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Classification of problems that have manifested themselves in the training of students after opening up access to artificial intelligence services

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Abstract. The relevance of the study arises from the rapid proliferation of artificial intelligence (AI) services in education, which creates new challenges for pedagogical practice. The use of AI by students leads to decreased motivation for independent learning, problems with academic integrity, deformation of critical thinking and the need to adapt teaching methods. The objective of this paper was to categorise the key problems arising from the use of AI in education and to propose solutions, including the author's pedagogical model for teaching programming. The research methods included analysis of scientific publications, experiment with control and experimental groups of students, quantitative and qualitative analysis of the results, questionnaire survey, content analysis of code and comparative analysis of traditional and AI-integrated approaches. As a result of the study, a classification of problems including decreased motivation, lack of AI skills, violations of academic integrity, deformation of critical thinking, the need to adapt teaching methods, changes in knowledge assessment and digital inequality was performed. A pedagogical model for teaching Java programming based on individualisation, project structure and AI integration was proposed. The model included setting up personal projects, step-by-step mastering of the material, code performance control and formative assessment. The experiment showed that the application of the model increased the amount of code executed by 216%, the average score by 18.3%, and the students' motivation by 36%. At the same time, the level of independence decreased slightly (–1.35%). It was found that the use of AI in teaching requires a revision of control methods, including oral defences, portfolios and cross-checking of work. The practical value of the paper lies in the development of an adaptive teaching methodology that minimises the negative impact of AI and promotes programming skills. The model can be scaled to other disciplines that require practical application of AI. The results of the study are useful for teachers, methodologists and developers of educational programmes

Keywords: education; programming; pedagogical model; academic integrity; critical thinking; student motivation; digital divide

INTRODUCTION

The spread of publicly available artificial intelligence (AI) services to students, schoolchildren and teachers has become one of the most prominent trends in modern education. AI offers unprecedented opportunities to optimise the learning process, automate routine tasks and personalise learning. However, along with the obvious advantages, the widespread implementation of AI gives rise to a number of complex issues and problems that require in-depth analysis and development of adequate solutions. In particular, as V. Pogrebnoi (2023), AI capabilities can not only positively but also negatively affect the learning process and the quality of learning. This aspect deserves special attention, because ignoring potential risks may lead to undesirable consequences for the educational system as a whole.

The relevance of this topic is confirmed by many studies on the impact of AI on various aspects of educational

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activities. For example, the study by B. Ogunleye *et al.* (2024) focuses on the experience of using ChatGPT by undergraduate engineering students to debug, generate and explain code. The authors observe a decline in code quality and interaction in pair programming, highlighting the need to reconsider learning objectives and collaborative working models with AI in mind. This study clearly demonstrates that without proper adaptation of teaching methodologies, the introduction of AI can lead to negative effects. On the other hand, A. Park & T. Kim (2025) in their study showed that students who used ChatGPT performed significantly better in practical big data analysis tasks compared to groups using StackOverflow or a control group. This result, however, comes with an important observation about the need for a balanced approach and maintaining academic integrity. Thus, the success of using AI in teaching depends largely on how well it is integrated into the educational process and how aware students are of the ethical aspects of its use.

The problem of students' adaptation to working with AI is also central. H. Güner & E. Er (2025) analysed student interaction profiles with ChatGPT and found that after prompting training, the majority of students switched to AI collaboration, which was associated with improved academic performance. This indicates that preparing students to effectively interact with AI tools is critical to the successful implementation of technology in the classroom. Without targeted training, AI skills can be used ineffectively or even detrimentally. Particular attention should be paid to ethical and methodological challenges. The UN News (2025) article emphasises the need to maintain human control over technology, the importance of ethical considerations and investment in teacher and student learning. This global vision confirms that the introduction of AI in education is not just a technological issue, but also a social, ethical and pedagogical issue (Dodonova & Dodonov, 2022). Specific methodological aspects are equally important, for example, C. Sengul *et al.* (2024) in their review of the impact of chatbots on software engineering education point out that basic skills (such as declarative thinking) are important to teach prior to AI uptake, given the complexities of formulating tasks for AI tools. This indicates the need to build a strong foundational knowledge base in students before they can effectively apply AI in their academic endeavours.

Thus, against the background of the rapid development and widespread introduction of AI into the educational sphere, the need for a deep understanding of the emerging problems and challenges becomes obvious. From issues of declining quality of learning and deteriorating interaction to ethical dilemmas and the need to revise pedagogical approaches, all this requires systematisation and the search for effective solutions. Based on the analysis of the reviewed publications, synthesis of the information received and the author's three-year experience, the aim of the paper was formulated: to determine the classification of problems that seem to be the most important for pedagogical practice, and within the framework of this classification to outline general ways to overcome them, and in particular, for some problems to propose the author's approach to their solution.

