



Развитие критического мышления будущих педагогов при работе с сервисами генеративного контента

Е. А. МАМАЕВА, Д. Ю. ЛЯПУНОВ, З. В. ШИЛОВА, Н. Н. ШАДРИНА

АННОТАЦИЯ

Проблема и цель. Одна из проблем высшего образования – поиск эффективных форм обучения, обладающих дидактическим потенциалом в плане развития системного, критического, креативного и других типов мышления, востребованных цифровым обществом. Авторы предлагают для формирования критического мышления как универсального навыка, соответствующего вызовам трансформации и глобализации, использовать средства технологии искусственного интеллекта. **Цель исследования** – выявить возможности информационного взаимодействия будущих педагогов с сервисами генеративного контента для развития их критического мышления.

Методы исследования. В качестве образовательного сервиса генеративного контента, позволяющего создавать новый электронный материал дидактического назначения, используется нейросеть Aiguso. Опытно-поисковая работа проведена на базе Вятского государственного университета (Российская Федерация). Задействовано 72 студента направления подготовки – 44.03.05 Педагогическое образование, профиль "Предметное обучение, Технологии обучения и воспитания". Для оценки уровня критического мышления авторами разработан тест, учитывающий умения, выделенные Б. Блумом. При статистической обработке данных использован критерий χ^2 -Пирсона.

Результаты. Особенность представленного варианта деятельности: с одной стороны, сервис генеративного контента является объектом изучения (политика использования, возможности, шаблоны, панель инструментов). С другой стороны, применение сервисов генеративного контента – это дополнительный ресурс для развития критического мышления. Работа будущих педагогов экспериментальной группы организована по следующим этапам: изучение сервиса по инструкции, применение функционала и генерация нового материала, обсуждение и формулирование промежуточных выводов; анализ и оценка результата. Студенты применяют инструменты нейросети Aiguso для написания академических эссе и статей, редактирования текста и сохранения его в разных форматах, проектирования диалога с виртуальным ассистентом, генерации изображений. Выявлены статистически достоверные различия в качественных изменениях, произошедших в педагогической системе ($\chi^2 = 6,527$; $p < 0,05$).

Заключение. Определены факторы, влияющие на качество применения сервисов генеративного контента для развития критического мышления педагогов: возможности анализа больших данных, выявление закономерностей и противоречий; интерактивность взаимодействия; создание оригинального оформления и уникального диалога; прогнозирование результата.

КЛЮЧЕВЫЕ СЛОВА

цифровизация общества, онлайн-сервис, контент образовательного назначения, педагогическая деятельность, информационное взаимодействие, нейросеть, Aiguso

Для цитирования: Мамаева Е. А., Ляпунов Д. Ю., Шилова З. В., Шадрин Н. Н. Развитие критического мышления будущих педагогов при работе с сервисами генеративного контента // Перспективы науки и образования. 2025. № 5. С. 681–694. <https://doi.org/10.32744/pse.2025.5.44>

Поступила: 27.04.2024 | Одобрена: 21.06.2025 | Опубликована: 31.10.2025



Лицензия «С указанием авторства — С сохранением условий». Позволяет перерабатывать, исправлять и развивать произведения при условии указания авторства и лицензирования производных работ на аналогичных условиях.



Developing critical thinking in future teachers when working with generative content services

E. A. MAMAEVA, D. YU. LYAPUNOFF, Z. V. SHILOVA, N. N. SHADRINA

ABSTRACT

Problem and aim. One of the problems of higher education is the search for effective forms of training that have didactic potential in terms of developing systemic, critical, creative, and other types of thinking in demand in the digital society. The authors propose to use artificial intelligence technology to develop critical thinking as a universal skill that meets the challenges of transformation and globalization. The purpose of the study is to identify the possibilities of information interaction between future teachers and generative content services to develop their critical thinking.

Research methods. The Airuco neural network is used as an educational service of generative content that allows the creating of new electronic material for didactic purposes. The experimental and search work was carried out based on Vyatka State University (Russian Federation). 72 students of the training program – 44.03.05 Pedagogical education, profile "Subject training. Teaching and Education technologies" are involved. To assess the level of critical thinking, the authors developed a test that takes into account the skills identified by B. Bloom. In statistical data processing, the Pearson's chi-squared test was used.

Results. The peculiarity of the presented activity: on the one hand, the generative content service is the object of study (use policy, capabilities, templates, toolbar). On the other hand, the use of generative content services is an additional resource for the development of critical thinking. The work of future teachers of the experimental group is organized in the following stages: studying the service according to the instructions, using the functionality and generating new material, discussing and formulating intermediate conclusions; analysis and evaluation of the result. Students use the Airuco neural network tools to write academic essays and articles, edit text and save them in different formats, design a dialogue with a virtual assistant, and generate images. Statistically significant differences in the qualitative changes that occurred in the pedagogical system were revealed ($\chi^2 = 6.527$; $p < 0.05$).

Conclusion. The factors influencing the quality of the application of generative content services for the development of critical thinking of teachers are identified: the possibilities of big data analysis, identification of patterns and contradictions; interactivity of interaction; creation of original design and unique dialogue; forecasting of the result.

