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ORIGINAL

# Teaching German within digital paradigm of education: AI-based approaches and tools

## La enseñanza del alemán en el paradigma digital de la educación: Enfoques y herramientas basados en IA

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## ABSTRACT

In view of the increased popularity of AI tools in teaching foreign languages, particularly German, and the corresponding concerns that arose, this article explored the futuristic prospects of learning German with AI. It examined how these technologies had revolutionized the learning process and what learners could expect in the future. The study's methodology was based on a systemic paradigm and involved the use of content analysis and elements of case studies, relying on a wide array of literature sources extracted from general and specialized scientometric databases. The findings showed that AI in language teaching represented a powerful approach to engaging students and enhancing learning outcomes. The most innovative methods, such as the integration of massively multiplayer online role-playing games (MMORPGs) into educational processes, yielded the most effective results. The study attempted to outline the correlation between various AI-based teaching approaches and existing educational theories that characterized the contemporary educational landscape. Furthermore, it proposed an appropriate schematic model that could serve as a foundation for further research in the field, including studies with an interdisciplinary focus.

**Keywords:** German Language; Intercultural Communication; Higher Education; Digitalization; Ukrainian Education; AI-Based Teaching.

## RESUMEN

En vista de la creciente popularidad de las herramientas de IA en la enseñanza de lenguas extranjeras, en particular del alemán, y de las correspondientes preocupaciones que suscitan, este artículo explora las perspectivas futuristas del aprendizaje del alemán con IA. Se examinaba cómo estas tecnologías habían revolucionado el proceso de aprendizaje y qué podían esperar los alumnos en el futuro. La metodología del estudio se basó en un paradigma sistémico e implicó el uso de análisis de contenido y elementos de estudios de caso, apoyándose en una amplia gama de fuentes bibliográficas extraídas de bases de datos cienciométricas generales y especializadas. Los resultados mostraron que la IA en la enseñanza de idiomas representaba un poderoso enfoque para atraer a los estudiantes y mejorar los resultados del aprendizaje. Los métodos más innovadores, como la integración de juegos de rol multijugador masivos en línea (MMORPG) en los procesos educativos, dieron los resultados más eficaces. El estudio intentaba esbozar la correlación

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entre diversos enfoques pedagógicos basados en la IA y las teorías educativas existentes que caracterizaban el panorama educativo contemporáneo. Además, propuso un modelo esquemático adecuado que podría servir de base para futuras investigaciones en este campo, incluidos estudios con un enfoque interdisciplinar.

**Palabras clave:** Lengua Alemana; Comunicación Intercultural; Educación Superior; Digitalización; Educación Ucraniana; Enseñanza Basada en IA.

## INTRODUCTION

German is the most widely spoken language in Europe and the eighth most widely spoken language globally. There is no doubt that the study of German is becoming more popular all around the world. German is the tenth most frequently spoken language in the world by the number of native speakers. However, it ranks fourth globally in terms of economic effect, which is determined by the gross national product (GNP) produced by German speakers, behind only English, Chinese, and Spanish.[1]

German language study has grown significantly in emerging countries, particularly Brazil, China, and India, during the last five years, according to studies done in the second decade of the twenty-first century.[2] Another major element contributing to the growing popularity of studying German is the increased role of Germany as a guarantee of European security in the context of the conflict in Ukraine, the new multipolar world, and the emergence of new, unprecedented dangers.

Additionally, as more and more German businesses are at the forefront of research and development, sustainable practices, and renewable energy, speaking German enables professionals and students to participate in some of the most innovative initiatives and partnerships.

Teaching German is also becoming important for countries in the process of European integration, in particular, Ukraine. Ukrainian researchers Yankovets and Yankovets[4] highlight the special importance of English and German as tools of international, intercultural communication. Researchers emphasize that the effectiveness of learning German depends on the effectiveness of the leading teaching methodology, an adequate assessment of the target audience (German language students) and its needs for learning German, a positive psychological mood of subjects and objects of study, and students' motivation to learn foreign languages.

Meanwhile, language learning methods are changing along with technology, which is developing at a never-before-seen pace. German has always been a difficult language to learn because of its complicated grammar and lengthy history. However, the field is changing as a result of artificial intelligence's incorporation into language acquisition, becoming more approachable, effective, and interesting.

At the same time, as the Ukrainian researcher Osarchuk[5] rightly notes, the teacher's task is to develop interest in learning the German language, increase students' motivation for self-development and self-education, and encourage students to apply existing knowledge of Ukrainian and English when learning German as a holistic system. The scientist claims that teachers use many technological tools to improve students' language skills.

These include language learning applications, online learning platforms, virtual classrooms, and language learning games. Teachers use technology in different ways, while some of them prefer traditional methods. However, one of the manifestations of the expediency of using AI, according to Osarchuk,[5] is the efficient use of resources and rapid processing of information, which will allow other interactive forms to be used with less time, without affecting efficiency.

