre-service or in-service teacher, in which there is an aim for the observation, the observation takes place, and then there is a debriefing regarding what happened.

In simulation, this procedure is known as the Action Review Cycle (futher – ARC). The ARC began in 1981 at the United States Army Training Center and has been developed over time. The military has utilized the ARC procedure for almost 35 years. ARC research focuses on an interactive conversation to determine what happened, why it happened, and how to enhance or maintain collective performance in future exercises (Efron & Ravid, 2019). By introducing the ARC into virtual scenarios, instructors can engage in self-reflection, ask questions, receive coaching, and think beyond of their comfort zones in order to achieve positive social and academic outcomes in their classrooms.

Figure 4
A concept of multimodal AGI for education



Note. Developed by the authors based on Lee et al. (2023).

In later stages of simulation-based learning, a cyclical process can be changed from ARC to Kolb cycle. It should be noted that while the Action Review Cycle and Kolb's Experiential

Learning Cycle are both models for experiential learning, their focus and application differ. Kolb's cycle focuses on the learner's personal experiences and how they process them through observation, conceptualization, and experimentation, resulting in new experiences. The Action Review Cycle, which is commonly used in action learning sets, emphasizes reflecting on a given activity to improve future actions and organizational learning.

On the initial stages of learning in simulation environments, application of Kolb cycle seems not expedient, since the basis of personal experience is not yet sufficient for reflection. But later stages, when a student is already well acquainted of working on simulation platform and developed own specific didactic principles, teaching methods, ways of communication with students, etc., introduction of Kolb cycle principles into learning can further improve reflection practices and facilitate shaping FL digital competence of a future teacher.

CONCLUSION

The digital era, marked by the prominence of AI, VR, AR, and MR, is reshaping traditional teaching and learning paradigms, in particular within the realm of pre-service teachers training. Since FL skills are increasingly becoming an integral component of 21st century teacher competence, the potential of digital tools application for ensuring the quality of FL training for teachers represents highly relevant space of scientific and practical discourse. Moreover, to support professional competence development in teacher education (which includes, in particular, FL skills and digital skills), learning environments should allow learners to engage with, 'delve into' professional tasks.

It is crucial for knowledge and skill transfer in such learning environments to real-life context that preservice teachers perceive the task as authentic. At the same time, contemporary AI-based and immersive means allow creating integrative digital learning environments for pre-service teachers, combining simultaneously three domains—professional 'hard' skills (teaching skills) learning, FL learning, and digital skills learning. The research showed that this can be implemented through an educational landscape where AGI is utilized to innovate and transform traditional teaching and learning practices.

This is especially important for pre-service teachers training in war-affected areas, since AGI platforms can be easily scaled for smartphones, and thus learning process can be carried out actually in any place, without interruptions caused by safety situations.

REFERENCES

Adarkwah, M. (2024). GenAI-infused adult learning in the digital era: A conceptual framework for higher education. *Adult Learning, 36(*2). https://doi.org/10.1177/10451595241271161

Badiee, F., & Kaufman, D. (2015). Design evaluation of a simulation for teacher education. *Sage Open, 5*(2). https://doi.org/10.1177/2158244015592454

Belda-Medina, J. (2022). Using augmented reality (AR) as an authoring tool in EFL through mobile computer-supported collaborative learning. *Teaching English with Technology, 22*(2), 115–135. https://files.eric.ed.gov/fulltext/EJ1354648.pdf

Blaz, D. (2018). *The world language teacher's guide to active learning: Strategies and activities for increasing student engagement.* Routledge.

Bradley, E. (2020). Introduction. In E. Bradley (Ed.), *Games and simulations in teacher education* (pp. 1–5). Springer. https://link.springer.com/book/10.1007/978-3-030-44526-3

Bush, L., & Hall, J. (2013). Rethinking pre-service teacher training: Lessons learned with simSchool. In R. McBride & M. Searson (Eds.), *Proceedings of SITE 2013: Society for Information Technology & Teacher Education International Conference* (pp. 2550–2553). Association for the Advancement of Computing in Education. https://www.learntechlib.org/primary/p/48488/

Chen, Y.-L., Hsu, C.-C., Lin, C.-Y., & Hsu, H.-H. (2022). Robot-assisted language learning: Integrating artificial intelligence and virtual reality into English tour guide practice. *Education Sciences, 12(*7), 437. https://doi.org/10.3390/educsci12070437

Dieker, A., Rodriguez, J., Kraft, B., Hynes, C., & Hughes, C. (2014). The potential of simulated environments in teacher education: Current and future possibilities. Teacher Education and Special Education, 37(1), 21–33. https://doi.org/10.1177/0888406413512683

Efron, S., & Ravid, R. (2019). *Action research in education: A practical guide*. The Guilford Press.

