

PERSONALIZATION OF THE EDUCATIONAL MODEL FOR DEVELOPING LINGUISTIC AND CLINICAL-COMMUNICATIVE COMPETENCE IN INTERNATIONAL MEDICAL STUDENTS THROUGH ARTIFICIAL INTELLIGENCE

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Abstract Linguistic and clinical-communicative competences are essential for the professional success of future medical practitioners, yet traditional teaching methods often fail to meet individual learning needs. Artificial Intelligence (AI) offers transformative potential in foreign-language education by personalizing instruction, adapting content, and enhancing communicative skills in clinical contexts. This study investigates the integration of AI in medical language education, focusing on mechanisms, tools, and outcomes that support the development of both language mastery and practical communication abilities. The research employs theoretical analysis, pedagogical observation, and experimental implementation of AI platforms to create a personalized educational model that addresses students' specific language and communicative requirements. Ultimately, the study aims to evaluate the effectiveness of AI-driven approaches in fostering essential competencies for foreign medical students.

Keywords: Linguistic competence; clinical-communicative competence; medical education; artificial intelligence; personalized learning; foreign language acquisition.

1. INTRODUCTION

Linguistic competence (mastery of grammar, vocabulary, and syntax) and clinical-communicative competence (the ability to communicate effectively and appropriately in a given context; the communicative skills required in medical practice – such as history taking and interaction with patients, which are critical for medical students) are fundamental prerequisites for the personal and professional success of future medical professionals. Traditional teaching methods, which often rely on general textbooks and group-based instruction, fail to adequately address the individual learning pace and the specific needs of each learner.

In the context of language instruction, clinical-communicative competence refers to students' ability to use the language effectively in various communicative situations, which includes both comprehension (listening and reading) and language production (speaking and writing). Contemporary technologies, particularly artificial intelligence (AI) systems, open up new opportunities for enhancing teaching methodologies in foreign-language education.

Relevance of the study. Before accepting the fact that artificial intelligence (AI) will become an integral part of the future and, consequently, of the educational process, it is essential to address the social and ethical implications of implementing such technologies. The principal challenge of the twenty-first century is arguably the digital transformation of society, which makes an interdisciplinary approach to the study and development of AI a matter of pressing relevance. Future students must possess skills that extend beyond the boundaries of a single discipline [1]. Consequently, AI demands a range of competencies that are not currently encompassed by existing educational curricula [2, 4]. The widespread adoption of AI necessitates a reconsideration of the ways in which AI is applied in education, as well as a revision of curricula, in order to address the fundamental question: what are we doing, and where are we heading? [3]

The object of the study is the educational process for forming the language and clinical-communicative competence of foreign medical students. The subject examines the mechanisms, tools, and results of personalizing this educational model through Artificial Intelligence (AI) technologies, i.e., the way AI modifies, adapts, and influences the teaching and acquisition of language and communication skills in a clinical context.

Research methods: analysis and synthesis of existing approaches to foreign language teaching in medical education, the method of pedagogical observation, as well as the experimental implementation of AI platforms in the learning process.

The aim of the study is the development, implementation, and evaluation of a personalized educational model, based on Artificial Intelligence (AI), for effectively enhancing the language and clinical-communicative competence of foreign medical students.

To achieve this goal, the research can set the following main tasks:

Theoretical analysis and review - to conduct an analysis of existing theoretical models for language and clinical-communicative competence, as well as the application of AI in personalized medical education (e.g., adaptive learning, chatbots, simulations).

Needs diagnostics - to diagnose the specific language and communicative needs and deficits of foreign medical students (e.g., through surveys, tests, and observation of clinical simulations).

Model development - to develop a conceptual and methodological model for personalized learning that integrates AI algorithms to adapt the learning content, pace, and format of feedback according to the individual progress of the student.