The researcher writes that AI-based programs provide faster learning, because such programs enable instant individual feedback and correct information, and the 'bonus' is the acceleration of the learning process. This approach to understanding the role of AI in the learning process, including when teaching German, is, unfortunately, typical for most educational institutions in Ukraine: AI is seen as a purely technological improvement, without reference to the essential, paradigmatic side of education.

The capacity to offer individualized learning experiences is actually one of the biggest benefits of integrating AI into language learning. Conventional classroom environments frequently find it difficult to meet each student's unique demands. AI-powered systems, on the other hand, are able to analyze a learner's preferences, shortcomings, and skills in order to customize courses. For example, the AI system may shift the focus to spend more time on verb conjugation exercises while still reinforcing vocabulary knowledge if a learner suffers with German verb conjugation but succeeds in vocabulary.

Research shows that these tailored strategies are more engaging as well as more successful.[6,7] When students perceive success in areas they find difficult, they are more likely to remain motivated. AI systems are also capable of real-time adaptation, giving prompt feedback and modifying the degree of difficulty in response to the learner's performance. Creation of an ideal environment for learning is possible namely due to this dynamic method, which guarantees that students are continuously encouraged without being overwhelmed.[8]

Naturally, AI-based tools integration in the practice of teaching German implies both opportunities and

challenges. In view of this, the current study aims to develop systematized outlining of these opportunities and challenges, best practices and pitfalls, and identify the vectors of prospective development within this field.

## METHOD

The type of research is qualitative. The study was carried out in frames of systemic paradigm. The methodological basis of the study is made of the provisions of the system approach, the communicative-cognitive approach, the personal-activity approach. The theoretical basis of the study included the works on the application of modern information technologies based on AI in teaching a foreign language, as well as the theoretical justification for the feasibility of using AI tools and their expected results in the context of learning theories.

The study employed method of content analysis and the elements of case study method. The selection of literary sources for analysis was carried out, using keywords "innovations in teaching German", "digital tools in teaching German", "AI in teaching foreign languages", "AI in teaching German", "intercultural aspects in teaching German", in scientometric databases Google Scholar, ScienceDirect, JSTOR, and specialized databases IEEE Xplore (literature in engineering and technology, including AI), as well as ERIC and EBSCO (education research). Experts' opinions and articles in LinkedIn professional network were also included in consideration. The final size of sample included 43 items.

## RESULTS AND DISCUSSION

One of the many areas of education where AI is characterised by a sound influence is language instruction. Students of all grade levels, both in schools and universities, are benefiting from more immersive and captivating learning experiences, personalized learning, and prompt feedback, which are provided thanks to AI-powered tools and technology. AI is seen as having the ability to make education more equitable, effective, and pleasurable for every student.

According to experts, artificial intelligence enabled creation of immersive and interactive learning resources that improve the effectiveness and engagement of learning German.[9] With the help of AI-powered virtual reality and augmented reality technology, immersion of students in German-speaking contexts appears possible.

By simulating real-life scenarios (for example, such as placing an order at a German restaurant or navigating a Berlin train station), these technologies can provide students real-world experience.[10] Also, learners may practice speaking and listening in a relaxed setting by interacting with AI-driven chatbots and language assistants – in particular, Google Assistant or Alexa from Amazon. It is possible to practice pronunciation, intonation, and conversational flow by using these tools, which can rather precisely imitate discussions with native speakers. Moreover, the AI may enable immediate feedback, fixing errors and making recommendations for enhancements.[11]

The country-specific experience of creating AI-based learning resources for teaching German as a foreign language is described in the publication of Julaikah et al.[12] The authors demonstrated, using a comprehensive literature review, that (1) Gemini can assist in creating resources for German teachers, such as lesson plans and student activities, and (2) Quizlet can offer a wide range of learning resources for German classes. Based on the results of G-form's observations of German language instructors in several Javan towns, the authors found that while most teachers utilize Chat GPT, Canva, Kahoot, Grammarly, and Microsoft Sway often, they seldom ever use AI tools like Quizlet and Gemini.

Accordingly, Julaikah et al.[12] assert that while it is crucial for instructors to use AI responsibly, improving teachers' AI proficiency is absolutely necessary to enable the successful integration of AI in German language instruction. It is important, in particular, because AI-Quizlet can let students collaborate, exchange knowledge, and learn from one another. Students thus have more fun and are more motivated during classes. Moreover, Quizlet may assist teachers accommodate different learning preferences and provide evaluations such as multiple choice, true/false, and matching, as well as collaborative learning by allowing users to exchange study sets with one another and encouraging peer-to-peer learning.

