

examples of minority role models, such as athletes, ensures that students appreciate contributions across a wide range of disciplines and societal roles.

Classroom environments can be designed to promote cultural responsiveness by displaying non-stereotypical representations of diverse groups, marking students' ancestral countries on maps, and including multilingual signs. These seemingly small interventions create an inclusive environment in which students feel comfortable expressing their identities, fostering respect for others, and resisting stereotypical representations prevalent in media.

Culturally responsive education also emphasizes the importance of students understanding and valuing their own cultural heritage. Minority students may feel pressured to abandon cultural norms to conform, leading to disconnects between home and school experiences, which can adversely affect social and academic development. Educators can encourage heritage exploration through activities such as interviewing family members or documenting community experiences, thereby fostering cultural pride and self-efficacy.

Integrating cultural perspectives into core curricula enhances student engagement and achievement. Highlighting contributions of diverse individuals in math, science, reading, and writing, and accommodating preferred learning styles associated with cultural backgrounds, supports student performance and confidence. Inclusive lesson planning, student journaling, and leveraging social media for collaboration and participation further facilitate engagement in culturally diverse classrooms.

Overall, culturally responsive classrooms promote personal growth, intercultural understanding, and career readiness. Exposure to diverse perspectives allows students to develop communication and collaboration skills necessary for navigating the globalized workforce. By fostering an environment of respect, equity, and inclusivity, culturally responsive teaching equips students to thrive academically, socially, and professionally in diverse societies.

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### **INDIVIDUALISATION OF FOREIGN LANGUAGE TEACHING IN THE DIGITAL ENVIRONMENT**

*The article explores individualisation in foreign language teaching within digital learning environments. It argues that digital transformation enables personalised learning trajectories that account for learners' proficiency, cognitive styles, motivation, and digital competence. The study examines theoretical foundations of individualisation, including constructivist approaches and learner autonomy, and analyses digital tools such as learning management systems, AI-based adaptive platforms, mobile applications, and immersive technologies. Particular attention is given to artificial intelligence, which enables real-time adaptation of content and feedback. The findings highlight the teacher's evolving role as facilitator and instructional designer. Effective*

*implementation requires pedagogical design, digital competence, and balanced technology integration.*

**Keywords:** *individualisation, foreign language teaching, digital environment, personalised learning, artificial intelligence, learner autonomy, ICT*

*У статті розглядається індивідуалізація навчання іноземних мов у цифровому освітньому середовищі. Обґрунтовується, що цифрова трансформація забезпечує персоналізовані навчальні траєкторії з урахуванням рівня володіння мовою, когнітивних стилів, мотивації та цифрової компетентності здобувачів освіти. Проаналізовано теоретичні основи індивідуалізації, зокрема конструктивістський підхід та автономію навчання, а також цифрові інструменти: системи управління навчанням, адаптивні платформи на основі штучного інтелекту, мобільні та імерсивні технології. Підкреслено роль штучного інтелекту у динамічному коригуванні навчального процесу. Висвітлено трансформацію ролі викладача та необхідність педагогічного проектування.*

**Ключові слова:** *індивідуалізація, викладання іноземної мови, цифрове середовище, персоналізоване навчання, штучний інтелект, ІКТ*

The rapid digitalisation of education has fundamentally transformed the methodological foundations of foreign language teaching, shifting the focus from uniform instruction to learner-centred and individualised approaches. Individualisation in foreign language education refers to the adaptation of content, pace, methods, and learning trajectories to meet the specific needs, abilities, and preferences of each learner. In the context of the digital environment, this process is significantly enhanced through the integration of information and communication technologies (ICT), artificial intelligence (AI), and adaptive learning systems.

The relevance of the study is determined by the growing demand for flexible and personalised learning solutions in higher education, particularly in conditions of global instability, digital transformation, and the diversification of learner profiles. Modern students differ significantly in their linguistic background, cognitive styles, motivation, and digital competence, which necessitates the implementation of individualised teaching strategies supported by digital tools.

This publication aims to analyse the theoretical foundations, technological tools, and pedagogical implications of individualising foreign language teaching in the digital environment, as well as to identify its advantages and challenges.

Individualisation is closely related to learner-centred and constructivist approaches, which emphasise the active role of the learner in constructing knowledge. In digital environments, this paradigm is reinforced by the possibility of creating *Personal Learning Environments (PLEs)*, where learners independently select resources, formats, and learning paths.

Research demonstrates that ICT enables learners to tailor their learning experiences by choosing materials (text, audio, video), controlling the pace of learning, and engaging in both synchronous and asynchronous activities. Such environments foster autonomy, motivation, and self-regulation, which are key components of successful language acquisition.

Furthermore, the concept of personalised learning is grounded in the idea of adapting instruction to learners' individual characteristics, including prior knowledge, learning styles, and goals. According to recent studies, personalised learning models in English language teaching involve the systematic integration of digital tools, differentiated tasks, and flexible assessment strategies.

