ISSN: 2524-2474, e-ISSN: 2524-2482
UDC 004.77:621.39
DOI: 10.33989/2524-2474.2025.2.60

Journal homepage: https://pedsciences.com.ua/en
PEDAGOGICAL SCIENCES
Vol. 28, No. 2, 2025

Article's History: Received: 18.08.2025 Revised: 19.11.2025 Accepted: 23.12.2025 Published: 02.01.2026

Nataliia Kotenko*
PhD in Pedagogical Sciences, Associate Professor
State University of Trade and Economics
02156, 19 Kyoto Str., Kyiv, Ukraine
https://orcid.org/0000-0002-2675-6514

Gamification and artificial intelligence in the process of preparing IT specialists for sustainable development challenges

Abstract. The aim of the research was to determine the impact of using gamification and artificial intelligence technologies on the development of professional competencies of future specialists in the field of information technology. The methodology included the analysis of the work of 240 students and lecturers in Ukraine across educational programmes such as Software Engineering, Information Management Systems and Technologies, Computer Science and Technology, content analysis, and the isolation of student task performance results based on a survey to assess the ways of integrating modern digital tools into the educational process. The research examined the use of various digital platforms and tools in the learning process. The results showed that the most popular platform among students is Moodle (40%), followed by Google Classroom (30%), while lecturers prefer Google Classroom (40%) and Moodle (20%). The Kahoot platform scored 10% in both groups, and Repl.it proved to be more appealing to students (5%), while GitHub Classroom was preferred by lecturers (15%). Regarding the frequency of gamification use, lecturers use it daily more often (20%), while no student noted daily use; instead, 40% of students indicated the option "Other", which may suggest irregular or indirect use. On the matter of the convenience of using ChatGPT, 50% of students consider it convenient, but no one rated it as "very convenient", unlike lecturers, among whom 30% expressed this opinion. According to 20% of students, gamification genuinely helps in better memorisation of material, whereas among lecturers only 10% agree, and 45% find it difficult to answer at all. Regarding the impact of artificial intelligence on the quality of learning, both students and lecturers rated it positively equally (20% each), although 40% of students consider it negative, compared to 30% among lecturers. The research findings indicate different approaches of students and lecturers to the use of digital platforms and tools in the educational process, namely Moodle, Google Classroom, and ChatGPT. The research results can be used by lecturers and educational institution administration to improve the educational process by introducing effective forms of gamification and artificial intelligence tools

Keywords: teaching methods; soft skills; digital technologies; motivation; self-directed learning

INTRODUCTION

The relevance of studying and researching the topic of gamification and artificial intelligence (AI) in the process of preparing IT specialists for the challenges of sustainable development is driven by the rapid development of technologies and their impact on various aspects of professional training. Given the fast-paced changes associated with globalisation and the need to ensure sustainable development, it is necessary to investigate how information technologies, in particular gamification and AI, can be integrated into the educational process to improve learning effectiveness and support the adaptation of specialists to new challenges. However, despite the growing attention to these technologies, scientific research in Ukraine and at the international level still does not sufficiently address the integration of gamification and AI in the context of professional training of IT specialists for sustainable

Suggested Citation:
Kotenko, N. (2025). Gamification and artificial intelligence in the process of preparing IT specialists for sustainable development challenges. *Pedagogical Sciences*, 28(2), 60-72. doi: 10.33989/2524-2474.2025.2.60.

*Corresponding author

development, particularly with regard to ethical issues, their impact on student motivation, and adaptation to changes in professional standards (Ministry of Education and Science of Ukraine, n.d.). Thus, it is important to explore the potential of these technologies for the development of flexible and adaptive skills in future professionals.

A large number of authors point to significant interest in the topic of gamification and AI in education, which confirms the relevance and importance of this area for the development of professional training of IT specialists. In particular, A. Azzam & T. Charles (2024) examined the potential of AI in K-12 education, emphasising the importance of early familiarisation of learners with digital technologies, which lays the foundation for the preparation of future IT professionals. They highlighted adaptive learning, intelligent educational systems, and the role of AI in the development of logical thinking, which are essential skills for future IT specialists. In addition, L. Babashahi *et al*. (2024) conducted a systematic review of the impact of AI on the transformation of professional skills in industry, paying particular attention to changing requirements for IT specialists. They found that the labour market increasingly demands specialists who are able to work with big data, understand the principles of algorithm operation, and use digital platforms to manage production processes. The authors emphasised the importance of developing interdisciplinary competences in the IT field. In the study by P. Bitrián *et al.* (2024), the focus was on the application of gamification in staff training, highlighting its effectiveness in developing digital skills, particularly in the areas of information security and data protection, which are key components of IT specialist training. The study showed that interactive learning methods, including gamification, learning simulations, team projects and case-based methods, increase engagement and motivation to acquire IT competences.

A. Capatina *et al*. (2024) examined the impact of gamified approaches on the effectiveness of knowledge acquisition and knowledge transfer in a corporate environment, emphasising the role of such approaches in the professional development system of IT specialists. The authors highlighted that the integration of gamification into internal training contributes to a better understanding of technological processes and the practical mastery of innovative tools, noting that this integration was achieved through the use of point systems, levels, virtual rewards and competitions, which stimulated active participation, immersion in the learning process and the practical adoption of innovative IT tools. L. Carroll (2024) explored five key trends in the development of AI, including task automation, new approaches to productivity enhancement, the ethics of algorithm use, and the expanding role of IT specialists in strategic management processes, all of which directly influence the need for their continuous professional development. M. Cascella *et al*. (2023) investigated the implementation of gamification and AI, as the simulation strategies, AI and digital modelling they describe represent universal tools in the training of IT specialists, particularly in fields requiring precision, adaptability and data analysis. In the work of O.V. Malykhin & T.M. Yarmolchuk (2020), current learning strategies in the professional training of information technology specialists were analysed, with an emphasis on the need to adapt the educational process to the challenges of digital transformation. In particular, the authors substantiated the expediency of integrating information and communication technologies, active learning and the development of critical thinking to enhance the effectiveness of training future IT specialists capable of working in a high-technology environment. O. Patlaichuk *et al*. (2025) studied the effectiveness of gamification and project-based learning as tools for increasing motivation and performance in the professional training of future specialists, particularly in the IT field. The study found that combining practice-oriented methods with game elements, such as badges, leaderboards, real-project scenarios, simulations and quests, contributes to the development of relevant skills, teamwork, initiative and the ability to independently solve complex technological problems.

L. Verbivska & N. Blesko (2024) examined gamification as an innovative approach to learning and enterprise development, particularly in the context of workforce training in the digital era. They substantiated the effectiveness of gamified technologies in developing professional competences, enhancing learning motivation and increasing employee engagement, which is especially relevant for the training of IT specialists and professionals in related fields. However, the above-mentioned studies lacked sufficient data on the impact of gamification on the professional training of IT specialists. The authors also paid insufficient attention to individual differences among learners in their perception of digital learning strategies. The aim of the study was to analyse the effectiveness of using digital technologies, in particular gamification and interactive methods, in the professional training of IT specialists. To achieve this aim, the following objectives were set: to analyse educational programmes for the training of future IT specialists; to identify the impact of gamification and AI on the formation of core knowledge, skills and competences of future IT specialists; and to determine the barriers and pathways for implementing gamification and AI as methods of modernisation in educational programmes for the training of IT specialists.