Vo and Nguyen[13] researched employing Grammarly as a proofreader and observed the corresponding impact on students' writing skills. The researchers applied the Grammarly tool in their experimental study in English writing classes at a college of economic and social relations.

The sample of study's participants consisted of two writing classes. The experimental group was compiled of 17 students, whereas the control group included 20. Both classes studied the same material, including cause and effect essays, narrative, comparison and contrast, and descriptive essays. After three months, students in both classes were expected to write a concise essay on the allotted topic in 45 minutes. Students in the experimental group were urged to double-check their manuscripts before submission using Grammarly's free version, but the control group's submissions were not verified with any tools.

According to the data, students who used Grammarly in class performed better than those who didn't. This improvement can be credited to Grammarly's self-correction technology. Grammarly's feedback, which appears immediately after students submit their work, is more thorough for students who are still aware of their aims and ideas than the professors' corrected comments, which arrived a week after submission. Grammarly's awareness

and replacement alternatives allow students to rapidly notice the faults they make on a frequent basis, and they will be mindful not to make the same mistakes in their future work. Even though the study was conducted for English, its findings suggest that AI-based tools like Grammarly could be very effective in the German language context.

Examples of these tools include LanguageTool, which supports over 25 languages, Duden-Mentor, which is exclusively focused on German, Rechtschreibpruefung24, which is a service for spell and grammar check and readability analysis, and GermanCorrector, which highlights spelling and grammar errors and provides suggestions for improvement.

According to other research,[14,15] language learning applications have completely changed how students study German. They provide a whole range advantages that make the process more engaging, customized, and accessible. Interactive elements like games, exercises, and quizzes are among the main benefits of language learning applications, since they keep students interested and make learning more engaging.

Furthermore, AI-based applications offer individualized (customized) learning experiences according to each student's requirements, enabling a more specific, unique for everybody, method of language acquisition. Moreover, apps for language learning that use gamification strategies inspire users and make learning enjoyable, at the same time providing students with iterative-nature repetition of grammatical rules and vocabulary, which strengthens their grasp of the German language. Apps with progress monitoring capabilities make it simpler to keep an eye on students' performance and offer tailored assistance as necessary.

One of the well-known language learning applications that stands out for its immersive method of teaching German through context and visual cues is Rosetta Stone. It has been demonstrated that this approach, called Dynamic Immersion, helps students become more fluent speakers and get a more intuitive grasp of the language.

To help with natural language acquisition, Rosetta Stone uses a patented technology called Dynamic Immersion®. Users participate in interactive programs that teach grammar and vocabulary without the need for translation by combining text, voice, and visuals. This immersive method facilitates direct thinking in the target language. Users finish tasks and quizzes to reinforce teachings as they go.

Speaking abilities are further improved by speech recognition technology, which offers pronunciation feedback.[16] Talkpal, another AI application, transforms language learning by combining state-of-the-art GPT-powered AI. It provides real-time, individualized feedback on pronunciation, writing, speaking, and listening abilities. The easy-to-use website matches students with nearby instructors and personalized lesson plans that adjust to each student's requirements and development. Talkpal uses AI to mimic real-life discussion situations, emphasizing conversational practice.[17]

Based on an analysis of the literature on the use of AI in language learning and teaching, Cantos et al.[18] draw the conclusion that, because of its many benefits, AI is a valuable tool for both instructors and students. According to the authors, artificial intelligence is a science that is perpetually evolving and creating new resources for language instruction. As AI advances, it is expected to have a big impact on language acquisition in the future.

The remarkable and shocking developments in the use of artificial intelligence in creative activities and its possible influence on foreign language acquisition are highlighted in a research by Basaran[19] on learning German as a foreign language and learning foreign languages in general. According to Basaran,[19] one of the most significant issues is that members of Generation Alpha were born when Generation Z and the new era were transitioning.

Soon, this new generation will occupy schools and colleges, requiring special teaching-learning strategies tailored to their individual needs and skill sets. These students need to be able to actively influence change in both analogue and virtual spaces, as well as cope with it in a creative and productive manner, in order to succeed in the modern workplace.

It is obvious that the skills that are taught in the current educational systems will not be sufficient for the demands of the future. In order to inspire and teach the next generation, the educational system has to be rebuilt to be accountable for what really counts. This means coming up with creative ways to educate, learn, and evaluate. According to Basaran,[19] it is important to remember that AI systems for teaching and learning foreign languages are still in the early stages of research.

This process of development often takes place in the English language domain. It appears that there is a distinct area of research about when to purchase advanced artificial intelligence products for different languages, including German. All languages have intercultural factors as well as pragmatic, semantic, and stylistic variables that change concurrently. Thus, languages are not constrained by foreseeable elements and models. Multiple-choice examinations and vocabulary trainers are examples of very archaic "true/false" assessments that are obviously unrelated to artificial intelligence. Developments are still in their infancy and are continuing.