2. DISCUSSION

Teaching Bulgarian as a foreign and specialized language in international groups is characterized by multiple factors that influence the effectiveness of the learning process. First, there is the language environment, where Bulgarian is not the native language. Second, there is a cultural and cognitive specificity that requires an individual approach and the use of specialized teaching methods. Moreover, learners from different ethnic groups may have varying levels of motivation and prior experience in language learning, which makes the task of developing clinical-communicative competence even more challenging.

Artificial Intelligence (AI) offers a revolutionary change by personalizing the path to language mastery and communication. At the core of linguistic competence is the mastery of linguistic elements, where AI excels in precision:

Adapted exercises- AI-based platforms use algorithms to track which grammatical rules or lexical items have been mastered and which have not. The system automatically generates additional exercises focused on the learner's weaknesses. This saves time and maintains motivation by preventing the learner from unnecessarily repeating material they already know.

Intelligent pronunciation correction - using natural language processing (NLP) and machine learning, AI can analyze the learner's voice by comparing it with that of native speakers. The system provides immediate, detailed feedback not only on individual sounds but also on intonation, rhythm, and stress—critical aspects of comprehensibility.

Personalized content - AI can select or generate texts, audio, and video materials tailored to the learner's interests and professional context. For example, a lawyer would receive case studies in the target language, while a medical professional would get articles on new procedures.

Communicative competence goes beyond grammar; it includes sociocultural knowledge and the ability to use language pragmatically.

Role-playing with virtual avatars - generative AI creates realistic dialogue partners (chatbots and 3D avatars) that simulate complex communicative situations. These simulations can be personalized to train specific skills, such as:

Handling conflicts or complaints.

Conducting effective negotiations.

Providing feedback in a professional setting.

AI evaluates not only linguistic accuracy but also the appropriateness of responses in a given social or professional context.

Analyses show that interactive platforms based on artificial intelligence (such as ChatGPT, Duolingo, Grammarly, Google Translate, Reverso, Tweek and others) enable learners to study through an individualized approach. The main advantages of AI technologies include features such as public speaking and phonetics exercises, automatic detection of grammatical errors, rapid translation, and real-time practice. At the same time, when reading and analyzing literature, modern AI-based applications facilitate complex tasks such as text simplification, extraction of the main idea, and contextual analysis, helping learners achieve a deeper understanding. However, the use of artificial intelligence should be regarded only as a tool, which cannot fully replace the teacher.