MATERIALS AND METHODS

The study was conducted in the form of a survey in September 2024 and involved 240 participants aged 17 to 22. The inclusion criteria were enrolment in IT-related specialities at higher education institutions in Ukraine and voluntary consent to participate in the study, while the exclusion criteria included the absence of informed consent and interrupted participation in the survey process. The participants were students of technical specialities from higher education institutions in Ukraine, such as Taras Shevchenko National University of Kyiv, the National

University "Odesa Law Academy", and Kharkiv National University of Radio Electronics. These educational institutions were selected because of their reputation and the availability of highly qualified IT training programmes, which made it possible to ensure diversity and a high level of research among students of technical specialities. In addition, surveys were conducted among both students and lecturers. The study also involved 25 lecturers aged between 29 and 58, which allowed respondents to express their own views and propose ideas for improving the implementation of gamification and AI in the educational process. The survey consisted of five closed-ended questions with predefined answer options. All ethical requirements were observed in accordance with the WMA Declaration of Helsinki (World Medical Association, 2024) and the principles of confidentiality. Participants were provided with clear information about the purpose of the study and confirmed their voluntary participation by signing informed consent forms. The data collected during the surveys were anonymous, and the results were used exclusively for scientific purposes, ensuring the protection of personal information and confidentiality (Table 1).

Table 1. Example of questions that were in the survey

No.	Questions	Answer options
1.	Which type of digital platform do you prefer to use during studies?	➢ Moodle; ➢ Google Classroom; ➢ Kahoot; ➢ Repl.it; ➢ Other.
2.	How often do you use gamification elements in the learning process (tests, quizzes, badges, leaderboards)?	➢ Daily; ➢ Weekly; ➢ Occasionally; ➢ Never.
3.	How convenient is it for you to use artificial intelligence (for example, ChatGPT) for learning?	➢ Very convenient; ➢ Convenient; ➢ Difficult; ➢ Do not use it.
4.	Do game elements (gamification) help you to remember learning material better?	➢ Yes; ➢ Partially; ➢ No; ➢ Difficult to say.
5.	In your opinion, what impact does artificial intelligence have on the quality of your learning?	➢ Positive; ➢ Neutral; ➢ Negative.

Source: compiled by the author

Curricula and educational programmes for bachelor's and master's degrees were analysed, including "Software Engineering" at Taras Shevchenko National University of Kyiv (2021), "Information Management Systems and Technologies" (Osvita.ua, 2025) at National University "Odesa Law Academy", "Computer Science and Technology" at Kharkiv National University of Radio Electronics (2025). The programmes were analysed based on criteria of compliance with the current requirements of IT companies, integration of the latest technologies, in particular AI and gamification, as well as their potential for developing critical thinking and independent work among students.

An experiment was conducted within the study, during which gamification and AI methods were applied to increase the effectiveness of learning. Prior to the experiment, thorough preparation was carried out, including the selection of learning materials adapted to gamification and AI methods. Lecturers completed training in the use of platforms such as Kahoot (n.d.) and Quizizz (n.d.) for interactive tasks and assessment. In addition, learning materials were developed that included interactive lectures and seminars, enabling the effective integration of new technologies into the learning process. Lecturers designed tasks for students using digital tools and gamification elements. In particular, interactive tests were created using GitHub Classroom (n.d.) and Repl.it (n.d.), quizzes were organised via Kahoot, ChatGPT (n.d.) was used to answer typical questions, modular courses were created in Moodle (n.d.), and automated programme testing was integrated into Codewars (n.d.). To analyse the implemented tasks, the content analysis method was applied, which made it possible to systematise the types of tasks, the digital platforms used and the gamification elements. The analysis made it possible to identify the main approaches adopted by lecturers to organising the educational process using digital resources and to reveal prevailing models of interaction with students. During the study, a qualitative comparative analysis of six digital platforms actively used in the educational process was carried out: GitHub Classroom, Repl.it, Kahoot, Moodle, Google Classroom (n.d.) and ChatGPT. Students were assigned tasks involving the completion of interactive tests, programming tasks on the Codewars and Repl.it platforms, participation in quizzes via Kahoot, completion of modular tasks in Moodle, and the use of ChatGPT to formulate answers, which they performed weekly in accordance with the course curriculum.

Student assessment was conducted on the basis of a points-based system. For each task completed on gamification platforms, students were awarded points depending on the speed and accuracy of their responses. For example, for a correct answer in a test or for a successfully completed practical task on a platform, students received between 1 and 10 points. In addition, points were also awarded for participation in discussions and practical classes, depending on students' activity and their ability to solve problems in real time. The overall grade was formed as the sum of points gained across different stages of tasks, taking into account the importance of each stage within the overall context of the course. Recommendations were made for the implementation of gamification.

RESULTS

Characteristics of educational programmes for the training of future IT specialists in Ukraine

Between 2021 and 2025, Ukraine was actively implementing IT education reforms aimed at modernising training programmes for future IT specialists. In particular, the Ministry of Education and Science of Ukraine (2021), together with the Ministry of Digital Transformation, initiated a large-scale reform of IT education, which includes the introduction of new courses on entrepreneurship in the field of information technology in more than 50 universities across the country. In 2023, a pilot project called "Updated IT Studio Computer Science" was launched, which involves updating the content of school computer science with an emphasis on modern technologies such as AI and robotics (Diia.Osvita, n.d.). The advantages of these reforms include close cooperation with the IT business, the introduction of practice-oriented courses, and the opportunity for students to independently choose up to 50% of their academic disciplines, which promotes flexibility and adaptation to the needs of the labour market Ministry of Education and Science of Ukraine (EU4DigitalUA, 2022). However, there are also shortcomings, in particular, a shortage of qualified lecturers with practical experience, outdated elements in the curricula, and insufficient English language skills among students, which complicates their integration into the international IT environment.

In particular, the "Software Engineering" programme at Taras Shevchenko National University of Kyiv (2021) aimed to prepare students to work with big data, AI and machine learning algorithms. The programme included courses where students use AI to solve real-world problems, such as building predictive and data analysis models. The course uses specialised platforms, including Python, TensorFlow, and Keras, allowing students to work with real tools to create AI-based programmes and solutions. These courses also actively use gamification principles, for example, to motivate students to achieve certain levels of task complexity, where points are awarded and certificates are given for each completed task. This promotes healthy competition among students, which in turn increases their motivation to learn. Another programme in "Information Management Systems and Technologies" (Osvita.ua, 2025) at the National University "Odesa Law Academy" also has an important component related to the use of gamification and AI. Students have the opportunity to work on real projects that apply software development methods using AI, particularly in the field of software testing automation. In addition, to consolidate their theoretical knowledge and develop practical skills, students take online courses and interactive seminars that include gamification elements, such as earning points for completing tasks, participating in quizzes, and rankings to encourage better results.