LITERATURE REVIEW

In addition to the studies already mentioned, there is a vast literature that delves into various aspects of the impact of AI on the educational process. Analysing these sources allows for formation a more complete picture of the challenges and opportunities associated with the integration of AI in learning. One of the significant challenges arising from the use of AI is the risk of superficial understanding and decreased creativity in students. W. Takerngsaksiri *et al.* (2024) looked at student audiences' perceptions of autocompletes (e.g., GitHub Copilot). Their study showed increased productivity and help with syntax, but simultaneously revealed decreased creativity and superficial understanding of the subject matter. This emphasises the need to introduce explanations and practices that encourage deeper understanding of the material, rather than simply getting ready-made solutions.

The readiness of AI to solve complex problems and adequately assess student work is also under active debate. N. Dunder *et al.* (2024) tested ChatGPT on 127 Kattis tasks, where successful solutions were obtained only in 19 cases. Their finding that AI copes with simple tasks but is not ready for complex tasks indicates the need to refine approaches to assessing student work in AI environments. In the context of active learning methodologies, D. Córdova-Esparza *et al.* (2024) reviewed 15 papers on approaches such as PBL, flipped classrooms and gamification. They concluded that these methodologies stimulate motivation, participation and the development of cognitive and socio-emotional skills. This is particularly important in the context of AI, as active methods can help compensate for potential disadvantages associated with passive information consumption. Algorithmic bias is also a serious problem. A study by S. Chinta *et al.* (2024) points to sources of algorithmic bias such as training materials, model training, and cultural context. The authors suggest techniques for assessing and mitigating bias, such as auditing and participation of diverse groups, are critical to ensure fairness and inclusivity in AI-enabled educational systems.

In the broader context of the application of AI tools, W. Holmes *et al.* (2019) in their extensive report consider the applicability of adaptive learning, assessment and chatbots in real educational contexts. They focus on ethical concerns, privacy and the need for digital literacy, which emphasises the multifaceted nature of AI adoption in education. For educators, the development of AI also brings its own challenges. P. Shah (2023) notes that there is widespread rumour, confusion and fear among educators about the development of AI. Understanding what AI is, how it works, and how it can be used to improve education can help overcome these fears and use AI for administrative tasks, lesson design, and professional development.

In the work of S. Kramarov *et al.* (2025) reviewed the basic concepts and methods of using AI technologies in educational activities, with the goal of providing educators with practical guidelines for integrating these technologies. A. Mills (2023), in a selection of articles, suggests how education must change to meet today's AI systems and what role teachers and researchers should play in shaping the future of generative AI. Her papers also explain AI concepts, describe possible applications of AI in education, and describe negative consequences such as loss of knowledge and increased inequality.

The issues and challenges faced by teachers and educational institutions following the widespread adoption of generative AI models such as ChatGPT and GPT-3 are discussed in detail by J. Rudolph *et al.* (2023). They suggest temporary solutions, such as developing writing assignments that AI cannot yet cope with and incorporating elements of personal experience into assignments. The authors emphasise the need not to ban but to intelligently integrate AI tools into educational practice, as well as training students in the critical use of AI, updating academic honesty policies and developing clear guidelines. A. Vieriu & G. Petrea (2025) discuss the impact of AI on students' academic development, emphasising the need for a balanced approach so that AI complements rather than replaces human interaction and the development of critical thinking. This is in line with the study by Q. Ju (2023), which showed that complete reliance on AI for writing assignments resulted in decreased accuracy.

A survey of 262 university students in Florida and Pennsylvania conducted by G. Pitts *et al.* (2025) found that while the benefits of AI (feedback and learning support) are recognised, there are concerns about academic honesty, accuracy of information and loss of critical thinking skills. These concerns are supported by the analysis of J. Wecks *et al.* (2024) which showed that students using generative AI scored lower on average in examinations. A study at universities in Bahrain conducted by A. Ateeq *et al.* (2024) also showed that the adoption of AI affects academic integrity and requires a shift to more comprehensive assessment methods.

In the context of the need to redesign the learning process, W. Holmes *et al.* (2019) propose a model that utilises different types of technology exposure, from simply replacing a tool to performing new previously unimaginable tasks. G. Davydova & N. Shlykova (2024) analyse the future of higher education and outline a number of expected challenges, including issues of monopolisation of AI algorithms. Finally, Sberbank Corporate University (2024) discusses the main risks and practical ways to minimise them for a more effective and safer implementation of AI in pedagogical practice. Thus, a vast body of research confirms that the introduction of AI in education is a multifaceted process that requires not only technical solutions, but also a deep rethinking of pedagogical approaches, ethical standards and academic integrity to ensure an optimal balance between innovation and quality of learning.

MATERIALS AND METHODS

The methodological basis of the research was the aim to systematise the key problems arising in the process of student learning when using artificial intelligence services, as well as to develop and test a pedagogical model aimed at minimising the negative consequences of their use. To achieve the goal, a set of complementary methods was used. First of all, a review and analysis of publications concerning the impact of AI on the educational environment, academic integrity, digital inequality and transformation of pedagogical strategies was carried out. On the basis of theoretical analysis, problem areas were identified that require piloting in a practical teaching context.