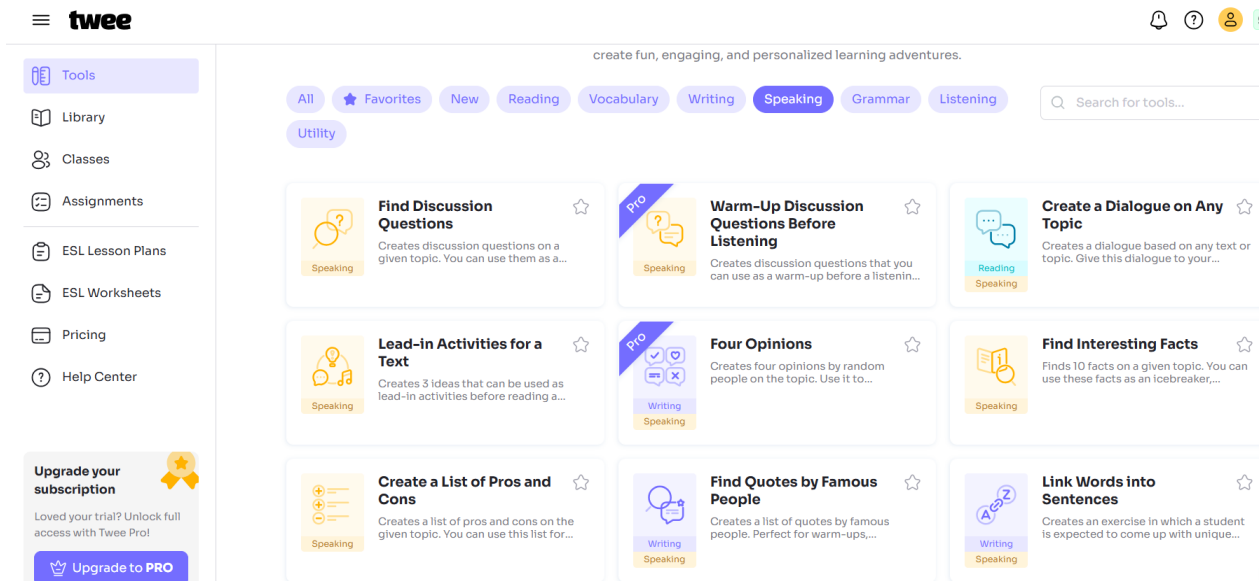


Figure 1. Key applications and advantages of artificial intelligence [5].

This visualization presents the key applications and advantages of artificial intelligence (AI) in the educational process, with a particular emphasis on personalized and efficient learning. The diagram is hierarchically structured and clearly illustrates how AI supports various aspects of teaching and learning.

At the core of the model is personalization, as AI enables the adaptation of lessons and instructional content to the individual needs, proficiency levels, and learning pace of each learner. This feature is especially significant in heterogeneous and international learning groups.

The diagram also highlights the role of AI in assessment and correction, including the rapid generation of tests, automated evaluation, and the provision of objective feedback, thereby reducing the workload of instructors. Closely related to this is the delivery of immediate and intelligent feedback, which supports knowledge acquisition and enhances learner motivation.

Furthermore, the visualization emphasizes AI-assisted content generation, such as worksheets, grammar exercises, writing tasks, quizzes, and reading comprehension activities, demonstrating how AI can facilitate the development of all core language skills. In addition, the diagram incorporates creative and interactive elements, including lesson planning support, visual resource generation, and learner engagement analysis, contributing to a more dynamic and motivating educational experience.

Finally, the image clearly underscores the supportive role of AI as an instructional assistant, which enhances teaching efficiency without replacing the educator. In this regard, the visualization effectively conveys the concept of AI as a tool for optimizing and enriching the educational process rather than substituting the pedagogical role.