In the context of studying German as a foreign language in India, Kumari[20] examines how AI models affect students' writing proficiency and motivation. The influence of ChatGPT on students' writing proficiency and motivation in the context of studying German as a foreign language in India is examined in this research through a case study. According to the case study's findings, "Limited Experience" and "Personal Writing Style" are the two elements that make academic writing in a foreign language the most difficult.

The results underline the significance of the writing context and validate the frequency of cross-cultural rhetorical patterns. The significance of manual human agencies in teaching and learning academic writing in foreign languages is also examined in this work. It was discovered that ChatGPT and other generative AI systems may create and spread misleading information in addition to maintaining biases. The field of academic writing in German is at risk from both of these scenarios, which also seriously hurt students who rely solely on ChatGPT. Language learning now has a new platform thanks to the rapid advancement of communication technology.

As much as AI has the potential to revolutionize both individual and classroom foreign language learning, Kumari[20] highlights that linguistic specialists are necessary at all stages of learning in order to continuously examine the quality and authenticity of the learning process. In the domains where AI is or will impact academic learning, more thorough study is needed.

Moreover, preconceived notions, biases, and prejudices can be reinforced and amplified by language models such as ChatGPT. The use of these models carries this danger. For example, if the training data used to train ChatGPT had negative biases about specific groups, ChatGPT may respond in a biased and discriminatory manner when deployed in educational settings.[21] These preexisting prejudices can cause issues for humanities research, particularly in foreign language literature classes where students must evaluate literary works and/or their characters in the context of the historical period or eras they are studying.

Winzer[22] focuses on immersive AI-driven language learning, specifically gamifying interactions to make languages more animated. The author talks about how developments in AI output might lead to more generative, multi-modal, highly personalized, and gamified language learning experiences. Examples from the industry that are leading this approach are also included. She asserts that the structure of the information, the language being taught, and the learner level are all varied across various gamified applications.

However, teaching content by mixing visuals, reading, writing, and listening (to native pronunciations) with vocabulary and grammatical tasks is a pretty popular and successful subject. With a more accurate representation of the language, this multimodal method is ultimately more successful for instruction and enables students with a wide range of learning styles to interact with the content in the right way. This method is used to teach grammar and vocabulary.

Despite relatively wide array of publications devoted to the use of AI tools and platforms in teaching German as a foreign language and availability of case studies and practices description, one should state that theoretical pedagogical base is actually lacking in authors' arguments, which necessitates filling in this gap.

The discussion of improving methods and procedures for teaching and learning German is even more pertinent now that foreign enrolment in German universities has reached a record high: 367,578 international students were admitted to Germany in the winter semester of 2022–2023 a 5 % increase over the total in 2021-2022 (figure 1).[3]

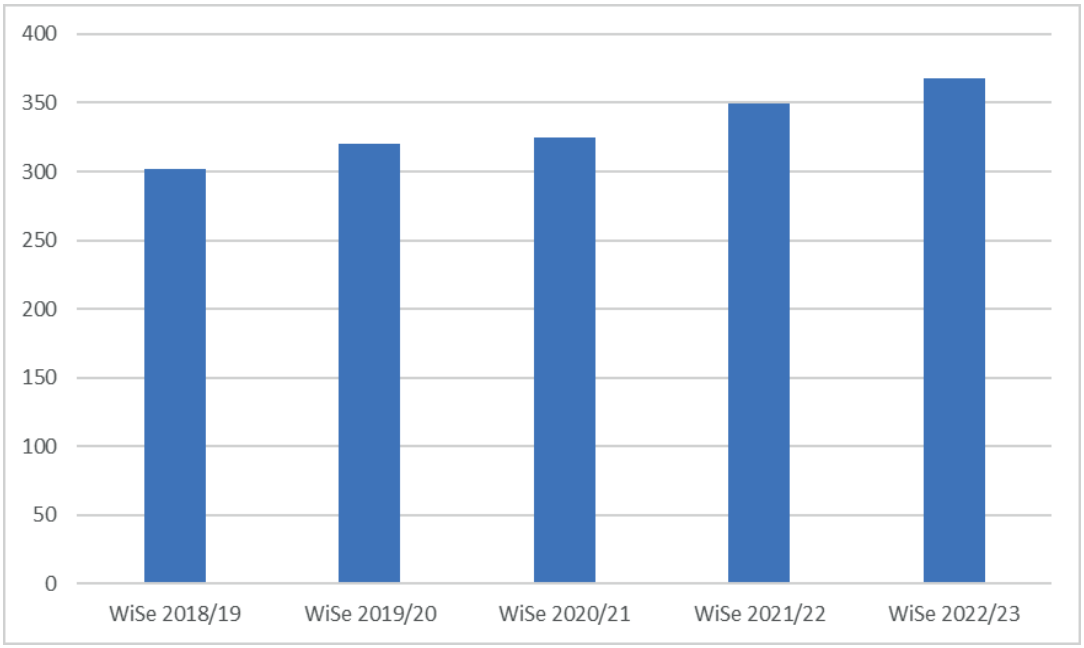


**Figure 1.** International student enrolment growth in German higher education 2018/19 to 2022/23, winter semesters
**Source:** ICEF Monitor[3]