KEYWORDS

digitalization of society, online service, educational content, pedagogical activity, information interaction, neural network, Airuco

For Citation: Mamaeva, E. A., Lyapunoff, D. Yu., Shilova, Z. V., & Shadrina, N. N. (2025). Developing critical thinking in future teachers when working with generative content services. *Perspektivy nauki i obrazovaniya = Perspectives of Science and Education*, (5), 681–694. <https://doi.org/10.32744/pse.2025.5.44>

Received: 27 April 2025 | Approved: 21 June 2025 | Published: 31 October 2025



This is an open access article distributed under a Creative Commons Attribution-ShareAlike International License (CC-BY-SA 4.0) that allows others to share the work with an acknowledgement of the work's authorship and initial publication in this journal

INTRODUCTION

At the World Economic Forum held in Davos in January 2025, experts analyzed changes in 42 indicators [1]. They combined them into five groups: "trade and investment", "innovation and technology", "climate and resources", "health and well-being", "peace and security", and determined that the main factor in shaping the information space remains a person. Among the key skills of a modern person, scientists recognize the leading role of critical thinking [1]. Although in the Atlas of New Professions, developed under the auspices of the Agency for Strategic Initiatives, not critical, but systemic thinking is defined as one of the most sought-after skills of the future [2]. Experts from the National Research University Higher School of Economics determine that systemic thinking is largely related to the 4K concept. It is impossible to critically evaluate information without creativity and the ability of a person.

International recommendations on the ethical aspects of the development and application of artificial intelligence were formulated within the framework of the UN General Conference on Educational, Scientific, and Cultural Affairs. It should be noted that the document does not contain any strict restrictions on the use of AI. As a result, there is an active introduction of AI models (in particular, services for generating various content) into the training, education, and development of members of a modern digital society [3]. For Russia, the provisions of the Federal Law No. 123-FZ determine that the use of AI for various spheres of public life is still under an experimental legal regime [4]. Therefore, many controversial situations arise: whether it is worth using generative neural networks in training; and how AI algorithms will contribute to the quality of improving education and training of in-demand specialists for the digital economy.

D. Okti, S. Solfema, Y. Karneli point out that the digital modernization of society and education has significantly changed the didactic landscape, requiring educators to adapt to technological innovations and the pace of their development [5]. J. Dempere et al. note the transformative role of ChatGPT and the need for appropriate training of educators to implement generative networks in the educational process [6]. M. Ali and L. Guibas note that, unlike traditional teaching methods, most of which are based on the passive transfer of information, ChatGPT involves students in interactive information interaction [7]. Such interaction is based on dialogues, problem-solving tips, and critical assessment tasks. The key advantage of ChatGPT in education, according to the authors, is its ability to provide a personalized learning experience. Moreover, ChatGPT supports the development of critical cognitive skills by simulating real interaction scenarios and facilitating productive discussions. Thanks to interactive dialogues, students can practice solving real problems in a "virtual" space. At the same time, conditions are created that ensure that students achieve academic success. At the same time, teachers themselves must consciously use generative neural networks, and critically approach their choice. And apply AI under educational goals and standards.

T. V. Kornilova and V. A. Savelyeva determine that critical thinking is an integrative construct reflecting the relationship of many different processes, both cognitive and emotional-personal [8]. However, as J. J. van Rensburg and W. Rauscher argue within the framework of complex analytical work: there are not enough systematic complete studies that could help teachers understand the essence of critical thinking and apply it within the framework of didactic interaction in the information environment [9].

Research hypothesis: organizing practical activities of teachers with generative content services will provide additional resources for developing their critical thinking as an important skill of a sought-after specialist of the future.

The purpose of the work – is to identify the possibilities of generative content services for developing the critical thinking of future teachers.

Research objectives:

- clarify the problems and possibilities of using generative content services in teaching students of pedagogical specialties;
- describe options for using generative services in the work of teachers, taking into account their future work functions;
- identify factors influencing the quality of using generative content services for developing critical thinking of future teachers;
- experimentally test the effectiveness of the proposed option for organizing practical activities when teaching students.

MATERIALS AND METHODS

Generative content is the material obtained using AI algorithms, which can take various forms: text, code, image, presentation, table, panorama, model, video, and audio. The educational service of generative content is an online resource that allows you to create new content for didactic purposes. Critical thinking of a teacher is his or her ability to analyze information obtained using generative neural networks, using the laws of logic; make judgments and reasoned decisions. It helps not to take anything on faith without evidence, but at the same time be open to new ideas and methods.

The experiment involved 72 first-year students of the Faculty of Pedagogy and Psychology of Vyatka State University (Russian Federation). Field of study – 44.03.05 Pedagogical education (with two training profiles), profile "Subject training. Teaching and Education technologies". The average age of students is 18 years (75% – female, 25% – male).

The authors of the study chose Airuco (<https://lk.airuco.ru/register>) as the main service of generative content with which students interacted. This is a domestic neural network that generates texts, articles, and other content to solve problems of professional activity. It allows you to easily create descriptions, and reveal the essence of the phenomena and processes being studied. It works on the basis of Chat GPT and offers more than 30 types of templates. When choosing the service, the advantages of its use, examples of generation, and the main built-in tools of the function were analyzed. A comparison with other analogs was made. User reviews, tariff plans, and terms of use of Airuco were studied. The functions of the service that were actively used in teaching and organizing information interaction aimed at developing students' critical thinking: paraphrasing and rewriting, creating descriptions for videos, a team of assistants in designing dialogues, content randomization, a document editor, and templates.

The following services were used as auxiliary services in the classes: YandexGPT (for example, as an alternative to Airuco and comparing them on several positions) and Gamma AI (for joint work on a project; creating presentations based on the results of discussions with the addition of argumentation text, images, animation and video).

Future teachers were involved in working with generative content services studying the discipline "Digital Information Processing Technologies". In the presented study, the authors adhere to the criteria of skills identified by R. Bloom to assess the development of critical thinking. The levels of students' critical thinking were assessed according to the following criteria: 1) knowledge (data and facts from the field of professional activity and related areas); 2) comprehension (interpretation of data and facts); 3) application (application of interpreted information in new professional situations to support/refute an opinion); 4) analysis (comparison of intermediate conclusions according to criteria significant for a professional situation); 5) generalization (formulation of a conclusion); 6) assessment (determination of validity, reliability, impartiality of conclusions).