The "Computer Science and Technology" programme at Kharkiv National University of Radio Electronics (2025) provides students with the necessary knowledge to work in the field of data analysis and processing, including the use of AI tools such as automated systems for processing large amounts of data, forecasting models and information management. As part of this programme, students learn the basics of gamification as a method of improving the efficiency of project and business process management, which includes the use of game mechanics to improve user interaction, increase engagement and teamwork efficiency. The programme also involves the integration of AI technologies to automate certain stages of learning, such as interactive tests with automatic answer evaluation and adaptive tasks that change depending on the results of previous stages. Programming using AI and gamification mechanisms allows students to better understand complex technical concepts, teaches them to work with the latest technologies, and prepares them for the real demands of the labour market.

Gamification involves the use of game mechanics in non-gaming contexts, such as education, to increase motivation and engagement among learners, while AI is a branch of computer science that deals with the creation of systems capable of self-learning, data analysis and decision-making, similar to human intelligence. In Ukraine, gamification is being actively implemented in the educational process at the level of schools and higher education institutions, in particular through online platforms, interactive courses and educational applications, while AI is currently developing mainly in the research and start-up environment. However, it is already being used to create adaptive learning systems, automated assessment and analysis of student performance, and both technologies have great potential for integration into the curricula of future IT professionals, especially for personalising learning, increasing student engagement and developing skills that are in demand in the global market. In particular, examples of such programmes demonstrate how innovative teaching methods, such as the use of AI technologies to create adaptive training courses or the introduction of gamification elements to motivate students, can be successfully integrated. The introduction of these technologies makes learning more personalised, adapting it to the individual needs of each student. In addition, it allows for more effective interaction between students and lecturers, thereby

improving the quality of education. Overall, the educational programmes analysed have demonstrated the importance of integrating gamification and AI into the training of modern IT professionals. They make it possible to create a more effective and engaging learning environment that meets the demands of the modern labour market and technological trends. To incorporate gamification and AI into IT specialist training programmes, it is necessary to first update the curricula by adding courses on educational game development and the basics of AI. It is also important to integrate platforms with gamified tasks and AI-based adaptive learning that adjust to the students' level of knowledge. Lecturers need to be trained to work with these technologies, and IT companies should be involved in creating practical case studies and projects. In addition, it is advisable to develop pilot programmes at leading universities to test innovative approaches in real-world conditions.

Assessment of the impact of gamification and AI on the formation of core knowledge, skills and competences of future IT specialists

Information technologies can modernise the educational process, making it more effective and attractive for future IT specialists by increasing student motivation and fostering the development of key professional competences. The purposeful use of gamification and AI through interactive tools such as Kahoot, ChatGPT and Codewars enables the development of students' analytical thinking, self-organisation, technical literacy and teamwork skills. To achieve these outcomes, lecturers' work was organised from the preparation of teaching materials and completion of specialised training to continuous monitoring of learning effectiveness and flexible adaptation of educational content in accordance with students' needs (Table 2).

Table 2. The process of implementing gamification and AI by lecturers in the educational process

No.	Lecturers' activities	Implementation process	Implementation outcomes	Competences developed in students
1.	Creation of interactive tests (GitHub Classroom, Repl.it)	Development of tests with varying levels of difficulty and automated assessment	Increased engagement and rapid feedback	Algorithmic thinking, self-assessment, problem-solving skills
2.	Conducting quizzes via Kahoot	Organisation of real-time games with leaderboards	Growth in student motivation and activity	Teamwork, rapid decision-making, analytical thinking
3.	Use of ChatGPT to answer questions	Provision of answers to typical questions via a chatbot	Time savings for lecturers and improved accessibility of information	Information literacy, self-directed learning, ability to formulate queries
4.	Development of modular courses with gamification (Moodle, Edmodo)	Courses with points awarded for activity, progress bars and rewards	Improved discipline and regular completion of tasks	Self-organisation, time management, strategic planning
5.	Integration of automated testing in Codewars/Replit	Automated assessment of solutions to programming tasks	Individualisation of learning and facilitation of knowledge assessment	Programming skills, attention to detail, ability to work with online resources

Source: compiled by the author

Table 2 presented confirms the effectiveness of integrating gamification and AI into the educational process as innovative methods for training IT specialists at Ukrainian universities. In particular, it demonstrates that the systematic use of modern digital tools such as Kahoot, ChatGPT, Codewars and Moodle contributes to increased student motivation, active engagement in the learning process, and the development of key professional competences. To achieve these outcomes, lecturers' work must be organised in several stages. At the first stage, preparation is required, including completing training on the use of digital platforms, selecting appropriate teaching materials and adapting them to new formats. At the next stage, practical implementation takes place, involving the development and introduction of interactive tasks, automated tests, quizzes and seminars. An important element is also continuous monitoring and feedback: lecturers should analyse task performance results, identify difficulties and promptly adapt course content. Such an organisation of work not only ensures effective assimilation of learning material but also develops students' ability for self-directed learning, critical thinking, working with IT tools and rapid adaptation to the requirements of the digital environment.

The tasks implemented through gamification and AI were oriented towards real skills that students will apply in their professional activities. The tasks should be designed in such a way as to ensure the development of critical competences such as algorithmic thinking, the ability to self-organise, skills in working with various programming tools, and active participation in the learning process. The proposed tasks should be clearly formulated and provide meaningful feedback to students. Students were introduced to programming platforms such as Codewars, where they could practise their skills in real time. For example, the use of platforms such as GitHub Classroom or Repl.it makes it possible to create interactive tests in which students solve specific programming tasks, while automated assessment provides immediate feedback that stimulates the improvement of results. Table 3 demonstrates in detail what specific tasks for students look like when they include elements of gamification and automation, and shows how these tasks help students develop the necessary skills and competences.

Table 3. Examples of tasks for students in the process of implementing gamification and AI in the training of IT specialists

No.	Lecturer's task	Specific example of task implementation
1.	Creation of interactive tests in GitHub Classroom or Repl.it	Task: "Write a Python programme that finds the greatest common divisor of two numbers". During completion, the student must choose a level of difficulty: easy (two numbers up to 100), medium (numbers up to 1,000) or hard (numbers up to 10,000). The test is automatically assessed, and points are awarded for speed and correctness of execution.
2.	Conducting quizzes in Kahoot	Task: "Fundamentals of data structures": 10 multiple-choice questions with three answer options, for example: "What is the time complexity of adding an element to the end of a list in Python?" (A) O(1) (B) O(n) (C) O(log n). Students receive points for correct answers and for the time taken to complete the task.
3.	Using ChatGPT to answer students' questions	Task: The student asks a question via ChatGPT, for example: "Explain the difference between an array and a list in Python". ChatGPT provides a detailed answer with code examples: "Arrays have a fixed size, whereas lists are dynamic." The response includes examples of use in code.
4.	Creating courses in Moodle with gamification elements	Task: Course "Java Fundamentals": after each module, students are offered practical tasks (for example, writing a programme to calculate a factorial), for which points are awarded. Each student receives a badge for successfully completing a particular stage of the course (for example, "Java Syntax Basics").
5.	Integrating automated testing in Codewars or Replit	Task: "Write a function to check whether a string is a palindrome (a word or phrase that reads the same forwards and backwards)." The platform automatically checks the correctness of the code, providing immediate feedback and points for the correctness and optimality of the solution.