The main empirical method was a pedagogical experiment organised with the participation of students of the specialties "Information Technology" and "Business Informatics". For the purity of the experiment, the control group (training without the use of AI) and the experimental group (training with the integration of AI) were formed. Training modules on the discipline "Programming in Java" were used as an experimental base. The control group included students of 2021 year of entry, the experimental group – 2024. The total sample coverage was 152 students, of which 65 – in the control group and 87 – in the experimental group. The following methods were used to evaluate the effectiveness of the developed pedagogical model: quantitative measurement of the amount of programme code performed by students; analysis of the dynamics of academic performance; questionnaire survey to identify the level of motivation and autonomy; content analysis of handed in assignments for code correctness, application of key language constructs and style integrity. Observation of learning activities was also used, which allowed for recording behavioural changes during the course and the degree of students' involvement in the learning process. Comparative analysis was carried out according to the following indicators: the average amount of programme code per semester, the percentage of those who successfully completed the course, the level of motivation and self-assessment of independent work on a Likert scale. As a result of the analysis, objective data demonstrating the impact of the introduction of AI tools on educational outcomes and features of learning dynamics were obtained. The experiment was conducted in accordance with the ethical principles outlined in The Guidance Note of the European Commission on Ethics and Data Protection (2021).

RESULTS AND DISCUSSION

Analysis of identified problems and their negative impact

The classification of problems in the use of AI and the author's approach to overcoming them are presented in Table 1. It should be noted that not all the named problems have been worked out by the author. It is intended to continue methodological research to cover all the missing problems. The following is a breakdown of each problem from the classifier.

Table 1. *Classifier of AI problems and approaches to their solution*

No.	Name of the problem	Author's approach
1	Reduced motivation for independent learning	+
2	Lack of AI skills	
3	Academic honesty	
4	Deformation of the critical thinking process	
5	Adaptations of teaching methods	+
6	Changing the assessment of knowledge	+
7	Digital competence gap	

Source: *developed by the author*

Reduced motivation for independent learning is usually due to the fact that AI services, such as ChatGPT, can independently solve problems, programme, write essays and perform other learning tasks that were previously performed by students. Students are able to get instant answers to complex questions, which makes the process of information retrieval and reflection unnecessary, resulting in students being less likely to engage in independent analysis, a reduced need to memorise and comprehend material, and a dependence on automated solutions. When a student receives a ready answer from an AI, he or she may think that he or she has understood the topic. However, superficial familiarity with information does not mean deep learning. It reduces the need to study the subject more thoroughly. If complex problems can be solved with the push of a button, students may lose interest in learning. The challenge that used to motivate them to find solutions on their own disappears. If knowledge can be obtained at any time with the help of AI, the question arises, "Why study when a machine can do everything for me?" This is especially true in disciplines where it is important not just to know the facts, but to understand the principles and be able to apply them in practice.

The lack of AI skills stems from the fact that not all students know how to effectively use AI for learning (Shevchuk & Hunaza, 2025). Some rely on it completely without validating information, while others do not understand how to use AI to improve their learning. Many educational institutions have yet to integrate AI courses, leaving students without the necessary knowledge. Teachers themselves often lack sufficient training to teach students how to use AI effectively. Students may not realise that AI does not always give reliable answers, have no knowledge of how AI learns and what data it is based on, leading to uncritical perception of information. Many students use AI only to get ready-made solutions, ignoring its potential as a learning tool. They don't know how to formulate queries properly to get more accurate and useful results. Some students do not realise the risks of plagiarism when using AI. Ignoring copyright and academic integrity can lead to serious consequences.

Problems with academic integrity are often associated with copying answers from AI without thinking about the material, which leads to violations of academic integrity. There is an increased risk of cheating, plagiarism and substitution of real knowledge with automated solutions. Students' actions with copying text without citing sources, recycling other people's ideas without critical thinking, automatic writing of essays, abstracts, and theses – also leads to violations of academic integrity. Many traditional plagiarism checking systems are not yet fully adapted to recognise AI-generated texts, which creates difficulties for teachers. Students may use AI to get answers during online exams, violating fair grading rules.

Deformation of the critical thinking process is manifested in the fact that students may accept AI answers as truth without fact-checking and logical analysis. This reduces the level of critical thinking and the ability to work with different sources of information. Critical thinking is the ability to: analyse information, find cause and effect relationships, compare different points of view, and formulate reasoned conclusions (Matviienko, 2022). When AI is overused without thinking, these skills can degenerate. Instead of analysing a text independently, a student enters a task into ChatGPT and receives a ready paraphrase, losing the skill of working with information. When writing an essay, the student uses data from AI without checking its validity and as a result refers to false facts. When preparing for an exam, the student does not learn how to solve problems, but simply copies ready-made solutions from the AI. When studying philosophy, the student receives brief definitions of concepts from the AI, but does not analyse them from different perspectives. In a discussion, the student may refer to the AI's opinion, but cannot explain why it is correct.