For diagnostics, the authors of the study developed a test of 60 questions (for each question on the Bloom criterion). The correctness of the question was assessed from 2 points. To formulate a conclusion about the formation of critical thinking, the level was calculated as follows: 110 and more – "high", 50-109 – "average", 49 and less – "low". A more accurate methodology and interpretation – of the program and the results of the study. A control (36 teachers) and an experimental (36 teachers) group were formed. In statistical data processing, the Pearson's chi-squared test was used.

LITERATURE REVIEW

S. Zhao examines an innovative system for assessing professional education based on the theory of multiple intelligences [10]. The author's study is a variant of the practical application of the theory of multiple intelligences, a direction for future educational reforms. D. Okti, S. Solfema, and Y. Karneli provide a comprehensive review of the literature on the required personality traits and competencies of teachers in the era of globalization, especially digital skills, innovative teaching methods, and the ability to adapt socially [5]. D. Okti, S. Solfema, and Y. Karneli highlight such aspects as digital literacy, creativity, and critical thinking. They also emphasize the problems of relevant innovations: the digital divide, the need for continuous improvement of professional skills, and the mental unpreparedness of some mentors for radical changes. E. V. Soboleva et al. prove that programming,

the development of a virtual game world is one of the effective original and non-standard techniques and ways of solving educational contradictions, problems, and difficulties [11].

R. Ganguly notes that radical changes caused by technological innovations, challenges of the digital society, and the geopolitical situation leave their mark on the role of teachers and school principals [12]. They should not only be able to independently manage future changes in the educational system but also be their initiators. Therefore, it is necessary to create conditions for participants in the didactic process that promote their involvement in learning, and the development of a digital culture of cooperation and critical discussion. The latter presupposes the formation of skills and abilities that form the basis of human critical thinking. E. Mäkiö and J. Mäkiö determine that critical thinking is one of the most important skills of the 21st century, which will become increasingly important according to employers [13]. However, many graduates of higher education institutions often lack the formation of those skills and abilities that form the basis of critical thinking.

J. Dempere et al. determine that the rapid development of AI necessitates a unified mental effort by all participants in the didactic process aimed at understanding the consequences of its implementation in the educational space [6]. The authors systematize various points of view on the potential of ChatGPT in education. They note the positive aspects of ChatGPT in education: research support, automated assessment, and optimization of human-computer interaction. Among the problems of innovations, J. Dempere et al. highlight: the need to ensure the security of online testing and track plagiarism, the digital literacy gap, violation of privacy, misuse of resources, bias, misinformation, a decrease in direct personal interaction and increased anxiety from virtual communication with a bot [6]. M. Ali and L. Guibas emphasize that the integration of generative AI tools such as ChatGPT into educational practice opens up innovative opportunities for the formation of a new approach to learning and the emergence of new tools for the development of cognitive skills [7]. The authors substantiate that ChatGPT is becoming a powerful tool for transforming traditional teaching methods, supporting interactive interaction, and developing cognitive skills.

C. Kooli presents a comprehensive review of the main potential problems associated with using chatbots in education [14]. The author studies the advantages and limitations of AI systems and chatbots, as well as their role in supporting human activity and judgment. The author concludes that the methods of assessing student work in a new era of education should be more creative and innovative. The article emphasizes the need for teachers to adapt to the new reality of active AI and chatbot implementation systems. Y. Wu considers the consequences of ChatGPT integration into the educational space, focusing on critical thinking [15]. The author points out that with the advent of ChatGPT and its rapid integration into education, teachers face such a dual problem: on the one hand, neural networks are innovative tools for improving the quality of education. On the other hand, they can create conditions that hinder the development of critical thinking and students' analytical skills.

N. A. Sheerawi et al. discuss the impact of digital tools on the level of logical and mathematical intelligence of future mathematics teachers [16]. The authors identify the problem of using exclusively traditional curricula for teaching mathematics, which leads to low student performance. According to the scientists' conclusions, the use of innovative tools contributes to the development of cognitive skills of all participants in the didactic process. M. Tashtoush et al. evaluate the effectiveness of AI methods and algorithms on the critical thinking skills in mathematics among secondary school students [17]. The authors found significant improvements in the level of critical thinking among students in the experimental group exposed to AI methods. Particular shifts are noted in deduction, interpretation, inference, and evaluation. The results of M. Tashtoush et al. prove the effectiveness of AI-based methods in improving both critical thinking skills and attitudes towards mathematics [17]. As a development of their study, the authors propose making appropriate changes to the training program for mathematics teachers.

R. Telussa, J. Kaihatu, and P. Arjanto evaluate how problem-based learning using AI elements can help in developing critical and creative thinking in 7th-grade students when teaching mathematics [18]. K. Reddy and G. Lakshmi determine that the use of digital and virtual technologies in teaching is the norm of the information educational space of the twenty-first century [19]. Therefore, their use in the development of critical thinking is not an exception. The authors point out that although several studies have been presented on the development of critical thinking using virtual/online tools, there are practical problems in the usage of new digital tools by teachers. Their experience describes the practice of students creating digital stories that contribute to the development of creativity and

critical thinking. A similar study is conducted by E. V. Soboleva et al., who evaluate the didactic possibilities of students' activities in creating timelines for their creative thinking development [20]. R. W. Santana, M. J. Alonzo, D. Cruz-Mena prove that interactive forms of interaction in a virtual format can be considered as a way to move away from the routine style of activity and search for optimal ways of further activity [21].