The variety and breadth of new tools is one of the challenges associated with the use of AIEd. ChatGPT has gained popularity among educators as a cutting-edge AI tool. A remarkable amount of research publications discussing the potential and risks that this technology poses have been produced on a variety of ChatGPT

application topics. Other AI tools, however, should not be disregarded as they may also aid in the learning process.

Alhusaiyan[23] looked at the developments and patterns in language learning assisted by AI throughout the previous ten years. The study sought to close the knowledge gap about the advantages and disadvantages of AI-assisted language learning for both first- and second-language learners by examining 15 empirical research studies.

According to the study, AI-supported technology has the potential to improve language acquisition, especially in areas like learner engagement, scoring accuracy, and writing quality. There are still issues with dialogic competency and the need for teacher intervention in educational design, though. Improvements are required to promote language use for communication and collaborative creation, even if AI-supported systems can successfully facilitate language acquisition.

Immersion technology improves immersion and involvement in language acquisition, according to growing research. It also lessens anxiety. Improved communication and vocabulary are among the advantages. However, one must take into account both technological difficulties and physical pain.[24,25] Tools such as Second Life and VRChat are utilized for gamified language learning.

Additionally helpful are Google Arts and Culture and Google Street View. The use of immersive simulators in language learning is growing in popularity. To practice speaking without fear, they develop virtual worlds. Leading the way in AI-powered language learning is Hyperspace. They provide virtual role-playing, real-time feedback, and customized learning pathways.[26] These characteristics facilitate and enjoy learning a new language. Hyperspace's systems are revolutionizing language learning using AI. They provide fresh chances for both career and personal development.

Cognitive science is used in simulated language learning to enhance language acquisition and retention. It produces engrossing experiences that stimulate a variety of brain regions. Better memory and simpler recall result from this. Learners engage with the language naturally when they are completely immersed. This helps the brain connect new vocabulary and grammar to situations in everyday life. According to studies, language acquired in virtual reality is twice as accurate and retained as that learnt in a regular classroom since it is stored differently in the brain. Multiple senses are stimulated by immersive experiences, which fortify the brain networks linked to language processing.[27]

As correctly noted by Vogt and Flindt,[28] foreign language learners utilize a variety of AI tools in their leisure time (such as spell checkers and automatic text correction on mobile devices) and presumably also use them for language learning outside of the classroom. Although such reflection might be incorporated into the foreign language classroom in a way that supports learning for a range of foreign language competencies, in this instance, the applications are not specifically considered.

Students may, for instance, utilize an automated writing tool to compose a social media post in class, and then have a plenary discussion on whether or not the tool was successful in conveying the intent of the intended speaker. Their linguistic awareness and pragmatic skill would both be improved by this process. There may be a disparity between students who use AI applications in their (informal) foreign language learning process and those who receive little to no attention in foreign language classrooms if AI-based applications are totally disregarded in EFL classes. The Bring-Your-Own-Device (BYOD) strategy is the best way to handle this issue.

Liu's[29] study attempted to determine how synchronized computer-mediated communication (SCMC) may improve learning outcomes and lessen foreign language anxiety (FLA) in face-to-face (FTF) classrooms. Fifty Chinese college students took part in a learning exercise in three different settings: a hybrid SCMC (BYOD), a regular FTF classroom (the blank sample), and a pure SCMC.

For SCMC applications, open internet, smartphones, PCs, and the bring-your-own-device (BYOD) idea were implemented. After finishing the learning exercise, the students filled out questions from the Foreign Language Classroom Anxiety Scale. In order to evaluate their interaction, anxiety, internet distraction, and classroom environment in the three modes, the students were also requested to fill out perceptual questionnaires. The findings demonstrated that while pure SCMC did not significantly increase interaction, the hybrid SCMC (BYOD) brought better results than the standard FTF classroom mode (the blank sample).

The advantages and opportunities that low-cost, portable devices can offer, as well as the widespread communication, hyper-connectivity, and information access that this "age of mobilizm" can bring about, are making BYOD more and more popular despite the possible drawbacks and dangers.[30,31] Campo[32] suggested the following tactics to support students' selection of tools and apps to utilize in a device-neutral assignment environment:

- Permit product selection. Through a presentation, essay, screencast, website, or video, students demonstrate what they have learned.
- Create the success criteria together. Let students help create grading standards and how goods can match curricular objectives if the items will be different.
- Make use of general descriptions. Use "presentation" rather than "PowerPoint". Use "text-based"

or "word-processing" in place of "Word".