The need to adapt teaching methods is a very important issue that all educational institutions must address. Teachers have to change their approach to teaching, develop new formats of assignments that require thinking about the material rather than simply reproducing information. With the development of artificial intelligence, especially generative models such as ChatGPT, learners are able to quickly get ready-made answers, generate texts, perform calculations and even program without deep understanding of the subject. This calls into question the effectiveness of traditional learning methods that focus on memorisation, reproduction and routine tasks. There is a need to rethink pedagogical goals: instead of focusing on information assimilation, the importance of critical thinking, the ability to analyse, synthesise and make decisions independently is increasing. Teachers need to adapt their methods in order to: integrate AI as a tool in the learning process rather than perceive it as a threat, motivate students to think independently despite the availability of ready-made solutions, move from testing knowledge to as-

sessing skills, including the ability to work with AI, interpret its answers and critically evaluate them, update forms of control and assignments, making them less vulnerable to automatic generation. Thus, the problem of adapting teaching methods lies not only in technological changes, but also in the need to revise pedagogical philosophy, goals and approaches to teaching in the era of artificial intelligence (Onyshchenko & Serdiuk, 2025).

Changing knowledge assessment as a problem echoes to some extent the previous one, but the author singles it out as a separate item because of its importance, as classical forms of knowledge testing (tests, essays, homework) are losing their effectiveness. New methods of assessment are required – oral examinations, work with cases, practical tasks that require personal participation of the student. Thus, it is necessary to evaluate the process, not just the result. For example, instead of just handing in a finished software assignment, a student records a video explanation of his code. It is also important to introduce oral exams and interviews (for example, instead of a test on the subject, students participate in debates, defending different points of view), project and practice-oriented assessment – when instead of a test paper a student develops a mobile application or application solution and explains its functionality. Instead of one-off test papers it is possible to assess the whole learning process, to create a collection of the best works of a student during the course. Analysis of learning progress – the teacher sees the growth of skills. In a design course, a student does not submit one final project, but builds a portfolio of several works, showing the development of their skills. It is also possible to use AI detectors to check the originality of texts.

The digital competence gap means that not all students have the same AI skills, creating a digital divide. Those who know how to use AI effectively gain an advantage, while others may fall behind. The digital divide is the difference in digital proficiency between different groups of people. In education, it is expressed in the following ways: the difference between students – some students easily use AI for learning, while others do not even understand how to use it; the difference between teachers – some teachers actively implement technologies, while others prefer traditional methods; the difference between educational institutions – some universities are equipped with modern digital platforms, while others lag behind in technical development; differences in access to technology – not all students have powerful devices, stable internet and paid access to educational services.

The consequences for education without solving the above problems can be very unpleasant: without independent study of the material, students remember less information, analyse data worse; AI does not always give correct or relevant answers, and without analysis skills a student may accept any information uncritically; lack of in-depth knowledge and practical skills may lead to problems in the future, especially in professions that require analytical thinking and creativity.

Author's approach to teaching programming

Based on more than three years of experience in using AI and "fighting" its consequences, the author has developed some practical techniques to solve individual ones (Table 1). Adaptation to the problem of declining motivation for independent learning and adjustment of teaching methods was required immediately after the emergence of open access to AI. All teaching materials and manuals were previously built on solving local examples, such as, for example, to sort a two-dimensional numerical array, of dimension 10 by 20, in ascending order, using the bubble method. This task can be solved with the help of AI, by entering the text of this task into a query and immediately get the code of the solution in any programming language. The learning process in this case is reduced to a formal recording of task completion and zero learning outcome. In this study, the author proposes a pedagogical model for teaching programming using AI (Fig. 1). The model was tested on the academic discipline "Programming in Java".