S. Wang et al. note that the development of AI: has profoundly affected the education sector; has opened up opportunities to improve the skills of teachers. Based on the study results, the authors offer recommendations to encourage teachers to use intelligent learning systems [22]. A. N. Lyonga, G. Moluayonge, A. Nkeng study the relationship between the skills that form the basis of computer literacy, teachers and their performance [23]. The authors recommend that practicing teachers know how to optimally and effectively combine the content of the subject area, teaching methods and innovative computer technologies to organize interaction in the classroom. M. Y. Tsenov and M. A. Bakracheva determine that digital competence should be considered a key position determining the demand for a teacher in the labor market and the field of education [24]. At the same time, the authors prove that there is no single attitude among scientists and methodologists to AI and its role in the professional self-realization of a teacher. The results of the study describe forms of critical and conscious choice of AI to support the activities of young teachers. The results of the study describe the forms of critical and conscious choice of AI to support the activities of young teachers.

E. A. Mamaeva, E. V. Shchedrina, L. A. Zhuravleva consider the possibilities of using game tools to develop critical thinking [25]. The authors based on the criteria proposed by B. Bloom. E. A. Mamaeva, E. V. Shchedrina, L. A. Zhuravleva note that studying new material in the format of quest rooms will not only contribute to increasing the motivation and involvement of students but also create additional conditions for them to acquire skills in analyzing data from the surrounding world, converting information from verbal form into a computer model, evaluating the resulting model and reasoned discussion of the results of cognition. E. A. Mamaeva et al. determine that the information interaction of future teachers during the design and technical implementation of the student's dialogue with the chatbot supports: cognitive and metacognitive development, solving educational and professional problems of a practical orientation, involving the implementation of plans and projects, tasks of analyzing the results of work based on their inclinations and interests [26].

S. P. Elshansky in his research tries to find an answer to the question of whether artificial intelligence can provide cognitive efficiency of learning [27]. The author identifies and analyzes such factors as gadget stress, misunderstanding of what has been read (functional illiteracy), different cognitive readiness of students in the classroom, and insufficient educational attention. A. V. Rezaev, A. M. Stepanov, N. D. Tregubova believe that in the era of AI, a fundamentally new approach is needed to understanding what higher education is and how to ensure high-quality training of in-demand specialists [28]. M. V. Vinichenko et al. identify the nature of threats and risks for humans and society from digitalization and the introduction of artificial intelligence from the perspective of Russian and Slovak students of generation Z [29]. The study allowed the authors to conclude that digitalization and AI provide comfortable conditions for the life of the younger generation. But at the same time, the danger of human dependence on the digital virtual environment is increasing.

I. A. Aleshkovski et al. prove that it is important for higher education and society as a whole to understand how students react to the new capabilities of AI, how they apply its resources in cognition, and how they evaluate their experience of using new technologies. In the article, the authors provide figures and facts on how Russian students evaluate their personal experience of using neural networks in educational activities [30]. Also, I. A. Aleshkovski et al. highlight the most popular AI functions and characterize the students' satisfaction with these functions. The authors propose to revise the forms of students' independent work, the wording, and the content of final and test assignments.

The performed analysis of the literature allows us to objectively conclude that:

- the introduction of AI-based models and algorithms, including services for generating didactic content, is an important area of modernization of education at the university;
- systematic teacher training is required, including practical activities to develop the critical thinking of digital school mentors, regarding their mastery of methods, ways of understanding, evaluating and applying AI models in their future professional activities.

RESEARCH PROGRAM

At the first stage, an analysis of literature and innovative practices on the use of AI algorithms in training and personal development was conducted. Various generative content services and their didactic potential (for working with text, images, videos, panoramas, code, presentations, etc.) were considered. Here, AI services that allow simultaneous work with the content of various contents (paraphrase texts, design scripts, create images) were highlighted. The authors specified Airuco and Gamma AI as such "magic" resources. However, the choice was made in favor of the first service, according to the criteria from the research methodology. The content of the discipline "Digital Information Processing Technologies" was clarified in terms of allocating time resources for working with generative content services.

Here, a methodology for assessing the level of critical thinking was selected. The authors reviewed the test for assessing critical thinking in schoolchildren (Yu. F. Gushchin), the "Complex Analogies" method by E. A. Korobkova, the "Exclusion of Concepts" method (adapted by A. A. Karelin), and Bloom's taxonomy. Reasons for choosing the following technologies: structuring the educational process, accurate and objective assessment, identifying gaps in knowledge, assistance in assessing the effectiveness of training and one's own actions. According to the criteria (knowledge, comprehension, application, analysis, generalization, evaluation), the authors formulated questions for testing first-year students studying in the field of 44.03.05 Pedagogical education (with two training profiles), profile "Subject training. Teaching and Education technologies". Examples of questions:

- according to the criterion "knowledge": define the concept of "digitalization of education";
- according to the criterion "comprehension": explain the meaning of each of the terms included in the concept of "digitalization of education";
- according to the criterion "application": it is necessary to develop a form designed for registration for an event and collecting information on the results of a completed event. Recommend a suitable online service;
- according to the criterion "analysis": indicate the advantages of the service recommended for registration for an event and collecting information on the results of a completed event;
- according to the criterion of "generalization": give examples of the use of digital services for information exchange between team members;
- according to the criterion of "evaluation": list at least three positive changes in the ways of interaction between participants in the educational process that have appeared as a result of the digitalization of education.

The integrated indicator for formulating a conclusion about the development of critical thinking was calculated as follows: 110 or more – "high", 50-109 – "average", 49 or less – "low".

In the second stage of the study, students studied the materials of the discipline and worked with services for generating didactic content. First, according to the instructions, they completed a creative task reflecting the specifics of their training.

In the third stage of the study, factors influencing the quality of the use of generative content services on the development of critical thinking of future teachers were identified.