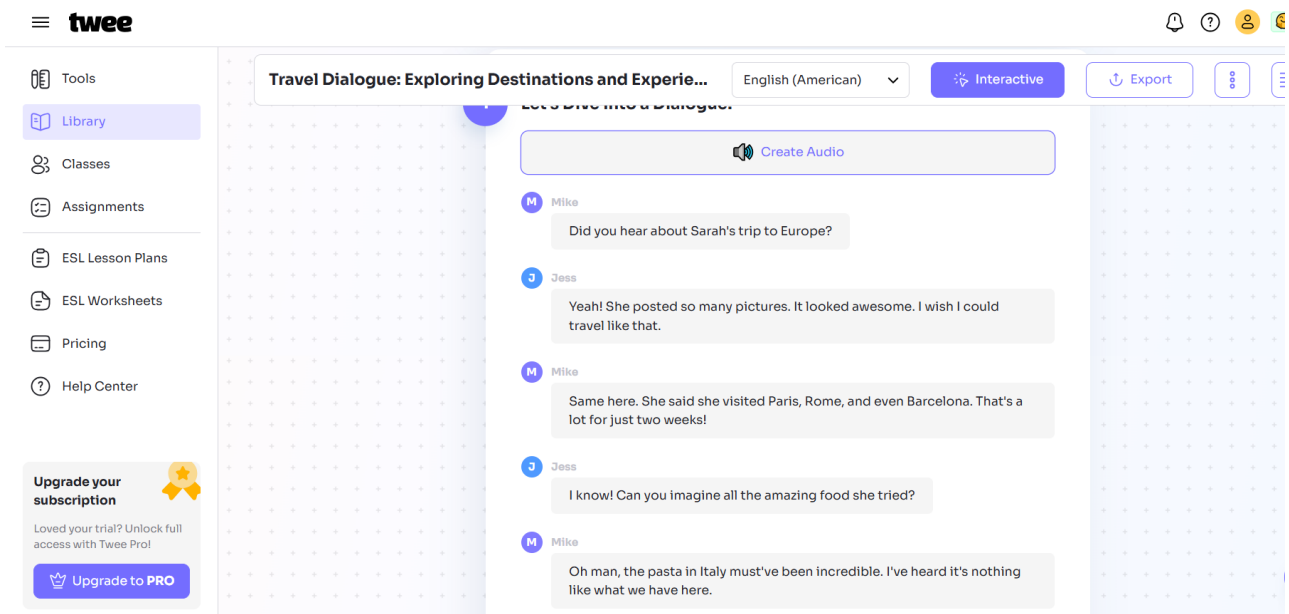


Figure 2. Integrated model for the application of Artificial Intelligence (AI) [5].

This visualization presents an integrated model for the application of Artificial Intelligence (AI) in education, clearly illustrating how various AI-driven functionalities support both teachers and learners. The upper section of the diagram groups specific pedagogical tools enabled by AI, including personalized learning, automated correction and assessment, generation of worksheets, grammatical exercises and writing tasks, reading comprehension activities, quizzes and tests, as well as the creation of visual resources. These components emphasize the potential for the rapid development of adaptive instructional content and the provision of immediate, intelligent feedback.

At the center of the model is learner engagement, highlighting how AI facilitates interactive learning environments and increases student participation through diverse formats and activities. The diagram also underscores the supportive role of AI as a teaching assistant, which streamlines everyday pedagogical tasks without replacing the instructor.

The lower section of the image summarizes the key practical benefits of integrating AI into the educational process: rapid lesson planning, automated correction of assignments, effortless differentiation of instruction, and more efficient communication with parents. This emphasizes the role of AI not only as a didactic tool but also as a means of optimizing time and resources within the educational environment.

Overall, the image illustrates a comprehensive concept of AI as a multifunctional educational tool that enhances efficiency, personalization, and instructional quality, while simultaneously reinforcing the role of the teacher and improving the overall educational process in the contemporary digital context.

The integration of artificial intelligence (AI) into the educational process enables the personalization of learning, the provision of immediate feedback, and the creation of conditions for more active engagement of medical students in learning activities [4].

Communicative competence is one of the key components of an individual's successful personal and professional development in society. In the context of language education, clinical-communicative competence is understood as students' ability to use language effectively in a variety of communicative situations. This competence encompasses both receptive skills (listening and reading) and productive skills (speaking and writing).

Instruction in Bulgarian as a foreign and specialized language in international student groups is characterized by multiple factors that influence the effectiveness of the educational process. First, learners operate in a linguistic environment in which Bulgarian is not the native language. Second, there are cultural and cognitive specificities that require an individualized approach and the application of specialized methodological strategies. In addition, learners from different ethnic backgrounds may demonstrate varying levels of motivation and prior experience in language learning, which further complicates the task of developing clinical-communicative competence.

Artificial intelligence offers a revolutionary shift by personalizing the pathway toward language acquisition and communicative mastery. Through data analysis, AI can create a learning environment that adapts in real time to the learner's unique profile, thereby ensuring the most efficient route to competence development.