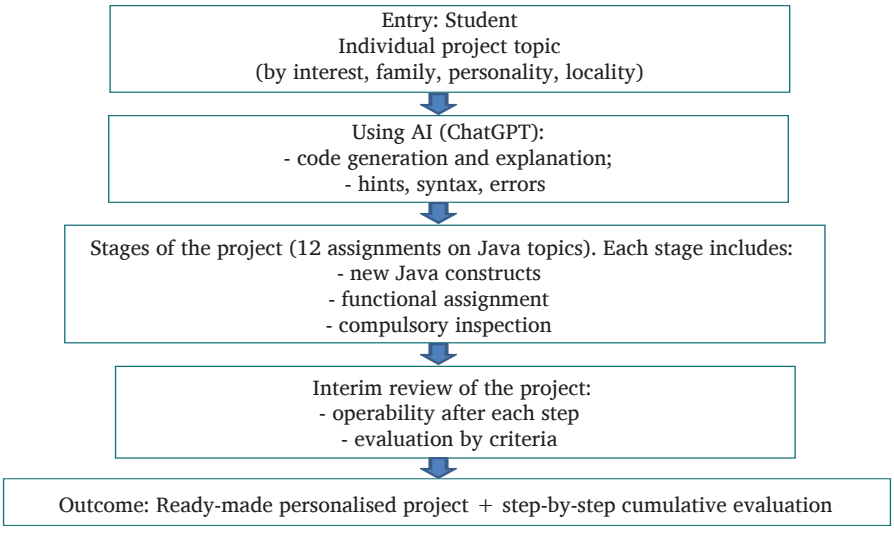

Figure 1. *Block diagram of the pedagogical model*

Source: *developed by the author*

The purpose of the pedagogical model of teaching the discipline "Programming in Java" with the use of AI was to develop practical programming skills, logical thinking and digital literacy in students, taking into account personal motivation, interests and active application of AI in learning activities. The principles of the model include:

- individualisation of learning: each student works on a unique topic related to their personal context;
- project structure: all learning activities are organised as a single project divided into linked tasks;
- AI integration: the use of ChatGPT and other AI tools is encouraged as part of practice, with an emphasis on code reflection;
- step-by-step mastery of the Java language: each step includes new language constructs;
- self-sufficiency of tasks: after each step, the project must compile and work correctly;
- continuity and obligation: skipping classes is not possible due to the dependence between stages;
- formative assessment: each task is assessed separately, the points are summarised;
- structure of the training process (Table 2).

The proposed pedagogical model in teaching the discipline "Programming in Java" is based on a number of key approaches. Among the pedagogical technologies used are project-based learning, competency-based approach and activity-based approach, which are complemented by formative assessment and digital didactics with artificial intelligence (AI) elements. In this model, the role of AI in learning is to provide support for creating code, generating examples and templates, explaining syntax and logic, and automating repetitive tasks. Importantly, AI is not a substitute for thinking, and students are required to modify and make sense of the generated code.

Table 2. *Structure of the training process*

Stage	Table of contents
1. Project setting	Assignment of the topic, formation of the assignment taking into account the student's interests
2. Planning	Division of the project into 10-12 phases/sessions
3. Classes	Each is a new Java construct + project functionality
4. Use of AI	Searching for solutions, explanations, testing with the help of AI
5. Control	Checking the result (whether the project works), analysing code correctness
6. Evaluation	Points for each assignment; final defence – summative assessment
7. Completion of the project	The project must be complete, workable and logically coherent

Source: *developed by the author*

The teacher's role includes methodological support, problem setting, individual counselling, formative assessment and control over the correct application of AI. The forms of control and evaluation provide for separate assessment of each task. The main evaluation criteria include absence of compilation errors, application of new language constructs, correctness of functionality, code quality (its structure and readability), and adequate use of AI. An important aspect of the model is ethical and legal standards. Project topics are developed taking into account the Law of the Kyrgyz Republic No. 58 "On Personal Information" (2008), students do not use personal data without consent, and AI is used exclusively for educational purposes.

As a result of implementing this model, it is expected that the student will develop a deep understanding of the Java language, valuable project development experience, a critical attitude towards AI-generated code, and the skill of incremental programme construction. This pedagogical model is scalable, allowing it to be applied to other disciplines such as Python, C++, Android development, databases and others due to its versatility.

Effectiveness of the developed pedagogical model

The developed model allows combining individual and competence-based approach with modern digital tools, including AI. It increases students' interest in programming, makes the process more visible and controllable. The model can be adapted to other languages and disciplines of technical profile. Further the mentioned techniques are considered in more detail.

For each student was asked to realise the project with a different option. Each option is related to data that are personal or local in nature, for example: "My hobbies"; "My street"; "Family history"; "Sports in Kyrgyzstan"; "Books in Kyrgyzstan"; "Films of Kyrgyzstan"; "Travelling in Kyrgyzstan"; "Banks in Kyrgyzstan"; "Famous people in Kyrgyzstan"; "Computers in Kyrgyzstan"; "Favourite music"; "Food in Bishkek"; "My studies"; "Health in Bishkek"; "Nature in Kyrgyzstan"; "My school"; "My hometown"; "Issyk-Kul"; "Animals of Kyrgyzstan". All variants were offered taking into account the Law of the Kyrgyz Republic No. 58 "On Personal Information" (2008).

The project was divided into sessions, for example, 12 sessions. Each lesson is a new programming material. For example, in the first lesson the topic was: "Main programme". Here the student learnt how to create new classes and objects, as well as how to organise input-output with control. The programme should give a list of modes. Some modes are mandatory: data entry, view and delete. To implement the main programme, a new class must be created, and for each mode also separate classes, initially "blanks". The student was required to come up with additional modes for their topic. The number of modes is at least four. For example, "Give out books for the specified year", "Give out tours of Kyrgyzstan in 2025" and so on. Each mode is a separate Java class. All classes should have names

according to their theme. Then, in accordance with his variant, the student realised his project. And the work was built in such a way that after each class, the project should fully work without errors. At each lesson students had to add one or more programming techniques as instructed by the instructor, but the project must remain functional. Dependency of classes is very important. It is impossible to skip classes because they are dependent on each other.