RESEARCH RESULTS

The course "Digital Information Processing Technologies" is studied by students, future teachers, in the second semester of the first year. Approximate list of topics studied: "Digitalization of Society and Education", "Classification of Information Technologies", "Digital Educational Environment", "Digital Educational Resources", "Information Security", "Digital Technologies for Processing Text Information for Educational Purposes", "Digital Technologies for Processing Tabular Information for Educational Purposes", "Digital Means of Presentation Graphics and Visualization of Information for Educational Purposes", "Application of Cloud Technologies in Education".

As part of the lesson devoted to studying the range of digital educational resources, the teachers of the course together with the students during a brainstorming session highlighted the advantages of using AI in the work of a digital school teacher: automatic checking of assignments and tests; creation of individual curricula; development of new teaching methods; formation and development of student motivation; analysis of the emotional state of students; development of online courses and distance learning programs. Here we also looked at various services for generating text (CopyMonkey), images (Shedevroom), spreadsheets (GPT Excel), scripts (Gamma), and presentations (Wepik).

Their didactic capabilities in checking written work are highlighted (for example, <https://rehand.ru/#rates>). Or resources for checking spelling, style, and grammar, which helps to correct and paraphrase texts (LanguageTool), and checking practical reading skills (<https://skorochtenie.online/test>). Then, all participants were divided into experimental and control groups using control testing materials.

Stage "Critical understanding of the results of "foreign" analytical activity". Participants in the experimental group were asked to do the following work: check the current information from neural network developers for the relevance of functionality, and tariffs. For example, students found that the Yandex.Practicum Code magazine contains the material: "Neuronki-2025: an overview of the best for creating images". Also, during the analytical work, future teachers established that the text was updated on 01/16/2025, but some of the information in the article, unfortunately, is out of date.

Fact 1. For example, the article says about Shedevroom that "Shedevroom only works in mobile application (App Store, Google Play), generation takes a couple of minutes. For one request, 4 options are created that cannot be edited. On the site, you can view images generated by requests from other users, rate pictures, comment, or forward them". But in practice, it has been verified that on the Shedevroom website, since last year, you can create 70 pictures and videos.

Fact 2. It is written that Lexica "in the free version, you can create up to 48 images per month (four are written off per request)". When opening an account in the neural network, users from the Russian Federation do not have free options. A subscription is required. And so on. The conclusion that was formulated in the experimental group: you can (even should) view the services from the review, but not all the information is relevant at the moment.

Then the students studied each of the information technologies in detail: text processing technology, graphics, and spreadsheets. The logic of their study: purpose, basic concepts, functional capabilities, and application for solving practical problems. As part of the lesson "Application of cloud technologies in education", students were asked to do a project, a creative task: 1) study the service for working with generative content according to a short instruction from a mentor; 2) apply the service to support the didactic process on materials from their professional interest.

As noted earlier, the authors of the presented study chose Airuco as a key service for organizing information interaction. Stage "Studying the service according to the instructions". Register on the website and log in to your account (<https://lk.airuco.ru/user/templates>).

1. Study the vertical toolbar: Templates, AI Article Wizard, Smart Editor, AI Editor, AI Image, Text Voiceover, Speech Recognition, Chat with AI, and others.

2. For each item of the vertical menu, a horizontal menu also opens. For example, the AI Article Wizard contains "Get Ideas", "Summaries", "Topics for Discussion", and "Images".

2.1. Let's look at an example of the function working on the topic for the article "Critical Thinking in a Digital Society". Enter this phrase in the topic block (by definition, use a maximum of 2000 characters). Number of topics: 3. Set the maximum number of keywords and their meanings. For example, 10 words and meanings – "criticality, competence, digitalization, analysis comparison, demand, information". Idea options from the service: "Comparison of the demand for information", "Analysis competence in digitalization", and "The role of criticality in a digital society".

2.2. Select the topic "The role of criticality in a digital society" and go to the next step. Similarly, configure the number of notes (3) and the number of subheadings (5). One of the options for 5 subheadings of the note: "Teaching criticality in a digital environment, The role of education in

developing critical thinking, Analysis of students' digital skills, Comparison of educational programs on digital literacy, The need to introduce critical thinking into the educational process."

2.3. Select the specified summary and then go to the "Topics for discussion" step. Here you can customize the structure of the article and get a set of key points from the service. For example, for the subheading "Teaching criticality in the digital environment", the service will offer 2 key points: "Criticality is an important competence in the digital environment", and "Analysis and comparison of information are key skills".

2.4. In the next step, add images to your article. Images are also generated by the service based on keywords.

3. To switch to chat mode, select the appropriate tool in the vertical menu. The process of communicating with the bot itself is carried out through a dialog box. Choose the role of the interlocutor depending on what task you have. Take the first role-playing chat with AI (with the "Travis Guider") and find universities in Kirov.

4. Independently study the remaining tools of the vertical menu. The "Generation of personalized content" stage. At this stage, each participant used assistants (and other tools) specifically for their professional field. For example, they defined what "digitalization of education" is. Or they wrote an academic essay on the use of AR/VR in education.

Stage "Discussion and formulation of intermediate conclusions". During the discussion, based on the results of the work described above, the participants identified the key functional capabilities of Airuco:

Paraphrasing and rewriting. The presented online neural network is a text generator that paraphrases content without losing its original meaning. Allows you to increase the uniqueness of content for SEO optimization.

Creating descriptions for videos. The AI text generator can automatically create interesting and creative descriptions for videos. Descriptions are generated based on introductory information about the video: keywords and other initial data.

Chatbot for dialogues. Airuco provides the ability to communicate with a chatbot that will help in solving various problems in a dialogue format. If clarification or revision is required, it is necessary to specify the task. The intelligent assistant will rework the answer taking into account the new input data.