The digital environment offers a wide range of tools that facilitate individualisation in foreign language teaching. Adaptive Learning Systems and Artificial Intelligence analyse learners' performance in real time and adjust the difficulty, sequence, and type of tasks accordingly. These systems create a unique learning trajectory for each student, enhancing learning efficiency and engagement. Adaptive technologies can personalise: content (e.g., vocabulary level, grammar structures), feedback (immediate, targeted correction), and assessment (dynamic testing based on learner progress).

Learning Management Systems (LMS) and Digital Platforms enable teachers to differentiate instruction by assigning individual tasks, tracking progress, and providing personalised feedback. They also support blended and flipped learning models, which allow learners to study at their own pace.

Mobile-assisted language learning (MALL) provides learners with continuous access to authentic materials and interactive exercises. The availability of diverse digital content contributes to the creation of individualised learning paths.

Recent research highlights the role of augmented reality, virtual reality, and big data analytics in enhancing personalised learning experiences. These technologies enable immersive environments and data-driven decision-making in teaching.

The integration of digital technologies into foreign language teaching requires a redefinition of the teacher's role. Instead of being a primary source of knowledge, the teacher becomes a facilitator, designer, and moderator of individualised learning experiences. Key pedagogical principles include: differentiation of tasks based on learner needs, flexible pacing and modular course design, continuous formative assessment, fostering learner autonomy and metacognitive skills.

Additionally, the development of teachers' digital competence and Technological Pedagogical Content Knowledge (TPACK) is essential for the effective implementation of individualised instruction.

The individualisation of foreign language teaching through digital technologies offers several significant benefits: increased learner motivation and engagement, as students work with materials relevant to their interests and level; improved learning outcomes, due to targeted instruction and immediate feedback; development of learner autonomy, enabling lifelong learning; flexibility and accessibility, allowing learning to occur anytime and anywhere.

Empirical studies confirm that the integration of adaptive systems, mobile applications, and virtual technologies significantly enhances language proficiency levels and learning efficiency.

Despite its advantages, individualisation in the digital environment faces several challenges: technological barriers, including limited access to devices and internet connectivity; insufficient teacher training in digital pedagogy; over-reliance on technology, which may reduce human interaction; cognitive overload and distraction, particularly due to excessive use of digital media. Moreover, the effective implementation of personalised learning requires careful pedagogical design to balance technological and human factors.

In conclusion, individualisation of foreign language teaching in the digital environment represents a key direction in modern education. The integration of ICT, AI, and adaptive technologies enables the creation of flexible, learner-centred educational systems that respond to individual needs and promote effective language acquisition.

However, successful implementation depends on a balanced approach that combines technological innovation with sound pedagogical principles and teacher expertise. Future research should focus on developing sustainable models of personalised learning, evaluating their long-term effectiveness, and exploring new technological possibilities for enhancing individualisation.

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## BIOTECHNOLOGICAL APPROACHES TO WASTE TREATMENT: CURRENT TRENDS AND PROSPECTS

*У статті розглядаються сучасні біотехнологічні підходи до переробки органічних відходів, аналізуються ефективні мікробіологічні методи, їх застосування у промисловості та вплив на навколишнє середовище.*

**Ключові слова:** біотехнологія, переробка відходів, мікроорганізми, біоремедіація, сталий розвиток.

*The article examines modern biotechnological approaches to organic waste treatment, analyses effective microbiological methods, their application in industry and environmental impact.*

**Keywords:** biotechnology, waste treatment, microorganisms, bioremediation, sustainable development.

Environmental pollution caused by industrial and household waste has become one of the most pressing global challenges of the 21st century. Traditional methods of waste disposal – landfilling and incineration – are increasingly criticized for their negative ecological impact. Against this background, biotechnological approaches to waste treatment are gaining significant attention, offering environmentally friendly and economically viable alternatives [1].

Bioremediation – the use of living organisms, primarily microorganisms, to neutralize or remove pollutants from the environment – is one of the most studied and applied areas of environmental biotechnology. Bacteria, fungi, and algae are capable of decomposing complex organic compounds, heavy metals, and even synthetic polymers, converting them into harmless substances [2].

Anaerobic digestion is a widely applied biotechnological process for the treatment of organic waste, such as food waste, agricultural residues, and sewage sludge. During this process, specialized microorganisms break down organic matter in the absence of oxygen, producing biogas – a mixture of methane and carbon dioxide – which can be used as a renewable energy source [3].

Composting is another well-established biotechnological method based on the aerobic decomposition of organic waste by microorganisms and invertebrates. The result is a valuable organic fertilizer – compost – which improves soil structure and fertility. Modern industrial composting technologies allow for the processing of large volumes of organic waste, significantly reducing the burden on landfills [4].

In recent years, particular attention has been paid to the biotechnological degradation of plastic waste. Certain strains of bacteria and fungi, including *Ideonella sakaiensis*, are capable of destroying polyethylene terephthalate (PET), opening up new possibilities for solving the global problem of plastic pollution. This direction of research is actively developing and holds great potential for industrial implementation [5].

A promising area is also the use of microalgae for wastewater treatment. Algae effectively absorb nitrogen and phosphorus compounds, preventing eutrophication of water bodies. Simultaneously, algal biomass accumulated during the treatment process can be used to produce biofuels, biogas, and valuable biochemical compounds [6].