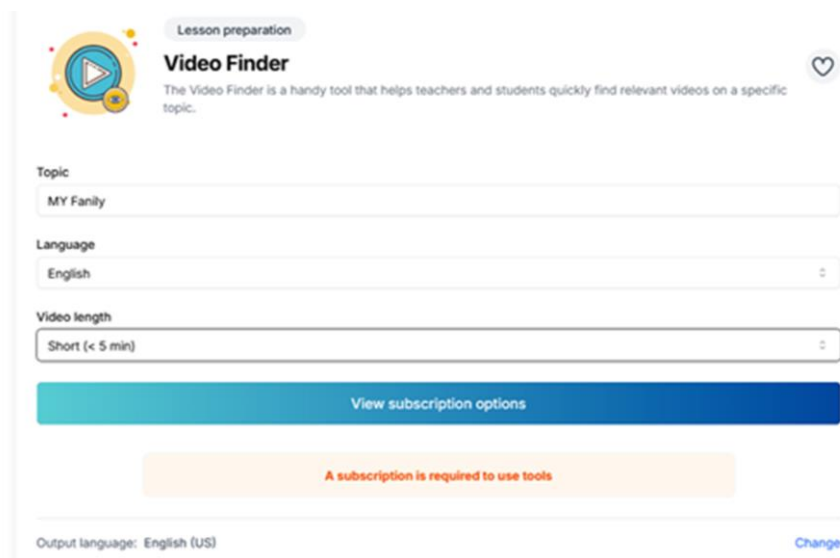


Figure 3. Digital AI-supported tool for lesson preparation.

The image illustrates a digital AI-supported tool for lesson preparation, specifically a Video Finder designed to assist teachers and students in rapidly identifying relevant video materials related to a selected topic. The interface allows users to define key parameters such as the thematic focus, language of instruction, and video length, thereby facilitating targeted and efficient content selection.

By enabling the filtering of educational videos according to pedagogical criteria (e.g., short duration suitable for classroom use), the tool supports time-efficient lesson planning and aligns multimedia resources with specific learning objectives. The option to specify the output language further enhances its applicability in foreign-language education, where exposure to authentic audiovisual materials is essential for developing listening comprehension and contextual language use.

The visual emphasis on subscription-based access also reflects a broader trend in contemporary educational technologies, where advanced AI-driven functionalities are often integrated into commercial platforms. Overall, the tool exemplifies how artificial intelligence and digital platforms can streamline instructional design, promote the use of authentic materials, and support personalized and context-sensitive teaching practices.

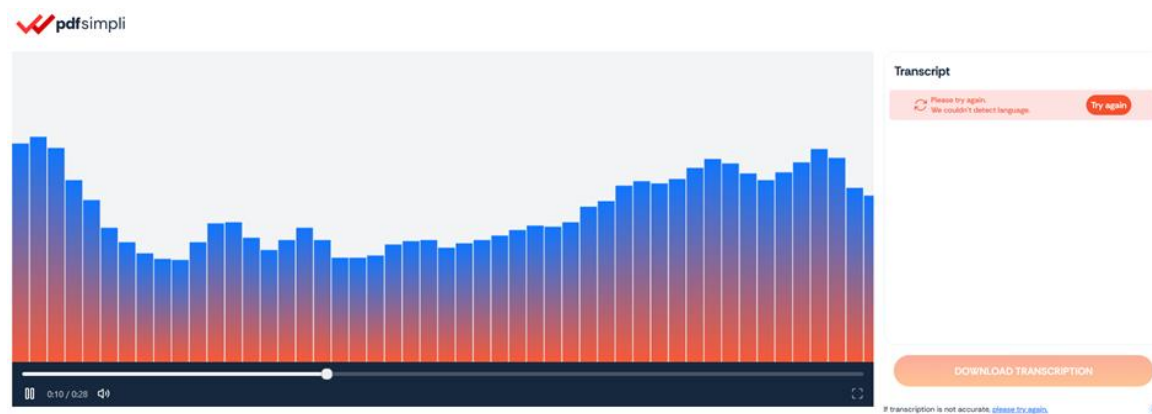


Figure 4. Exercises aimed at developing listening, speaking, and reading skills through the processing of human speech in written form.

The provided image illustrates a critical juncture in the automated processing of audiovisual data via the cloud-based platform pdfsimpli. An examination of the graphical user interface (GUI) and systemic indicators reveals the following technical dimensions:

Systemic error diagnostics - the right-hand pane of the interface displays a language detection failure notification ("We couldn't detect language"). This indicates a misalignment between the input audio signal and the algorithm's constituent linguistic models, effectively terminating the text transcription process.

Spectral analysis visualization - the central portion of the image features a frequency spectrum histogram. Despite the reported software exception, the graphical representation exhibits a distinct, high-amplitude signal, which precludes the absence of data as the primary cause of the systemic refusal.