The author accepted the work in parts, according to the class number. This was possible because, according to the condition, the project must remain workable. Often, the programme code was not checked, but only the result of execution was viewed and the correctness of using the required programming technique, for example, the use of exceptions, was checked. This simplified the checking of assignments, which is also important, because with a large number of students and, consequently, topics, the load on the instructor increased significantly. If all criteria are met, the assignment is evaluated according to the rules adopted by the educational institution. For example, in 2024 the total number of points for the module was accepted 30. Therefore, the price of one completed assignment was 30:12 = 2.5 points. If an assignment did not fulfil the criteria, it was valued at zero points, but it was allowed to be handed in at one of the subsequent classes, with no possibility of starting the next assignment, due to interdependence. The final grade depended on the number of completed and defended assignments. A fully completed project gave the maximum grade, which in 2024-2025 was 30 points per module and 60 points per semester. In the final session, the project had to be completed in its entirety, in which case the student received the maximum number of points. Otherwise, the number of points depended on the number of defended classes.

To confirm the effectiveness of the outlined methodology, measurements and surveys were conducted: measurement of the complexity of the tasks performed by the number of programme code and student surveys to determine the level of independence and motivation. The general population for the experiment was represented by students in the speciality “Information Technologies” and “Business Informatics”. For the sample population were selected first year, second semester students for whom the author conducted classes on Java programming. The age of the students: 18-19 years old. Gender composition was approximately equal. The sample consisted of two groups of students: control group – students of 2021 year of enrolment and experimental group of 2024 year of enrolment. This was possible because the author kept the data on academic disciplines from 2007 to 2025, as well as the results of academic practical assignments for 2020 to 2025. The 2021 sample covered 65 students and the 2024 sample covered 87 students. Students in 2021 completed 12 practical assignments, of which 3 assignments were 12 academic hours and 9 assignments were 24 hours, totalling 36 hours. Students by the second semester had already acquired skills in the basics of programming, so the emphasis was on the features of the Java language, e.g., use of classes, various controls in data entry, I/O operations, exceptions, interfaces, etc.

At that time AI services were unknown to students, so the tasks were a separate standard variant for each participant, for example, to develop a class for entering the book title, author, year of release, price. The class should have a constructor, getter and setter. It was necessary to create an object of this class and perform the input. The second activity was to equip the input with control and re-entry. Such an assignment was designed for 4 academic hours. Other assignments were designed in a similar way and were not very dependent on each other, although even then there was an aspiration to unite all the assignments into one project. The complexity of the assignments for the academic years 2021 to 2022, when the AI services were unknown to the students, the amount of programming code, averaged about 250 statements per semester. The number of students in the control group that were counted was 65. The students who completed all the tasks were – 35 students. This category was considered successful by the author. Thus, the successful students were 54%. The category of “Successful” students was considered and analysed in the experiment. The average number of points for all students for the spring term, including successful students, of the control sample was 35 points.

Students in the 2024 entry year also completed 12 practical assignments, of which 3 assignments were 12 academic hours and 9 assignments were 24 hours, totalling 36 hours. Students by the second semester were also gaining skills in basic programming, so the emphasis was on the features of the Java language. AI services, in particular ChatGPT, were already well known to the students, so the assignments, in accordance with the principles outlined above, were an individual project, according to the model discussed above, which took into account the requirements of the curriculum and the personal or local characteristics of the student. For the experimental group (2024), the amount of programme code was 540 operators per semester. The number of students in the sample that were counted was 87. The students who completed all the tasks were – 59. This category was also considered successful by the author. Hence, the successful students were 59%. Thus, the complexity of the developed programme code increased by 2.16 times. The number of successful students increased by 5% (54 and 59), i.e., it changed but not significantly. The average score for all students for the spring term, including successful students, of the experimental sample was 46 points.

As an illustration of the proposed approach, a brief description of task No. 1 for option No. 12 “Health in Bishkek” is given. Students were required to develop a new class for data mode input, corresponding to the selected variant. The name of the class had to be in Latin or English, for example, WriteNumModeHealth. Inside the class, a list of modes was to be output, including the mandatory ones: “data entry”, “view entered data”, “delete” and “exit”. The total number of modes was to be at least eight,

and the missing modes were to be invented by the students themselves. The data storage structure included the name of the organisation (string), type (string with a choice from a list, e.g. "fitness" or "trade"), address (string), specialisation (string with a choice from a list, e.g. "volleyball" or "football") and telephone (format string). It was important to name all the elements of the programme in Latin letters, avoiding uninformative names like name1 or str2; names like PrintOpenChopCentre were recommended. The result of this task was displaying the name of the variant ("Health in Bishkek") in the Main class, displaying the list of numbered modes and entering one mode (WriteNumModeHealth class). Erroneous entry of the mode number was accompanied by a corresponding message and re-entry, and the "Exit" mode terminated the programme execution.