- Make cross-platform service recommendations. Numerous services and apps are compatible with all smartphones.
- Purposely organize students into groups. An activity may necessitate the use of a camera as well as a computer/laptop; pair one student with a smartphone and another with a laptop. In contrast, group students with comparable equipment.

Burston[33] refers to this strategy as "Mobile-Assisted Language Learning" (MALL), which is enabled by the use of students' personal mobile devices. The widespread ownership of smartphones and tablet computers among teens and adults has made the BYOD strategy a viable alternative to desktop computer laboratories.

Interestingly, studies on the impact of BYOD adoption in the workplace reveal that employees are typically more comfortable and effective when using gadgets they are acquainted with, which leads to increased productivity. Personal gadgets are often tailored to user preferences, providing faster access to the programs and tools they use the most.

According to polls, employee productivity climbed by a staggering 68 % at firms that introduced BYOD programs. The average worker who uses their own device for work under a BYOD policy works two more hours per day.[34] These findings definitely should not be overlooked when designing BYOD models for language classes.

Moreover, the combination of gamification with AI in education provides a highly potent strategy to engaging students and improving learning results.[35] One should mention that, despite the fact that digital game-based language learning (DGBLL) represents a relatively new method, interest in it has grown significantly in recent years.

Despite evident interest in DGBLL, its studying within the discourse of teaching German as a Foreign Language (FL) is characterized with limited nature. Alyaz et al.[36] discuss a research initiative begun in 2014 at a large public institution in Turkey to investigate the potential and limits of DGBLL. The study focuses on serious games for foreign language teaching and learning. In addition to promoting learners' language abilities, the initiative aims to contribute to the development of professional credentials for future FL instructors. Two serious games for German were chosen and utilized with typical dictation, transcription, and reading comprehension exercises.

The findings of gaming activity with 11-week duration revealed substantial variations between pre- and post-tests in vocabulary. Additionally, age was discovered to be a key factor influencing participants' opinions about serious games. The findings show that participants viewed gaming activities beneficial to the development of language abilities.

Furthermore, massively multiplayer online role-playing games (MMORPGs) have become increasingly popular in language education, and computer-assisted language learning (CALL) research has recognized them as having an important role in second language acquisition (SLA).[37]

Bamrungsuntorn and Attaviriyanupap's[38] study sought to create and implement an RPG (role-playing game) to educate culture in the subject of German as a Foreign Language in higher education. The study focused on the history of the Berlin Wall. The produced RPG was tested, and its teaching effectiveness was assessed based on a pre- and post-test, as well as a questionnaire.

Data on the game's appropriateness and learners' perspectives on this instructional material were gathered and examined. The study of the data collected from the 40 students who participated in the game testing revealed that the students' average scores rose considerably between pre-test and post-test. The game's content provided kids with a better grasp of the historical significance of the Berlin Wall.

The majority of students expressed satisfaction with the use of the role-playing game as instructional material. Additionally, the game made it easier for them to comprehend the material, which lessened their learning burden. AI integration in MMORPGs has recently produced amazing outcomes. Adaptive bosses who evaluate player methods, remember previous bouts, and modify tactics to guarantee that no two fights ever feel the same take the role of scripted, predictable confrontations in this new gaming paradigm. Thus, teaching German may be greatly improved by using AI-based MMORPGs.

Despite the fact that the use of AI in teaching German is becoming more and more popular, its distinctive feature is its 'common sense' approach, which is not based on learning theories.[39,40] However, there have previously been some initiatives in this area. Specifically, Gibson et al.[41] talk about a three-level model that models how artificial intelligence may support learning processes by combining and synthesizing current learning theories.

The model incorporates a causal learning mechanism that describes how learning takes place and functions at the micro, meso, and macro levels. It is based on developmental psychology, computational biology, instructional design, cognitive science, complexity, and sociocultural theory. The model also describes how knowledge acquired via education is dispersed, or released and utilized both within and across levels, and aggregated, or gathered together.

According to the model's characteristics, 14 roles for AI in education are suggested: six at the macro level of cultural historical activity, four at the meso level of teams and knowledge communities, and four at the individual or micro level. Included are assessment standards, a discussion of limits, and implications for research and practice. Equipped with the suggested model, AI developers may concentrate their efforts on collaborating with academics, practitioners, and learning designers to utilize the suggested roles to enhance knowledge communities, team performance, and individual learning.

In our opinion, some higher-order educational scope theories represent a basis of AI integration into teaching-learning process. These theories are summarized in table 1.