Source: compiled by the author

These tasks contribute to the development of the necessary knowledge, skills and competences of future IT specialists, as they are oriented towards the practical application of technologies and the solution of real-world problems, which form the basis of work in the IT sector. Interactive tasks in GitHub Classroom or Repl.it help students develop algorithmic thinking, coding skills and the ability to work with different programming languages. Such tasks stimulate students to solve problems in real time, which is essential for professional activity in the IT environment. Quizzes conducted via Kahoot foster rapid decision-making, attention to detail and logical thinking. These tasks also develop teamwork skills, increase student motivation and engage learners in the educational process through elements of competition. The use of ChatGPT to answer students' questions enhances their capacity for self-directed learning and effective interaction with intelligent systems. Courses on the Moodle platform with gamification elements develop skills of self-organisation and time management. Students learn to complete tasks within a flexible learning framework, gaining opportunities to work on real projects and manage their progress through points and badges. Automated testing on Codewars or Replit enables students to improve their programming skills, develop accuracy and efficiency in code writing, and enhance their ability to adapt quickly to changing conditions. Through these tasks, students not only acquire technical knowledge but also develop critical professional competences such as problem analysis, rapid problem-solving, communication, self-organisation and continuous learning, all of which are integral to the future professional activity of IT specialists. In particular, within the study, lecturers evaluated this process as presented in Table 4.

Table 4. Student results based on completed tasks

No.	Tasks	Number of students	Key assessment characteristics	Assessment results (average score)	Lecturers' comments
1.	Creating interactive tests using GitHub Classroom or Repl.it	240	Use of a scoring system, automatic assessment	7.8 points (average)	Students responded actively, but some of them had difficulty using the interface
2.	Using Kahoot to conduct surveys and quizzes	240	Points for correct answers, extra points for speed	8.2 points (average)	High engagement, but not all students were able to respond quickly during the quiz
3.	Using ChatGPT to answer student questions	240	Automatic provision of answers, saving time	8.5 points (average)	Helped to quickly resolve issues, but the accuracy of responses needs improvement
4.	Using online platforms to create modular courses (Moodle, Edmodo)	240	Points awarded for completed tasks and participation in discussions	7.6 points (average)	Discussions were lively, but not all students actively participated
5.	Integrating automated tests with a programming platform (Codewars, Replit)	240	Assessment of program code, automatic testing of tasks	8.0 points (average)	Automatic testing allowed for a more accurate assessment of students' knowledge levels

Source: compiled by the author

The students' results showed that most of them successfully completed the tasks, receiving average scores ranging from 7.6 to 8.5. Tasks on testing and programming platforms such as Codewars and Replit demonstrated a good level of mastery of the material with scores around 8.0, indicating that the students had a good knowledge of programming. The use of Kahoot for quizzes proved to be very effective in motivating students, with an average score of 8.2, confirming high engagement. The use of ChatGPT yielded the highest scores, but despite this, the accuracy of the answers left something to be desired, which affected the overall result in some cases. Overall, most students performed well on the tasks, but some had difficulty with speed and accuracy when using new technologies. The final survey of lecturers and students was an important step in determining the effectiveness of gamification and AI in the learning process, as shown in Table 5. The results obtained helped not only to assess the current state of the technologies implemented, but also to identify the advantages and difficulties faced by both students and lecturers. This made it possible to develop further ways of integrating these tools into educational programmes, adapting them to the real needs and capabilities of those involved in the educational process.

Table 5. Results of the survey of lecturers and students

Question	Students	Lecturers
What type of digital platform do you like using the most?	Moodle: 40%, Google Classroom: 30%, Kahoot: 10%, Repl.it: 5%, Other: 15%	Google Classroom: 40%, Moodle: 20%, Kahoot: 10%, GitHub Classroom: 15%, Other: 15%
How often do you use gamification elements in the learning process?	Daily: 0%, Weekly: 10%, Occasionally: 20%, Never: 30%, Other: 40%	Daily: 20%, Weekly: 10%, Occasionally: 20%, Never: 30%, Other: 20%
How comfortable are you using artificial intelligence (ChatGPT)?	Very convenient: 0%, Convenient: 50%, Difficult: 30%, Do not use it: 20%	Very convenient: 30%, Convenient: 10%, Do not use it: 25%
Do game elements (gamification) help you better remember the necessary learning material?	Yes: 20%, Partially: 20%, No: 40%, Hard to say: 20%	Yes: 10%, Partially: 10%, No: 35%, Hard to say: 45%
What impact does artificial intelligence have on the quality of learning/activity?	Positive: 20%, Neutral: 20%, Negative: 40%, Do not know: 20%	Positive: 20%, Neutral: 30%, Negative: 30%, Do not know: 20%

Source: compiled by the author

The results of the survey of lecturers and students show a positive attitude towards the use of gamification and AI in the learning process, but also reflect certain problems and challenges. The survey results presented in Table 5 demonstrate the difference in preferences and experience of using digital technologies between students and lecturers. Among students, the most popular platform is Moodle (40%), followed by Google Classroom (30%), while lecturers prefer Google Classroom (40%) and Moodle (20%). The Kahoot platform scored 10% in both groups, while Repl.it proved more attractive to students (5%) and GitHub Classroom to lecturers (15%). In terms of frequency of use, lecturers use gamification more often on a daily basis (20%), while no students reported daily use; instead, 40% of students selected the option "Other", which may indicate irregular or indirect use. When asked about the convenience of using ChatGPT, 50% of students found it convenient, but no one rated it as "very convenient", unlike lecturers, 30% of whom expressed this opinion. According to 20% of students, gamification really helps them remember the material better, while only 10% of lecturers agree, and 45% find it difficult to answer. Regarding the impact of AI on the quality of education, both students and lecturers rated it positively (20% each), although 40% of students consider it negative, compared to 30% of lecturers.