Enkin, E. (2022). Comparing two worlds: Spanish learners' face-to-face and immersive social VR speaking experiences. *Computer Assisted Language Learning, 23*(1), 22–42. https://callej.org/index.php/journal/article/view/369

Godwin-Jones, R. (2023). Presence and agency in real and virtual spaces: The promise of extended reality for language learning. *Language Learning & Technology, 27*(3), 6–26. https://hdl.handle.net/10125/73529

Haleem, A., Javaid, M., Qadri, M., & Suman, R. (2022). Understanding the role of digital technologies in education: A review. *Sustainable Operations and Computers, 3*, 275–285. https://doi.org/10.1016/j.susoc.2022.05.004

Hasan, M. (2022). What makes an effective teacher in the 21st century? *Educational Quest: An International Journal of Education and Applied Social Sciences, 13*(1), 29–32. https://doi.org/10.30954/2230-7311.1.2022.5

Hazaymeh, W. A., Bouzenoun, A., & Remache, A. (2024). Efl instructors' perspective on using ai applications in english as a foreign language teaching and learning. *Emerging Science Journal, 8*, 73–87. https://doi.org/10.28991/ESJ-2024-SIED1-05

Hui, J. I. (2019). A study of language learning paradigms from the perspective of emerging technologies. *Jianghan Academic, 38*(6), 111. https://qks.jhun.edu.cn/jhxs/CN/abstract/abstract2020.shtml

Khairon, I., Jasmi, K. A., Rahman, Z. A., Sazali, N. S. A. N., Latif, M. K., Kanafiah, M. Y. H. M., & Sazali, N. S. A. N. (2022). Mastering foreign language skills for effective teaching among excellent teachers of Islamic education in Malaysia. *International Journal of Academic Research in Business and Social Sciences, 12*(1), 1700–1708. http://dx.doi.org/10.6007/IJARBSS/v12-i1/12206

Kuh, G. D. (2003). What we're learning about student engagement from NSSE: Benchmarks for effective educational practices. *Change: The Magazine of Higher Learning, 35*(2), 24–32. https://doi.org/10.1080/00091380309604090

Lai, T., Lin, Y., Chou, C., & Yueh, H. (2021). Evaluation of an inquiry-based virtual lab for junior high school science classes. *Journal of Educational Computing Research, 59*(8), 1579–1600. https://doi.org/10.1177/07356331211001579

Landon-Hays, M., Peterson-Ahmad, M. B., & Frazier, A. D. (2020). Learning to teach: How a simulated learning environment can connect theory to practice in general and special education educator preparation programs. *Education Sciences, 10*(7), 184. https://doi.org/10.3390/educsci10070184

Lee, E. A.-L., & Wong, K. W. (2014). Learning with desktop virtual reality: Low spatial ability learners are more positively affected. *Computers & Education, 79*, 49–58. https://doi.org/10.1016/j.compedu.2014.07.010

Lee, G., Shi, L., Latif, E., & Gao, Y. (2023). Multimodality of AI for education: Towards artificial general intelligence. *arXiv*. https://doi.org/10.48550/arXiv.2312.06037

Lowell, V. L., & Tagare, D. (2023). Authentic learning and fidelity in virtual reality learning experiences for self-efficacy and transfer. *Computers & Education: X Reality, 2*, 100017. https://doi.org/10.1016/j.cexr.2023.100017

Lowell, V. L., & Yan, W. (2023). Facilitating foreign language conversation simulations in virtual reality for authentic learning. In T. Cherner & A. Fegely (Eds.), *Bridging the XR technology-to-practice gap: Methods and strategies for blending extended realities into classroom instruction* (pp. 119–133). Association for the Advancement of Computing in Education. https://www.learntechlib.org/p/222242/

Lowell, V. L., & Yan, W. (2024). Applying systems thinking for designing immersive virtual reality learning experiences in education. *TechTrends, 68*(1), 149–160. https://doi.org/10.1007/s11528-023-00922-1

Makransky, G., & Petersen, G. B. (2021). The Cognitive Affective Model of Immersive Learning (CAMIL): A theoretical research-based model of learning in immersive virtual reality. *Educational Psychology Review, 33,* 937–958. https://doi.org/10.1007/s10648-020-09586-2

Malicka, A., Gilabert Guerrero, R., & Norris, J. M. (2019). From needs analysis to task design: Insights from an English for specific purposes context. *Language Teaching Research, 23*(1), 78–106. https://doi.org/10.1177/1362168817714278

Mishra, P., Warr, M., & Islam, R. (2023). TPACK in the age of ChatGPT and generative AI. *Journal of Digital Learning in Teacher Education, 39*(4), 235–251. https://doi.org/10.1080/21532974.2023.2247480

Mollen, A., & Wilson, H. (2010). Engagement, telepresence and interactivity in online consumer experience: Reconciling scholastic and managerial perspectives. *Journal of Business Research, 63*(9–10), 919–925. https://doi.org/10.1016/j.jbusres.2009.05.014