**Table 1.** Educational theories, representing a basis of AI integration into teaching-learning process

| Theories | The essence |
|---|---|
| Constructivist and Sociocultural Learning Theories | Understanding how students actively create knowledge via their own cognitive processes and social interactions is made possible by constructivist ideas, especially Piaget's writings. The importance of social and cultural elements in the learning process is emphasized by the sociocultural approach. Since AI may promote active, collaborative, and context-dependent learning experiences, these theories advocate for integrating AI into education. By providing collaborative learning platforms and intelligent tutoring systems (ITS) that encourage social engagement and active learning, AI may bolster these notions. AI-powered chatbots, for instance, can simulate social interactions in online learning settings by involving students in discussions that promote critical thinking and problem-solving. |
| Theory of Situated Learning | According to this theory, learning can be most successful when it takes place in real-world settings and entails active engagement with a community of practice. By relating students to real-world issues, resources, and communities, artificial intelligence may facilitate situated learning and promote the acquisition of pertinent information and skills. By creating realistic, immersive, and contextually rich learning environments, AI can improve situated learning experiences. For instance, learners may practice skills and solve challenges in a community of practice by immersing themselves in real-world circumstances using AI-powered simulations and VR environments. |
| Theory of Cognitive Load | According to the idea, learning strategies should maximize relevant load associated with the learning task while minimizing unnecessary cognitive load since students have a limited working memory capacity. By adjusting material and educational process speed to a particular learner's cognitive demands and capability, AI tool may improve teaching strategies and resources, increasing learning effectiveness and results. |
| Analytics for Learning and Data Mining for Education | To enable data-driven decision-making and enhance learning processes, it entails gathering, analyzing, and interpreting data produced by students and learning environments. Large volumes of educational data may be processed and analyzed using AI techniques like machine learning and natural language processing, which can give instructors and students insightful feedback. |
| Self-controlled Education and Metacognition | Metacognition is the awareness and control of one's cognitive processes. By offering personalized feedback, scaffolding, and opportunities for introspection, artificial intelligence (AI) can support self-regulated learning and metacognition, enabling students to refine their skills in planning, monitoring, and evaluating their own learning. |
| Connectivism | Knowledge is found in dispersed networks of people and technology, according to a learning theory that highlights the value of connections and networks in the digital era. By linking students to pertinent resources, classmates, and communities, artificial intelligence may support the creation and upkeep of learning networks, encouraging cooperation, knowledge exchange, and lifelong learning. |
| Experiential Learning (Doing to Understand) | Through try, error, and reflection, David Kolb's experiential learning theory promotes learning by doing. This is enhanced by AI through gamification and simulations. |

**Source:** developed by the author based on Matthews,[42] Walters,[43] Shurry et al.[44]

A future where education is more flexible, inclusive, and motivating is promised by the way AI develops and interacts with learning theories. But the secret is striking a balance by empowering instructors and students equally by utilizing AI as a tool rather than a crutch. LinkedIn[45] asserts that there need to be "dance between theory and technology".

We created a pyramid scheme (figure 2) in an effort to organize the best practices of using AI to teach German

and to match them with educational theories. This scheme illustrates the potential for a gradual integration of AI into the teaching process, which can be used in Ukrainian education as well as in the educational systems of other developing nations. Every step of the pyramid implies the development of high-level (aggregative) abilities, which encompass both soft and hard (mostly language) talents.

The conventional function of educators must be reevaluated in light of the incorporation of AI in education. Teachers are becoming facilitators of individualized and data-driven learning experiences rather than merely information distributors because to the development of AI-driven technologies like Intelligent Tutoring Systems (ITS) and adaptive learning platforms.

Teachers need to adjust to a more dynamic classroom setting where AI helps with evaluation, material delivery, and individualized support. Teachers must become technology orchestrators to successfully incorporate AI into the classroom and assist students in navigating AI-enhanced learning environments.

This move underlines the need of professional development courses that teach teachers how to utilize AI technology effectively, fostering a collaborative relationship between AI systems and human educators to enhance learning outcomes. To enable a seamless transition to AI-enhanced learning environments, educators may fully leverage AI to improve teaching techniques and learning outcomes while prioritizing professional growth.