Content randomization. The online text generator allows you to create many unique versions of the same text. The function can be used for announcements, short descriptions, and notes. Airuco allows you to preserve the humanness of the text as much as possible.

Convenient document editor. The platform provides a convenient built-in editor for modifying and formatting the created content. Users can edit texts directly on the platform, and save them in various formats, including PDF, Word, and TXT. The editor supports the import and export of files and simplifies working with documents.

Templates. The platform offers a wide selection of templates for various tasks. You can use a lyrics generator for a song, ideas for a blog, or create advertising texts or articles on a given topic. Templates are constantly updated and replenished.

Stage "Conclusion in the format of a presentation". Participants of the experimental group made a presentation in which they presented the results of their information interaction with the service tools.

Methodological recommendation 1. Note that future teachers could use an alternative service, for example, YandexGPT. In the presented study, only two students took advantage of the proposed opportunity.

Methodological recommendation 2. Future teachers could develop a presentation both independently and with the help of a generative content service, for example, Gamma AI.

Stage "Critical understanding of the results of their analytical activity". At this stage, students analyzed the results of their interaction with generative content services. Here is one of the answers received during critical understanding: "Artificial intelligence technology still has its shortcomings, so it is recommended to double-check its answers. Neural networks are not yet capable of producing the very product of cognitive activity that a person is capable of creating. But being an irreplaceable information and creative assistant is quite possible". Since there was an option to use the alternative YandexGPT service. It was suggested to compare the functionality (advantages and disadvantages). For example, the advantages of YandexGPT: it is free and works in Russia without restrictions; there is a function of a brief retelling; it saves time when you need to get acquainted with a large amount of material. Disadvantages: it makes mistakes in facts, often makes things up; it does not always personalize the request. Pros of Airuco: it operates on the basis of ChatGPT, designing the structure of an article/essay, description, or development idea. Cons: the quality of the generated images does not meet the requests and expectations, only 10,000 characters and 5 images are free. Based on the results of this stage, future teachers formulated the following recommendations for the use of generative AI services in the work of a digital school mentor:

1. Clearly define the goals and objectives. Before choosing an AI service, determine what didactic tasks you want to solve;
2. Study the functionality and tools of AI services that suit your needs. Check out various platforms for the specifics of your didactic aspirations;
3. Evaluate the quality and accuracy of responses to your prompts - the results of the activities of online services;
4. Consider the cost and tariffs of use;
5. Pay attention to other users' reviews and their objectivity. But remember that self-testing is the main selection criterion.

The participants in the control group also developed a project demonstrating the use of cloud technologies in education. However, AI services usage was not a mandatory criterion for completion. Topic options: "Prepare a newsletter providing information on the main objects that may be subject to intentional or unintentional impact, from the point of view of the information security of the educational organization"; "Develop an interactive application for knowledge control in a game form (for example, to check how the multiplication table by 2 is learned). Use any software"; "Develop a test task of 7 questions of different types on one of the topics of your subject area, using any of the online test designers known to you". After the experimental work on the proposed stages, testing was again carried out to determine the teacher's level of critical thinking. To interpret the results, the following levels were introduced: "high", "low", and "average".

"High level" – the student independently, without errors and in compliance with the principles of ethics and information security used generative content services to obtain knowledge (data and facts) from the field of professional activity and related areas. The future teacher used the service for understanding (interpretation of data and facts), applying the information in new professional situations to support/refute an opinion, comparing intermediate conclusions, formulating a conclusion, and a final assessment.

"Average level" – the student, with minor assistance from a mentor, with one or two minor errors, used generative content services in his/her activities, according to Bloom's taxonomy.

"Low level" – the student needed intensive assistance from a teacher, both in mastering the generative content service and applying it in practice to solve professionally oriented problems. In most situations, the student did not think about the need to comply with the principles of ethics and information security when implementing AI algorithms in didactic interaction. Table 1 presents the results of the assessment of intellectual skills as indicators of the development of critical thinking of future teachers before and after working with services for generating various content.

The following hypotheses were accepted: H_0 : the level of critical thinking of future teachers in the experimental group is statistically equal to the level in the control group; H_1 : the level in the experimental group is higher than the level of the control group. For $\alpha = 0.05$, χ^2_{crit} is equal to 5.991. It was determined that $\chi^2_{obs.1} < \chi^2_{crit}$ ($0.064 < 5.991$), and $\chi^2_{obs.2} > \chi^2_{crit}$ ($6.527 > 5.991$). Therefore, changes in the indicators of critical thinking development are not random.

Table 1

Assessment of indicators of development of critical thinking before and after working with AI services

Level	Groups			
	Control (36 students)		Experimental (36 students)	
	Before the experiment	After the experiment	Before the experiment	After the experiment
High	3 (8%)	4 (11%)	3 (8%)	9 (25%)
Average	13 (36%)	14 (39%)	12 (33%)	19 (53%)
Low	20 (56%)	18 (50%)	21 (59%)	8 (22%)

Let us analyze the dynamics by training levels:

1. In the control (56%) and experimental (59%) groups, the level of critical thinking of most students before working with neural networks is low. This situation is explained by the fact that first-year students are initially not very inclined to be independent in completing assignments, rarely show creativity, and are distinguished by inadequate self-esteem. Working with neural networks contributed to the fact that after the information interaction according to the plan described above, in the experimental group, the proportion of students with a low level of critical thinking decreased by 37%. In the control group, the dynamics are less significant - 6%.

2. In the experimental group, the dynamics at the "high" level is 17% (from 3 students to 9). In the control group – an increase of one respondent (3%). Such changes are since working with content generation services allowed students to look at themselves from the outside, re-evaluate their actions, and reconsider the meaning and role of error in their own thinking.