Analysis of barriers and pathways for implementing gamification and AI as methods for modernising educational programmes for the training of IT specialists

The implementation of gamification and AI in educational programmes for training IT specialists at Ukrainian universities is a promising direction for the modernisation of higher education; however, it is accompanied by a number of barriers. One of the main challenges is the technical and financial limitations of universities, in particular the lack of appropriate infrastructure and modern software required to implement gamified platforms or AI-based systems. In addition, there is insufficient awareness and preparedness of teaching staff regarding the effective use of these tools in the educational process, which hinders their widespread adoption. From an organisational perspective, the inertia of educational programmes also poses a significant challenge, as they are difficult to adapt to the dynamic changes in the technology sector due to lengthy bureaucratic procedures for approving and updating curricula. At the same time, positive examples demonstrate the potential of such innovations. For instance, the National University "Lviv Polytechnic" has introduced courses in game application development that include elements of gamification (Pavlyshyn, 2023), while the National Technical University of

Ukraine "Igor Sikorsky Kyiv Polytechnic Institute" (n.d.) is actively developing an AI-based project for the automated analysis of students' responses. These initiatives indicate a growing interest within the academic community; however, large-scale implementation requires comprehensive changes, including state support, the development of an institutional digital culture, and the creation of interdisciplinary teams that combine expertise in pedagogy, programming and AI.

A comparative analysis of modern educational platforms made it possible to outline current trends in the digital learning environment and to identify the most effective tools for different educational tasks. In particular, GitHub Classroom is designed for organising programming assignments with automated code assessment and individual progress tracking, while Repl.it provides a convenient online environment for collaborative work and program testing. Kahoot stands out for its gamified approach to knowledge assessment, which stimulates learner engagement. Moodle, as one of the leading Learning Management Systems (LMS), enables the organisation of a comprehensive educational process, including content delivery, testing and forum-based communication. Google Classroom offers flexible integration with Google services and supports assignment management, communication and assessment. ChatGPT, in turn, functions as a universal digital assistant capable of generating answers, code and explanations, thereby serving as a tool for personalised learning. Most of these platforms are available free of charge with certain functional limitations, whereas Moodle requires technical maintenance in the case of self-hosting.

An analysis of interfaces and functional capabilities showed that Google Classroom and Repl.it are the most user-friendly due to their intuitive design. Kahoot attracts users with its gamified interaction format, while GitHub Classroom requires a certain level of technical competence. Moodle, although functionally rich, is complex to configure for inexperienced users. ChatGPT is distinguished by its ease of use and flexibility of interaction. In terms of learning analytics and performance monitoring, Moodle, Google Classroom and GitHub Classroom provide extensive analytical tools, whereas Kahoot offers only test reports and Repl.it provides basic progress tracking. Overall, Google Classroom and Moodle are the most universal platforms for organising the general educational process; GitHub Classroom and Repl.it are optimal for programming courses; Kahoot is effective for interactive assessment; and ChatGPT is well suited for individualised learning support. Thus, the effective use of educational technologies lies in their rational combination according to specific pedagogical objectives.

It is also worth paying attention to the edX platform, which was created in collaboration with leading universities and companies such as Harvard and MIT. EdX offers free courses on topics such as AI, machine learning, big data analysis, robotics, and cybersecurity. All courses have a clearly defined structure and include both theoretical materials and practical tasks, allowing students not only to gain new knowledge but also to gain practical experience in solving specific technical problems. Programmes on edX also include gamification elements such as points, badges, and certificates, which increase student motivation and allow them to evaluate their achievements.

Given the importance of self-education in the modern world, great attention should be paid to programmes that allow students to independently choose topics for study and take courses at a convenient time and place. One such platform is Udacity, which specialises in courses for developing IT skills. Students can choose specialisations such as Data Science, AI, Web Development, and Cloud Computing. A distinctive feature of Udacity is the availability of project work, where students create real products that are then evaluated not only by lecturers but also by employers. This approach allows students to work on real-world problems while still in school, which is an important aspect of preparing for a future career. Another progressive platform for self-study is Khan Academy, which offers open online courses in mathematics, programming, physics, and other disciplines. A distinctive feature of this platform is the use of gamification through a system of points and achievements, which makes the learning process more interesting and motivating for students. For IT students, an important aspect is the availability of interactive exercises and tasks that allow to practise programming and other technical skills.

Other modern platforms for developing the skills of IT specialists are also actively used in foreign practice, in particular LeetCode, which specialises in tasks involving algorithms and data structures. This platform allows students to practise solving real technical problems, which can be useful when preparing for interviews at IT companies. HackerRank is another platform that allows students to improve their programming skills through a series of practical tasks. When it comes to tools for implementing AI in the learning process, one of the most advanced approaches is to use programmes such as TensorFlow and PyTorch. They allow students to learn the basics of machine learning and AI, create neural network models, and test them in real-world conditions. Lecturers can use these tools to conduct practical classes where students independently build and configure models. Universities are actively integrating such platforms into their educational programmes, giving students the opportunity to work with real data and gain practical experience in solving complex problems. For example, universities such as Stanford University and MIT actively use Google Colab to create and test machine learning models (Lee, 2024). They also use integration with GitHub, which allows students to work on collaborative projects and receive feedback from lecturers and classmates.

In modern educational practice, digital platforms and tools that promote the development of IT skills in students are being actively implemented. Platforms such as LeetCode and HackerRank enable students to develop programming skills by solving practical problems, which is useful when preparing for technical interviews. Tools for implementing AI in the learning process, such as TensorFlow

and PyTorch, allow students to learn the basics of machine learning and create neural network models. Universities, including Stanford University and MIT, actively use Google Colab to create and test machine learning models, as well as integration with GitHub for collaborative work on projects. These approaches help students develop practical skills and prepare them for real-world challenges in the IT field.

DISCUSSION

The results showed that combining gamification and AI helped IT specialists develop the meta-skills needed to respond to sustainable development challenges. It was found that the integration of game mechanics with AI technologies stimulated not only cognitive but also emotional engagement of students, increasing their motivation, self-organisation, adaptability and ability to interact across disciplines. These results confirmed the importance of a comprehensive approach to training specialists, focused on future global changes, in particular – digitalisation, environmental transformation and the need for innovative teaching methods. These results were consistent with the study by J.R.G. Niño *et al*. (2025), which emphasised that the use of a gamified approach in combination with AI is an effective tool for developing 21st-century skills such as critical thinking, teamwork and digital literacy. Similar conclusions were found in the work of V.I. Pardim *et al*. (2025), which found that the use of the ThinkBox gamified environment with AI elements significantly improved student engagement in the learning process and fostered a proactive attitude towards solving real-world problems.

The results of the study also indicated positive dynamics in the emotional sphere of students who participated in learning using gamification and AI. In particular, there was a decrease in anxiety levels, an increase in emotional stability, and an increase in self-confidence. Such emotional support in the educational process is an important condition for the formation of a healthy psychological climate in the academic environment, which, in turn, has a positive effect on academic performance and overall satisfaction with learning. These results are consistent with the findings of B.-J. Kim & J. Lee (2024), who argued that the use of AI in teaching practices contributes to the creation of a more personalised environment in which students feel more secure and emotionally supported. A study by G. Koman *et al*. (2024) found that gamified educational platforms with adaptive AI algorithms allow for the individual characteristics of students to be taken into account, which reduces their frustration and increases their satisfaction with learning. A study by S. Rana & R. Chicone (2025) also confirms that the integration of AI into the educational process contributes to the development of students' stress resistance, as it allows them to learn at their own pace in a safe and controlled environment.