Mystakidis, S., Fragkaki, M., & Filippousis, G. (2021). Ready teacher one: Virtual and augmented reality online professional development for K-12 school teachers. *Computers, 10*(10), 134. https://doi.org/10.3390/computers10100134

Ou, K., Liu, Y., & Tarng, W. (2021). Development of a virtual ecological environment for learning the Taipei tree frog. *Sustainability, 13*(11), 5911. https://doi.org/10.3390/su13115911

Pacheco, E., Lips, M., & Yoong, P. (2018). Transition 2.0: Digital technologies, higher education, and vision impairment. *The Internet and Higher Education, 37*, 1–10. https://doi.org/10.1016/j.iheduc.2017.11.001

Parsons, J., & Taylor, L. (2011). Improving student engagement. *Current Issues in Education, 14*(1). https://cie.asu.edu/ojs/index.php/cieatasu/article/view/745

Rodrigues, A. (2020). Digital technologies integration in teacher education: The active teacher training model. *Journal of E-Learning and Knowledge Society, 16*(3), 24–33. https://doi.org/10.20368/1971-8829/1135273

Rudolph, J., Tan, S., & Tan, S. (2023). ChatGPT: Bullshit spewer or the end of traditional assessments in higher education? *Journal of Applied Learning and Teaching, 6*(1). https://doi.org/10.37074/jalt.2023.6.1.9

Schmidt, T., & Strassner, T. (2022). Artificial intelligence in foreign language learning and teaching. *Anglistik, 33*(1), 165–184. https://doi.org/10.33675/ANGL/2022/1/14

Schutt, S., Miles-Keogh, R., & Linegar, D. (2022). Simulations in teacher education. In S. Schutt, R. Miles-Keogh, & D. Linegar, *Oxford Research Encyclopedia of Education*. Oxford University Press. https://doi.org/10.1093/acrefore/9780190264093.013.1829

Soylemez, N. (2023). Teacher and student in the 21st century: A mixed design research. *International Journal of Psychology and Educational Studies, 10*(3), 758–772. https://doi.org/10.52380/ijpes.2023.10.3.1128

Sweeney, J., Milewski, A., & Amidon, J. (2018). On-ramps to professional practice: Selecting and implementing digital technologies for virtual field experiences. *Contemporary Issues in Technology and Teacher Education, 18*(4), 670–691. https://citejournal.org/volume-18/issue-4-18/general/on-ramps-to-professional-practice-selecting-and-implementing-digital-technologies-for-virtual-field-experiences/

Thangavel, S. (2025). Revolutionizing education through augmented reality (AR) and virtual reality (VR): Innovations, challenges, and future prospects. *Asian Journal of Interdisciplinary Research, 8*(1), 1–28. https://doi.org/10.54392/ajir2511

Tlili, A., Shehata, B., Adarkwah, M. A., Bozkurt, A., Hickey, D. T., Huang, R., & Agyemang, B. (2023). What if the devil is my guardian angel: ChatGPT as a case study of using chatbots in education. *Smart Learning Environments, 10*(1), 15. https://doi.org/10.1186/s40561-023-00237-x

Turgut, Y. E., & Aslan, A. (2021). Factors affecting ICT integration in Turkish education: A systematic review. *Education and Information Technologies, 26*(4), 4069–4092. https://doi.org/10.1007/s10639-021-10441-2

Tzima, S., Styliaras, G., & Bassounas, A. (2019). Augmented reality applications in education: Teachers' point of view. *Education Sciences, 9*(2), 99. https://doi.org/10.3390/educsci9020099

Yilmaz, O., & Hebebci, M. (2022). The use of virtual environments and simulation in teacher training. *International Journal on Social and Education Sciences, 4*(3), 446–457. https://doi.org/10.46328/ijonses.376

Zhou, C., & Hou, F. (2025). How do EFL teachers utilize AI tools in their language teaching? *Theory and Practice in Language Studies, 15*(2). https://doi.org/10.17507/tpls.1502.10

CRediT Author Statement

Acknowledgements: We thank the Yuri Kondratyuk National University, Poltava Polytechnic University (Ukraine).
Funding: None.
Conflicts of interest: None.
Ethical approval: No ethical approval required.
Availability of data and materials: The data and materials used in the work are available at corresponding author's request.
Authors' contributions: Lada Petryk: Conceptualization, Methodology, Supervision, Writing – Original Draft. Yuliya Tretyak: Data Curation, Investigation, Validation, Writing – Review & Editing. Natalia Kosharna: Software, Visualization, Formal Analysis, Resources. Xu Pei: Project Administration, Writing – Review & Editing. Hanna Hlushchenko: Methodology, Data Curation, Writing – Review & Editing.

Processing and editing: Editora Ibero-Americana de Educação
Proofreading, formatting, standardization and translation