DISCUSSION OF RESULTS

In the presented research materials, the authors took into account the conclusions of experts from UNESCO [3], the Agency for Strategic Initiatives on the importance of developing critical thinking for the sustainable development of society [2]. At the same time, the work takes into account the conclusions, assumptions, and recommendations of the international community in terms of the impact of AI algorithms on the educational process: on the level of training and achievements (both the digital school mentors themselves and their future students), on the level of thinking development (in this case, critical). However, a number of the formulated conclusions can be considered as grounds for additional study of the issues of personality education by means of AI.

We believe that the study was able to confirm the findings of J. Dempere et al. on the transformative role of services for generating content of various formats (text, images, code, tables) [6]. In addition, there is a development of the ideas of M. Ali and L. Guibas that the use of AI contributes to the formation of cognitive skills [7]. The presented materials are a continuation of the early studies of E. A. Mamaeva et al. on the need to purposefully study the possibilities of integrating AI models into disciplines that form the basis of training programs for in-demand teachers of the digital society [26].

As further directions for refining the formulated conclusions, we will define: inclusion of other AI systems (for example, large language models) in the training of teachers; development of materials for the creation of a separate discipline adapted for students of pedagogical specialties.

CONCLUSION

Thus, the work of teachers with AI algorithms improves the quality of the learning process and personalization of the educational program. In addition, the organization of information interaction between digital school mentors and generative content services creates additional conditions for the development of their critical thinking because students use them at the stages

of: studying the generative content service according to the instructions; understanding the didactic potential and functionality of the AI service; generating new material using the tools of the personalized content service; discussing and formulating intermediate conclusions; presenting opinions in the format of presentations; assessing and critically understanding the results of their own/other people's analytical activities.

The participants in the experimental work identified the following factors influencing the quality of the use of AI services in the development of their critical thinking:

- 1) the ability to analyze big data, and identify trends, patterns, and contradictions. Teachers need to be able to interpret data obtained from neural networks to optimize the educational process;
- 2) interactivity of interaction and learning. Neural networks allow you to create personalized educational materials and adapt them to the individual needs of students;
- 3) the ability to create original designs and unique dialogue for different groups of users;
- 4) improved adaptation. Automated systems based on neural networks can analyze user performance and identify potential problems for prompt response;
- 5) assistance in developing new methods (notes, techniques) and refining those already used in practice;
- 6) predicting success. Neural networks can predict students' success based on their individual characteristics and the educational environment.

Limitations when working with generative content services in the didactic process:

- assistants cannot always formulate an answer to a request for users accurately and correctly, using complete and reliable information;
- virtual assistants do not take into account all possible answer options. Therefore, the teacher's task is to develop a well-structured and accurate set of questions with expected answers;
- insufficient service resources for context analysis, and understanding the specifics of the situation.

The results obtained can be used to improve training programs for future teachers in terms of mastering those AI tools that will allow digital school mentors to make the process of information interaction more interactive, exciting, and motivating: to independently acquire new knowledge and critically understand it.

REFERENCES

1. World Economic Forum Annual Meeting 2025. Available at: <https://www.weforum.org/meetings/world-economic-forum-annual-meeting-2025/> (accessed 01 March 2025).
2. Gokhberg, L., Shmatko, N., Chernogortseva, S., Volkova, G., Anastasia Vertinskaya, A., Permyakova, V., Dudina, N., Ratinskiy, M., Lebed, S., Sizov, Y., Yashina, K., Zykov, P., Fedotova, A. Professions of the Future. National Research University Higher School of Economics, 2021, p. 240.
3. Recommendation on the Ethics of Artificial Intelligence. Available at: <https://www.unesco.org/en/legal-affairs/recommendation-ethics-artificial-intelligence> (accessed 11 January 2025).
4. The Federal Law of April 24, 2020. No. 123-FZ "On conducting an experiment to establish special regulation in order to create the necessary conditions for the development and implementation of artificial intelligence technologies in the subject of the Russian Federation – the federal city of Moscow and amending articles 6 and 10 of the Federal Law "On Personal Data"". Available at: https://www.consultant.ru/document/cons_doc_LAW_351127/ (accessed 17 January 2025).
5. Okti, D., Solfema, S., Karneli, Y. Characteristics and Competencies of Educators in the Technological Era: Literature Review. *JISIP (Journal Ilmu Sosial dan Pendidikan)*, 2024, vol. 8, p. 1700. DOI: 10.58258/jisip.v8i3.7111.
6. Dempere, J., Modugu, K., Allam, H., Ramasamy, L. The impact of ChatGPT on higher education. *Frontiers in Education*, 2023, vol. 8, pp. 1-13. DOI: 10.3389/educ.2023.1206936