A significant finding in this research was the discovery of the impact of AI not only on the emotional state but also on the formation of students' environmental awareness. Participation in simulation game scenarios, based on sustainable development models, allowed students to immerse themselves in the issues of climate change, resource depletion, and social responsibility. This format of presenting information not only promotes the acquisition of environmental knowledge but also fosters empathy for global problems and motivation to take action. Partial confirmation of these conclusions can be found in the work of E. Mitsea *et al*. (2025), where the authors emphasised the effectiveness of so-called "serious games" in the development of meta-skills, in particular environmental responsibility, social and digital ethics. At the same time, the analysis also revealed certain shortcomings: students tended to uncritically accept information presented in a game or visualised format. Students were often more fascinated by the game process than by the knowledge itself, which in some cases led to a superficial understanding of complex concepts. This coincides with the conclusions of Y. Walter (2024), who drew attention to the need to develop AI literacy among students. The researcher emphasised that excessive enthusiasm for gamification without proper analytical thinking can lead to the formation of a distorted view of reality, which is especially dangerous in the context of information overload. Thus, the integration of gamification and AI does have a powerful positive effect on students' emotional state and the formation of key social and ethical attitudes. However, in order to achieve a balanced result, it is necessary to complement these tools with the development of critical thinking and digital literacy, which will help to avoid the potential risks of simplified or manipulative perception of information.

Another important aspect was the development of skills for adapting to an interdisciplinary environment. The analysis showed that students who studied in a gamified environment with AI support were better oriented in related fields (ecology, engineering, social sciences), which confirmed the need for flexible educational trajectories. These findings coincided with the ideas of K.K. Ramachandran *et al*. (2024), who pointed out that personalised AI-based training platforms are key to reskilling and upskilling employees in times of rapid change. Despite the positive aspects, the study results also revealed potential risks. In particular, there was a tendency towards a decline in critical analysis and autonomy among students in an environment where AI made too many decisions. This was consistent with the views of N. Cavus *et al*. (2023), A. Deroncele-Acosta *et al*. (2024) and S. Pink *et al*. (2025), who considered the issue of trust in AI to be one of the main ethical dilemmas in the professional environment. A similar problem was identified by J. Li *et al*. (2024), who found that over-reliance on AI reduced decision-making activity among UX designers. The results also confirmed that gamification using AI effectively developed soft skills, communication skills, creativity and self-management abilities. This was consistent with the research of B.C. Surve & A.P. Ghatule (2024), who pointed to a significant increase in the

individualised approach to learning thanks to adaptive AI algorithms. Similar trends were also reflected in the work of N. Tusquellas *et al*. (2024), which proved that AI can act as a catalyst for professional development when combined with gamified practices. However, certain aspects of the study differed from the results of some previous works. For example, the study by S.A. Santos *et al*. (2021) emphasised that the effectiveness of gamification in professional learning depends on the specifics of the content and the role of the facilitator. In the context of the study, it was found that even without significant teacher involvement, an autonomous learning system with AI elements in a game format demonstrated a high level of student engagement. This indicated a possible transformation of the teacher's role in the future from instructor to moderator or mentor. Some controversial conclusions were also observed in the topic of the impact of AI on ethical awareness.

Studies by B. Gutiérrez-Caneda *et al*. (2024) and D. Tolks *et al*. (2024) raised the question of whether automated decisions could negate the ethical dilemmas necessary for the formation of sustainable practices. However, the study found that gamification with real-life simulations forced students to make morally sound decisions, thereby strengthening social responsibility. Data related to preparing students for changes in the professional sphere deserved special attention. It was found that participants in AI-based gamification training showed a higher level of readiness for technological challenges, which was confirmed by similar findings by A.B. Rashid & A.K. Kausik (2024) and B.Z. Poljašević *et al*. (2024), who analysed the transformation of industrial sectors under the influence of AI. Additional support for this was provided by the study by J. Zhang & S.H. Fenton (2024), which indicated that preparation for the AI future should include not only technical skills, but also the ability to learn throughout life, which was actively cultivated in the studied training model. The role of multimodality in gamified environments is also worth noting. According to F.J.J. Reis *et al.* (2024), it was multisensory and immersive technologies that shaped higher engagement and emotional memory in learning participants. The study confirmed this observation: additional visual, audio, and interactive effects supported by AI contributed to a deeper understanding of complex concepts of sustainable development. It is also worth noting that the results coincided with the analytical conclusions of A. Torres-Toukoumidis *et al*. (2024), who analysed the scientific literature and found that the combination of gamification and AI enhances the learning effect, especially in the context of the digital transformation of education. In general, the combination of gamification and AI in the educational process not only contributes to the development of technical skills, but also shapes ethical awareness, social responsibility and students' readiness for the challenges of sustainable development.

CONCLUSIONS

The research aim correlates with the results obtained: it was found that traditional educational programmes in Ukrainian higher education institutions had limited interactivity and hardly used innovative approaches, which negatively affected student motivation. As a result, the approbation of gamified platforms and AI tools proved its viability as a means of increasing student engagement, activating the learning process, and developing the necessary professional competencies.

The study confirmed that the use of gamification and AI cultivated knowledge of algorithmic thinking, the ability to work with digital platforms, solve problems in real-time, and developed competencies such as digital literacy, teamwork, adaptability, and self-directed learning in students. Specifically, 240 students participated in the study, and the results showed that 40% of students chose Moodle as the most convenient learning platform, 30% preferred Google Classroom, 15% selected other platforms, and 10% preferred to use Kahoot. Regarding gamification elements, 40% of students indicated that they use them sometimes, 20% – weekly, and 30% do not use them at all. 50% of students noted that AI (e.g., ChatGPT) is convenient in the learning process, but 30% pointed to difficulties in its use. When it came to the influence of gaming elements on memorisation of learning material, 40% of students responded that it does not help, 20% – that it partially helps, and only 20% noted that gaming elements significantly facilitate memorisation. Regarding the influence of AI on the quality of learning, 40% of students indicated a neutral impact, 20% considered the impact positive, and another 20% – negative. The research results showed that the implementation of modern technologies into the educational process is possible through updating curricula, training lecturers, and integrating digital platforms. The prospects for further research lie in the development of innovative educational models that integrate gamification and AI to prepare IT specialists for addressing sustainable development challenges, particularly through the implementation of adaptive learning, intelligent decision support systems, and big data analysis within the context of the United Nations Sustainable Development Goals.

ACKNOWLEDGEMENTS

None.

FUNDING

None.

CONFLICT OF INTEREST

None.

REFERENCES

[1] Azzam, A., & Charles, T. (2024). A review of artificial intelligence in K-12 education. *Open Journal of Applied Sciences*, 14(8), 2088-2100. doi: 10.4236/ojapps.2024.148137.