In order to assess the indicators of the level of independence and motivation, a survey was conducted. Students from the control group (2021 year of entry), numbering 62, and the experimental group (2024 year of entry), numbering 84, in the second semester of study took part in it. Students in the control group (2021 entry year), prior to the availability of publicly available AI services, were asked the following questions to assess programming assignments: 1. Rate the level of independent mastery of the material on a scale of 0 to 10. 2. Evaluate the level of interest in performing laboratory works on a scale from 0 to 10. Students in the experimental group (2024), who already had access to AI services, were asked similar questions, but taking into account the availability of AI: 1. Rate the level of independent mastery of the material on a scale from 0 to 10, taking into account the availability of AI services. 2. Rate the level of interest in laboratory works on a scale from 0 to 10.

The results of the survey showed that independence before the AI was 7.4 points on average, and interest (motivation) was 6.1 points. After the introduction of AI in the educational process, independence slightly decreased to 7.3 points, while interest (motivation) increased significantly to 8.3 points. All the obtained results of the author's experiment are presented in more detail in Tables 3 and 4.

Table 3. *Measurement results of the experiment by complexity (code volume)*

Category	2021 (control)	2024 (experimental)	%
	Number of operators	Number of operators	
Code scope	250	540	216

Source: *developed by the author*

Table 4. *Measurement results of the experiment (quality)*

Category	2021 (control)		2024 (experimental)		+/– %
	people	%, points	people	%, points	
Total students	65		87		+33
Successful students (60 points)	35	54%	51	59%	+5
Average number of points per semester (max = 60)	62	35 points	84	46 points	+18.3
Level of independence according to the survey on a 10-point scale	62	7.4 points	84	7.3 points	–1.35
Level of motivation according to the survey on a 10-point scale	62	6.1 points	84	8.3 points	+36

Source: *developed by the author*

The presented results clearly demonstrate that the integration of artificial intelligence in the educational process, especially in disciplines requiring practical application of skills, such as programming, is possible and even desirable, which is also confirmed in the works of G. Fan *et al.* (2025), A. Gaitantzi & I. Kazanidis (2025). Despite the potential challenges of decreased motivation and changes in knowledge assessment, the tested pedagogical model shows how the purposeful use of AI within individualised projects can significantly increase the complexity of students' tasks and increase their interest in learning (Ali *et al.*, 2024). This confirms the need for further research and methodological developments to fully overcome all the identified challenges and ensure the most effective and harmonious implementation of AI in modern education.

CONCLUSIONS

AI is a powerful tool that can both facilitate and complicate the learning process. To minimise the negative effects, it is important to develop students' critical thinking, digital literacy and self-control skills, as well as to modernise educational programmes, adapting them to the realities of the AI era. The paper analysed the problems caused by AI in education and, based on this analysis, defined a classification of these problems. For each problem there are generally accepted ways of their solution and, separately, to overcome the problem of decreasing motivation for independent learning, as well as to adjust teaching methods, the author has given the author's methods of preparation for programming classes, formalised as a pedagogical model.

The results of the experiment indicate the practical value of the considered pedagogical teaching model, and allow for drawing the following conclusion: students are forced to refine the project on their own, as the AI is not able to know personal or local data, so it can only develop general programme code that needs to be refined. Using class, subroutine, and data names according to variant also makes it difficult to use the AI directly; dividing the project into coherent, mutually related activities that do not allow "jumping" through an activity makes it difficult to use the

AI directly. These techniques stand on the side of prohibitions against unfair use of AI.

On the other hand, the use of topics related to personality, family, interests and place of residence stimulates interest in independent work. According to the results of the measurements, students began to perform more complex tasks, which was expressed in the amount of programme code. This was an increase of 216%. The number of successful students per semester increased by 5% and the semester grade point average increased by 18.3%. Student surveys were administered using two criteria: independence assessment and interest (motivation) assessment. The results of the survey showed a decrease in the level of autonomy from 7.4 to 7.3 points, which was –1.35%, and interest increased from 6.1 to 8.3 points, which was 36%. The results of the survey showed the expected result. AI services had a negative effect on autonomy but increased students' motivation as students' ability to develop software code increased significantly. Based on this research, the author considers the proposed methods of class preparation satisfactory and, in order to increase the level of autonomy, in the future, it is expected to provide a more rigorous and diverse approach to the evaluation of each assignment. One of the ways of such control could be cross-checking of the application by the students themselves, under the supervision of the instructor.