Operational environment and software architecture - the document is being processed within the Microsoft Word environment under a Windows operating system. The presence of "Compatibility Mode" suggests that the file originates from a legacy version of the software—a significant factor in maintaining the structural integrity of the metadata.

Contextual framework - based on the active applications in the taskbar (Adobe Acrobat, multiple browser instances) and the document's volume (exceeding 3,000 words), the analysis appears to be situated within a complex research workflow involving the translation or secondary processing of technical documentation.

The image documents a technological limitation of the selected transcription tool, necessitating the employment of alternative language identification methods or the enhancement of the source file's signal quality.

To achieve the objectives of the study, a systematic approach is applied, encompassing theoretical analysis, needs assessment, development, and experimental implementation of a personalized learning model using artificial intelligence (AI). First, a review of existing models of linguistic and clinical-communicative competence, as well as applications of AI in medical and foreign-language education, establishes the theoretical framework of the research. Next, individual student needs are assessed through tests, surveys, and pedagogical observation during clinical simulations, enabling the creation of personalized learning profiles.

The developed model is based on the integration of AI algorithms that adapt content, pace, and feedback format according to each student's individual progress. The model includes adaptive exercises, intelligent pronunciation correction, personalized content, and role-playing with virtual avatars, while also emphasizing the ergonomic design of digital and physical learning environments.

Experimental implementation of the model allows for evaluation of its effectiveness through comparative analysis of results between experimental and control groups, combined with qualitative analysis of observations and student feedback. This approach provides a solid basis for drawing conclusions regarding the applicability and effectiveness of AI-based personalized learning in developing the linguistic and clinical-communicative competence of foreign medical students.



Figure 5. Successful automated transcription and speaker diarization of Bulgarian linguistic data.

Platforms such as Duolingo or LingQ automatically identify which grammatical structures and medical terms the student has already mastered and generate additional exercises targeting weaker areas.

Example: The student has mastered the nominative case but encounters difficulties with the genitive case in the short forms of personal pronouns during patient history-taking; the system generates specialized exercises incorporating medical terminology.

Intelligent pronunciation correction. NLP and machine learning-based software, such as Pronunciation Coach or iTalki, analyzes students' pronunciation and compares it to native-speaker models.

Example: a student mispronounces “кръвно налягане” (blood pressure); the system provides micro-corrections for stress and intonation, visually highlighting the correct pronunciation: кръвно НА-лягане.

Personalized content for professional context

Medical students receive texts, videos, and audio materials tailored to their professional practice: diagnostic case studies, procedure instructions, and clinical interviews.

Example: analysis of a recorded patient encounter demonstrating history-taking, followed by AI-generated feedback. Role-playing with virtual avatars.

Generative AI (chatbots or 3D avatars) simulates communication with patients or colleagues.

Example: a student conducts an interview with a virtual patient complaining of chest pain; AI reacts realistically, evaluates language accuracy, and assesses empathy and clarity of communication.

Analysis of non-verbal communication. AI analyzes video recordings from presentations or simulations, assessing body language, eye contact, and gestures.

Example: a student presents a case to a virtual committee; AI notes that the student avoids eye contact and suggests exercises to improve confidence.

Diagnosis of communication styles. AI analyzes written and spoken output to identify dominant communication styles (direct, indirect, analytical).

Example: an analytical student is asked to give a brief explanation of a procedure to a patient; AI provides recommendations for clearer, more concise phrasing.

Adaptation of learning materials. AI can analyze students' individual needs and provide tailored resources that address their linguistic and clinical requirements. Feedback. Artificial intelligence can provide instant feedback, which is crucial for the development of communicative skills.

Digital platforms. The use of AI in education requires user-friendly and intuitive platforms that facilitate students' interaction with learning materials. Physical and virtual environment. Ergonomics plays a role in designing learning spaces and software solutions that reduce fatigue and enhance learning effectiveness.

3. CONCLUSION

In conclusion, we can summarize that these common features highlight how the integration of artificial intelligence and ergonomic design can enhance the education of foreign medical students while simultaneously developing their linguistic and clinical-communicative skills.

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