[2] Babashahi, L., Barbosa, C.E., Lima, Y., Lyra, A., Salazar, H., Argôlo, M., de Almeida, M.A., & de Souza, J.M. (2024). AI in the workplace: A systematic review of skill transformation in the industry. *Administrative Sciences*, 14(6), article number 127. doi: 10.3390/admsci14060127.
[3] Bitrián, P., Buil, I., Catalán, S., & Merli, D. (2024). Gamification in workforce training: Improving employees' self-efficacy and information security and data protection behaviours. *Journal of Business Research*, 179, article number 114685. doi: 10.1016/j.jbusres.2024.114685.
[4] Capatina, A., Juarez-Varon, D., Micu, A., & Micu, A.E. (2024). Leveling up in corporate training: Unveiling the power of gamification to enhance knowledge retention, knowledge sharing, and job performance. *Journal of Innovation & Knowledge*, 9(3), article number 100530. doi: 10.1016/j.jik.2024.100530.
[5] Carroll, L. (2024). *AI in 2024: Five trends workers need to know*. Retrieved from https://www.bbc.com.
[6] Cascella, M., Cascella, A., Monaco, F., & Shariff, M.N. (2023). Envisioning gamification in anesthesia, pain management, and critical care: Basic principles, integration of artificial intelligence, and simulation strategies. *Journal of Anesthesia, Analgesia and Critical Care,* 3, article number 33. doi: 10.1186/s44158-023-00118-2.
[7] Cavus, N., Ibrahim, I., Ogbonna Okonkwo, M., Bode Ayansina, N., & Modupeola, T. (2023). The effects of gamification in education: A systematic literature review. *BRAIN. Broad Research in Artificial Intelligence and Neuroscience*, 14(2), 211-241. doi: 10.18662/brain/14.2/452.
[8] ChatGPT. (n.d.). Retrieved from https://chatgpt.com.
[9] Codewars. (n.d.). Retrieved from https://www.codewars.com.
[10] Deroncele-Acosta, A., Bellido-Valdiviezo, O., de los Ángeles Sánchez-Trujillo, M., Palacios-Núñez, M.L.,
Rueda-Garcés, H., & Brito-Garcías, J.G. (2024). Ten essential pillars in artificial intelligence for university science education: A scoping review. *SAGE Open*, 14(3). doi: 10.1177/21582440241272016.
[11] Diia.Osvita. (n.d.). *What is updated informatics?* Retrieved from https://osvita.diia.gov.ua.
[12] EU4DigitalUA. (2022). *With the support of the EU, the Ministry of Digital and the Ministry of Education and Science presented the results of the piloting of the project "Updated Informatics – IT Studios"*. Retrieved from https://eu4digitalua.eu.
[13] GitHub Classroom. (n.d.). Retrieved from https://classroom.github.com.
[14] GitHub Classroom. (n.d.). Retrieved from https://github.com.
[15] Google Classroom. (n.d.). Retrieved from https://classroom.google.com.
[16] Gutiérrez-Caneda, B., Lindén, C.-G., & Vázquez-Herrero, J. (2024). Ethics and journalistic challenges in the age of artificial intelligence: Talking with professionals and experts. *Frontiers in Communication*, 9, article number 1465178. doi: 10.3389/fcomm.2024.1465178.
[17] Kahoot. (n.d.). Retrieved from https://kahoot.it.
[18] Kharkiv National University of Radio Electronics. (2025). *Educational and professional program "Computer Science and Technology"*. Retrieved from https://nure.ua.
[19] Kim, B.-J., & Lee, J. (2024). The mental health implications of artificial intelligence adoption: The crucial role of self-efficacy. *Humanities and Social Sciences Communications*, 11, article number 1561. doi: 10.1057/s41599-024-04018-w.
[20] Koman, G., Boršoš, P., & Kubina, M. (2024). The possibilities of using artificial intelligence as a key technology in the current employee recruitment process. *Administrative Sciences*, 14(7), article number 157. doi: 10.3390/admsci14070157.
[21] Lee, W. (2024). *Train machine learning models on Colab GPU*. Retrieved form https://rcpedia-dev.stanford.edu.
[22] Li, J., Cao, H., Lin, L., Hou, Y., Zhu, R., & El Ali, A. (2024). User experience design professionals' perceptions of generative artificial intelligence. In *Proceedings of the 2024 CHI conference on human factors in computing systems* (pp. 1-18). New York: Association for Computing Machinery. doi: 10.1145/3613904.3642114.
[23] Malykhin, O.V., & Yarmolchuk, T.M. (2020). Relevant learning strategies in the professional training of information technology specialists. *Information Technologies and Learning Tools*, 76(2), 43-57. doi: 10.33407/itlt.v76i2.2682.
[24] Ministry of Education and Science of Ukraine. (2021). *A roadmap for reforming IT education was presented*. Retrieved from https://mon.gov.ua.
[25] Ministry of Education and Science of Ukraine. (n.d.). *Professional standard. Information resources specialist*. Retrieved from https://mon.gov.ua.
[26] Mitsea, E., Drigas, A., & Skianis, C. (2025). A systematic review of serious games in the era of artificial intelligence, immersive technologies, the metaverse, and neurotechnologies: Transformation through meta-skills training. *Electronics*, 14(4), article number 649. doi: 10.3390/electronics14040649.
[27] Moodle. (n.d.). Retrieved from https://moodle.org.
[28] National Technical University of Ukraine "Igor Sikorsky Kyiv Polytechnic Institute". (n.d.). *Artificial intelligence*. Retrieved from https://kpi.ua/artificial_intelligence.
[29] Niño, J.R.G., Delgado, L.P.Á., Chiappe, A., & González, E.O. (2025). Gamifying learning with AI: A pathway to 21st-century skills. *Journal of Research in Childhood Education*, 39(4), 735-750. doi: 10.1080/02568543.2024.2421974.