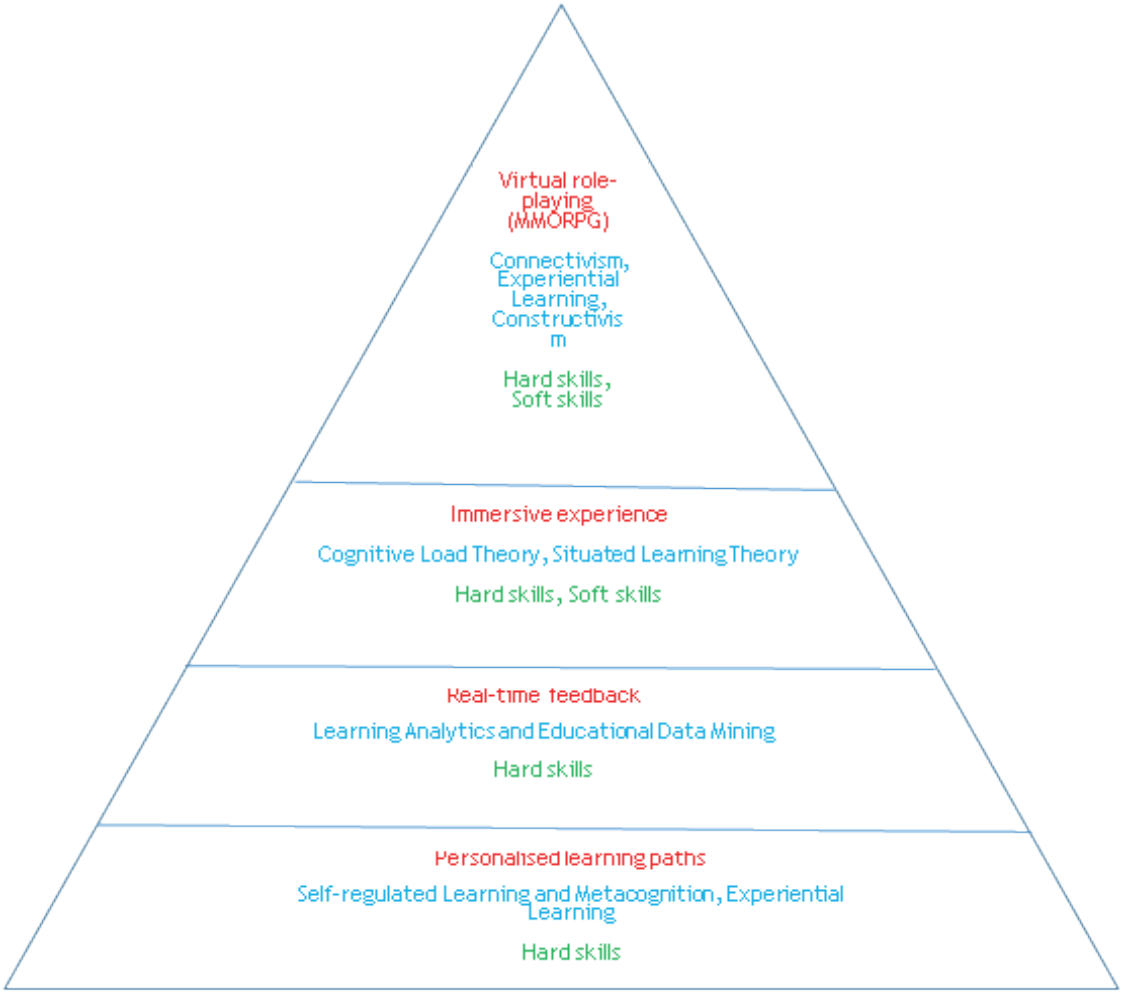


**Figure 2.** Alignment of AI integration approaches, learning theories, and implied developed skills

## CONCLUSION

The conducted research allowed developing systematized outlining of the opportunities and challenges existing within the application of AI-based digital tools in teaching German.In overall, it is demonstrated that the integration of artificial intelligence into educational environments marks a significant paradigm shift in the landscape of teaching and learning language, including German. Innovative solutions that accommodate a range of learning preferences and styles have been made possible by the convergence of machine learning, natural language processing, and adaptive algorithms.

The potential of AI to transform conventional teaching strategies and improve student results is becoming more apparent as AI solutions develop. Meanwhile, new AI-powered technologies and conventional ('traditional')

teaching approaches are interacting dynamically in the educational environment.

At the same time, there is the need for careful consideration of issues including the influence on teaching duties, the ethical use of student data, and the fair allocation of AI resources. In those educational environments where AI has not yet become integrated into educational process as whole, at a systemic level, in particular, in Ukrainian education, this is especially important.

As a whole, grounded in constructivist principles, the paper explores how AI can serve as a facilitator of active learning, supporting personalised and student-centered approaches within the ecosystem of teaching German in Ukrainian education (as well as in other similar educational systems).

By integrating theoretical perspectives, best practices, and concerns, this paper aims to offer a holistic understanding of the implications of AI in teaching German, providing a model of gradual progressive introduction of AI-based tools and appropriate pedagogical approaches into teaching process. At the same time, it is expedient to direct vectors of further research on the designing of models which would rely on interdisciplinary approach in the application of AI solutions within curricula, uniting learning language and other disciplines within the single digitalized ecosystem.

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## CONFLICT OF INTEREST

None

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