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Студенттерге жасалма интеллект сервистерине мүмкүнчүлүк ачылгандан кийин пайда болгон көйгөйлөрдүн классификациясы

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Аннотация. Изилдөөнүн өзгөчөлүгү искусственный интеллект (ИИ) технологияларынын билим берүү тармагында тез таралышы менен байланыштуу. Студенттердин ИИди колдонуусу өз алдынча окууга мотивацияны төмөндөтүү, академиялык адалдыктын бузулушу, сын ой жүгүртүүнүн начарлашы жана окутуу ыкмаларын өзгөртүү зарылчылыгын келип чыгарат. Изилдөөнүн максаты – билим берүүдө ИИди колдонуунун келип чыгарган негизги көйгөйлөрдү классификациялоо жана аларды чечүү жолдорун, анын ичинде программалоо үйрөтүү үчүн автордук педагогикалык моделди сунуш кылуу. Изилдөө ыкмаларына илимий адабияттарды талдоо, контрольдук жана эксперименттик студенттер топтору менен сыноо, натыйжаларды сандык жана сапаттык талдоо, сурамжылоо өткөрүү, программалык кодду анализдөө жана салттуу жана ИИди колдонгон ыкмаларды салыштыруу кирет. ИИ менен байланышкан көйгөйлөр классификациясы иштелип чыкты: мотивациянын төмөндөшү, ИИди колдонуу боюнча жетишсиздиктер, академиялык адалсыздык, сын ой жүгүртүүнүн начарлашы, окутуу ыкмаларын өзгөртүү зарылчылыгы, билимди баалоо стратегияларынын өзгөрүшү жана цифралык теңсиздик. Java программалоо тилин үйрөтүү үчүн персоналдаштырылган долбоорлорго негизделген педагогикалык модель сунушталды. Модель жеке долбоор тапшырмаларын, программалоо көндүмдөрүнүн этаптуу өнүгүүсүн, иштөөчү кодду текшерүүнү жана формативдик баалоону камтыйт. Сыноо натыйжасында модель программалык коддун көлөмүн 216 %, орточо бааны 18,3 %, студенттердин мотивациясын 36 % көбөйткөнү, ал эми өз алдынча окуу деңгээли бир аз гана төмөндөгөнү (–1,35 %) аныкталды. ИИди колдонгон окууда билимди баалоонун жаңы ыкмалары (ауызекүү корголуу, портфолиолор жана өз ара код текшерүү) зарылдыгы далилденди. Изилдөөнүн практикалык мааниси ИИдин терс таасирин азайтуучу жана программалоо көндүмдөрүн жогорулатуучу ылайыкталган окутуу методикасын иштеп чыгууда. Моделди ИИди колдонууну талап кылган башка дисциплиналарга да колдонсо болот. Натыйжалар окутуучуларга, окуу программаларын иштеп чыгуучуларга жана билим берүү саясатын иштеп чыгуучуларга пайдалуу

Негизги сөздөр: билим берүү; программалоо; педагогикалык модель; академиялык ак ниеттүүлүк; критикалык ой жүгүртүү; студенттерди шыктандыруу; санариптик теңсиздик

Классификация проблем, которые проявились при обучении студентов после открытия доступа к сервисам искусственного интеллекта

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Аннотация. Актуальность исследования обусловлена стремительным распространением сервисов искусственного интеллекта (ИИ) в образовании, что создает новые вызовы для педагогической практики. Использование ИИ студентами приводит к снижению мотивации к самостоятельному обучению, проблемам с академической честностью, деформации критического мышления и необходимости адаптации методов преподавания. Цель работы – классифицировать ключевые проблемы, возникающие при использовании ИИ в образовании, и предложить пути их решения, включая авторскую педагогическую модель для обучения программированию. Методы исследования включали анализ научных публикаций, эксперимент с контрольной и экспериментальной группами студентов, количественный и качественный анализ результатов, анкетирование, контент-анализ кода и сравнительный анализ традиционных и ИИ-интегрированных подходов. В результате исследования выполнена классификация проблем, включающая снижение мотивации, недостаток навыков работы с ИИ, нарушения академической честности, деформацию критического мышления, необходимость адаптации методов преподавания, изменение оценки знаний и цифровое неравенство. Предложена педагогическая модель обучения программированию на Java, основанная на индивидуализации, проектной структуре и интеграции ИИ. Модель включает постановку персональных проектов, поэтапное освоение материала, контроль работоспособности кода и формирующее оценивание. Эксперимент показал, что применение модели увеличило объем выполняемого кода на 216 %, средний балл – на 18,3 %, а мотивацию студентов – на 36 %. При этом уровень самостоятельности снизился незначительно (–1,35 %). Установлено, что использование ИИ в обучении требует пересмотра методов контроля, включая устные защиты, портфолио и перекрестную проверку работ. Практическая ценность работы заключается в разработке адаптивной методики преподавания, которая минимизирует негативное влияние ИИ и способствует развитию навыков программирования. Модель может быть масштабирована на другие дисциплины, требующие практического применения ИИ. Результаты исследования полезны для преподавателей, методистов и разработчиков образовательных программ

Ключевые слова: образование; программирование; педагогическая модель; академическая честность; критическое мышление; мотивация студентов; цифровое неравенство