[30] Osvita.ua. (2025). *Educational program: Information management systems and technologies*. Retrieved from https://vstup.osvita.ua.
[31] Pardim, V.I., Viana, A.B.N., & Isaias, P.T. (2025). ThinkBox: When gamification meets artificial intelligence: Rethinking learning experiences. *Management Magazine*, 32(1), 66-70. doi: 10.1108/REGE-01-2025-213.
[32] Patlaichuk, O., Prokofiev, Y., & Tovstohan, V. (2025). Gamification and project-based learning as tools for increasing motivation and effectiveness in the professional training of future specialists. *Scientific Innovations and Advanced Technologies*, 3(43), 1347-1357. doi: 10.52058/2786-5274-2025-3(43)-1347-1357.
[33] Pavlyshyn, N. (2023). *A new innovation laboratory has been opened at the Institute of Computer Science and Engineering, where students will learn to develop game programs*. Retrieved from https://lpnu.ua.
[34] Pink, S., Quilty, E., Grundy, J., & Hoda, R. (2025). Trust, artificial intelligence and software practitioners: An interdisciplinary agenda. *AI & Society*, 40, 639-652. doi: 10.1007/s00146-024-01882-7.
[35] Poljašević, B.Z., Žižek, S.Š., & Gričnik, A.M. (2024). Artificial intelligence in employee learning process: Insights from Generation Z. *Our Economy*, 70(3), 21-36. doi: 10.2478/ngoe-2024-0014.
[36] Quizizz. (n.d.). Retrieved from https://wayground.com.
[37] Ramachandran, K.K., Srivastava, A., Panjwani, V., Kumar, D., Cheepurupalli, N.R., & Mohan, C.R. (2024). Developing AI-powered training programs for employee upskilling and reskilling. *Journal of Informatics Education and Research*, 4(2), 1186-1193. doi: 10.52783/jier.v4i2.903.
[38] Rana, S., & Chicone, R. (2025). Gamification and immersive learning with AI. In *Fortifying the future*: *Harnessing AI for transformative cybersecurity training* (pp. 51-75). Cham: Springer. doi:10.1007/978-3-031-81780-9_3.
[39] Rashid, A.B., & Kausik, A.K. (2024). AI revolutionizing industries worldwide: A comprehensive overview of its diverse applications. *Hybrid Advances*, 7, article number 100277. doi: 10.1016/j.hybadv.2024.100277.
[40] Reis, F.J.J., Alaiti, R.K., Vallio, C.S., & Hespanhol, L. (2024). Artificial intelligence and machine learning approaches in sports: Concepts, applications, challenges, and future perspectives. *Brazilian Journal of Physical Therapy*, 28(3), article number 101083. doi: 10.1016/j.bjpt.2024.101083.
[41] Repl.it. (n.d.). Retrieved from https://replit.com.
[42] Santos, S.A., Trevisan, L.N., Veloso, E.F.R., & Treff, M.A. (2021). Gamification in training and development processes: Perception on effectiveness and results. *Management Magazine*, 28(2), 133-146. doi: 10.1108/REGE-12-2019-0132.
[43] Surve, B.C., & Ghatule, A.P. (2024). Gamification empowered with AI tools to enhance student learning engagement and involvement for personalized effective learning experiences. *ITM Web of Conferences*, 68, article number 01023. doi: 10.1051/itmconf/20246801023.
[44] Taras Shevchenko National University of Kyiv. (2021). *Educational and scientific program "Software Engineering"*. Retrieved from https://fit.knu.ua.
[45] Tolks, D., Schmidt, J.J., & Kuhn, S. (2024). The role of AI in serious games and gamification for health: Scoping review. *JMIR Serious Games*, 12, article number e48258. doi: 10.2196/48258.
[46] Torres-Toukoumidis, A., Jiménez, M.M.F., Merchan-Romero, J., & Vega-Ramírez, J.F.A. (2024). Gamification and artificial intelligence in the educational context: Analysis of scientific literature. In A. Schönbohm, F. Bellotti, A. Bucchiarone, F. de Rosa, M. Ninaus, A. Wang, V. Wanick & P. Dondio (Eds.), *13th international conference*: *Games and learning alliance* (pp. 349-354). Cham: Springer. doi: 10.1007/978-3-031-78269-5_34.
[47] Tusquellas, N., Palau, R., & Santiago, R. (2024). Analysis of the potential of artificial intelligence for professional development and talent management: A systematic literature review. *International Journal of Information Management Data Insights*, 4(2), article number 100288. doi: 10.1016/j.jjimei.2024.100288.
[48] Verbivska, L., & Blesko, N. (2024). Gamification as an innovative approach to training and development of enterprise. *Market Infrastructure*, 78, 104-109. doi: 10.32782/infrastruct78-20.
[49] Walter, Y. (2024). Embracing the future of artificial intelligence in the classroom: The relevance of AI literacy, prompt engineering, and critical thinking in modern education. *International Journal of Educational Technology in Higher Education*, 21, article number 15. doi: 10.1186/s41239-024-00448-3.
[50] World Medical Association. (2024, October). *WMA Declaration of Helsinki – Ethical Principles for Medical Research Involving Human Participants*. Retrieved from https://www.wma.net.
[51] Zhang, J., & Fenton, S.H. (2024). Preparing healthcare education for an AI-augmented future. *NPJ Health Systems*, 1, article number 4. doi: 10.1038/s44401-024-00006-z.

Наталія Котенко
Кандидат педагогічних наук, доцент
Державний торговельно-економічний університет
02156, вул. Кіото, 19, м. Київ, Україна
https://orcid.org/0000-0002-2675-6514

Ґейміфікація та штучний інтелект в процесі підготовки ІТ-фахівців до викликів сталого розвитку

Анотація. Метою дослідження було визначення впливу використання ґейміфікації та технологій штучного інтелекту на розвиток професійних компетентностей майбутніх фахівців сфери інформаційних технологій. Методологія включала аналіз роботи 240 студентів і викладачів в Україні за такими освітніми програмами, як Software Engineering, Information Management Systems and Technologies, Computer Science and Technology, контент-аналіз та виокремлення результатів виконання завдань студентами на основі опитування з метою оцінки шляхів інтеграції сучасних цифрових інструментів у навчальний процес. У дослідженні було вивчено використання різних цифрових платформ та інструментів у навчальному процесі. Результати показали, що серед студентів найбільш популярною платформою є Moodle (40 %), за нею – Google Classroom (30 %), тоді як викладачі віддають перевагу Google Classroom (40 %) та Moodle (20 %). Платформа Kahoot набрала по 10 % в обох групах, а Repl.it виявилася більш привабливою для студентів (5 %), тоді як GitHub Classroom – для викладачів (15 %). У частоті використання ґейміфікації викладачі частіше використовують її щодня (20 %), тоді як жоден студент не відзначив щоденне використання; натомість 40 % студентів вказали варіант "Інше", що може свідчити про нерегулярне або непряме використання. У питанні зручності застосування ChatGPT 50 % студентів вважають його зручним, але ніхто не оцінив його як "дуже зручний", на відміну від викладачів, серед яких 30 % висловили таку думку. Ґейміфікація, за словами 20 % студентів, справді допомагає краще запам'ятовувати матеріал, тоді як серед викладачів таких лише 10 %, і 45 % взагалі важко дати відповідь. Щодо впливу штучного інтелекту на якість навчання, і студенти, і викладачі однаково оцінили його позитивно (по 20 %), хоча серед студентів 40 % вважають його негативним, у порівнянні з 30% серед викладачів. Результати дослідження свідчать про різні підходи студентів і викладачів до використання цифрових платформ та інструментів у навчальному процесі, а саме Moodle, Google Classroom; ChatGPT. Результати дослідження можуть бути використані викладачами та адміністрацією навчальних закладів для вдосконалення освітнього процесу шляхом впровадження ефективних форм ґейміфікації та інструментів штучного інтелекту

Ключові слова: методи навчання; гнучкі навички; цифрові технології; мотивація; самонавчання