7. Ali, M., Guibas, L. ChatGPT and Cognitive Skills Development: Integrating Generative AI in Modern Pedagogics Design, 2024. DOI: 10.13140/RG.2.2.13630.29769
8. Kornilova, T. V., Savelyeva, V. A. The contribution of critical thinking to emotional intelligence. *Voprosy Psikhologii*, 2024, vol. 70(4), pp. 10-18.
9. Rensburg, van J. J., Rauscher, W. Strategies for fostering critical thinking dispositions in the technology classroom. *International Journal of Technology and Design Education*, 2022, vol. 32, pp. 1-21. DOI: 10.1007/s10798-021-09690-6
10. Zhao, S. Design of University Vocational Education Evaluation System Guided by Multiple Intelligence Theory. *Journal of Cases on Information Technology*, 2025, vol. 27, pp. 1-23. DOI: 10.4018/JCIT.368242
11. Soboleva, E. V. Suvorova, T. N., Zenkina, S. V., Bocharov, M. I. Developing Computational Thinking of Specialists of the Future Through Designing Computer Games for Educational Purposes. *European Journal of Contemporary Education*, 2021, vol. 10(2), pp. 462-475. DOI 10.13187/ejced.2021.2.462
12. Ganguly, R. Instructional leadership constellation for the 21st century changes in schooling through mobile technology. *International Journal of Development Research*, 2023, vol. 13, pp. 64145-64147. DOI: 10.5281/zenodo.10234906
13. Mäkiö, E., Mäkiö, J. The Task-Based Approach to Teaching Critical Thinking for Computer Science Students. *Education Sciences*, 2023, vol. 13, p. 742. DOI: 10.3390/educsci13070742
14. Kooli, C. Chatbots in Education and Research: A Critical Examination of Ethical Implications and Solutions. *Sustainability*, 2023, vol. 15, p. 5614. DOI: 10.3390/su15075614
15. Wu, Y. Critical Thinking Pedagogics Design in an Era of ChatGPT and Other AI Tools: Shifting from Teaching "What" to Teaching "Why" and "How". *Journal of Education and Development*, 2024, vol. 8(1), pp. 1-10. DOI: 10.20849/jed.v8i1.1404
16. Sheerawi, N. A, Alali, R., Wardat, Y., Tashtoush, M., Saleh, S., Helali, M. Logical Mathematical Intelligence and its Impact on the Academic Achievement for Pre-Service Math Teachers. *Journal of Educational and Social Research*, 2023, vol. 13, pp. 239-254. DOI: 10.36941/jesr-2023-0161
17. Tashtoush, M., Qasimi, A., Sheerawi, N. A, Hussein, A. L. The Efficacy of Utilizing Artificial Intelligence Techniques in Developing Critical Thinking in Mathematics among Secondary School Students and their Attitudes Toward it. *Iraqi Journal for Computer Science and Mathematics*, 2025, vol. 6, pp. 37-50. DOI: 10.52866/2788-7421.1231
18. Telussa, R., Kaihatu, J., Arjanto, P. Fostering Critical and Creative Thinking in Mathematics: A Study on Brain-Based and Problem-Based Learning. *Pedagogik Journal of Islamic Elementary School*, 2024, vol. 7, pp. 53-68. DOI: 10.24256/pijies.v7i1.4764
19. Reddy, K., Lakshmi, G. ICT and Critical Thinking. *Critical Thinking for Professional and Language Education*, 2024, pp. 141-168. DOI: 10.1007/978-3-031-37951-2_6.
20. Soboleva, E. V. Suvorova, T. N., Masharova, T. V., Boyarintseva, N. A. Researching the Potential of Interactive Timelines for the Development of Schoolchildren's Creative Thinking in Additional Education. *European Journal of Contemporary Education*, 2023, vol. 12(4), 1422-1437. DOI 10.13187/ejced.2023.4.1422
21. Santana, R. W., Alonzo, M. J., Cruz-Mena, D. El juego como estrategia lúdica: fortalecimiento de la competencia, pensamiento lógico, creativo y crítico en educación infantil. *Perspectivas en Inteligencia*, 2024, vol. 16, pp. 177-194. DOI: 10.47961/2145194X.718
22. Wang, S., Yu, H., Hu, X., Li, J. Participant or spectator? Comprehending the willingness of faculty to use intelligent tutoring systems in the artificial intelligence era. *British Journal of Educational Technology*, 2020, vol. 51(5), pp.1657-1673. DOI: 10.1111/bjet.12998
23. Lyonga, A. N., Moluayonge, G., Nkeng, A. A Study of Techno-Pedagogical Skills and Teachers' Performance in HTTC Kumba, Cameroon. *European Journal of Education and Pedagogy*, 2021, vol. 2, pp. 46-50. DOI: 10.24018/ejedu.2021.2.1.31
24. Tsenov, M. Y., Bakracheva, M. A. Attitudes towards artificial intelligence in professional and personal life. *Education and Science Journal*, 2025, vol. 27(2), pp. 159-174. DOI: 10.17853/1994-5639-2025-2-159-174
25. Mamaeva, E. A., Shchedrina, E. V., Zhuravleva, L. A. Formation of Critical Thinking of Future Teachers While Designing Quest Rooms for Didactic Purposes. *European Journal of Contemporary Education*, 2023, vol. 12(4), pp. 1348-1364. DOI 10.13187/ejced.2023.4.1348
26. Mamaeva, E. A., Gerasimova, E. K., Zaslavskaya, O. Yu., Shunina, L. A. Organization of Educational and Project Activities of Students to Create Chat Bots as a Condition to Train Future Teachers. *European Journal of Contemporary Education*, 2022, vol. 11(3), pp. 817-830. DOI: 10.13187/ejced.2022.3.817
27. Elshansky, S. P. School of the Future: Can Artificial Intelligence Provide Cognitive Learning Efficiency? *Tomsk State University Journal*, 2021, vol. 462, pp. 192-201. DOI: 10.17223/15617793/462/23
28. Rezaev, A. V., Stepanov, A. M., Tregubova, N.D. Higher Education in the Age of Artificial Intelligence. *Higher Education in Russia*, 2024, vol. 33 (4), pp. 49-62. DOI: 10.31992/0869-3617-2024-33-4-49-62
29. Vinichenko, M. V., Nikiporets-Takigawa, G. Y., Ljapunova, N. V., Chulanova, O. L. Threats and risks from the digitalization of society and artificial intelligence: Views of generation Z students. *International Journal of Advanced and Applied Sciences*, 2021, vol. 8 (10), pp. 108-115. DOI: 10.21833/ijaas.2021.10.012
30. Aleshkovski, I.A. Gasparishvili, A.T., Narbut, N.P., Krukhmaleva, O. V. Savina, N.E. Russian students on the potential and limitations of artificial intelligence in education. *RUDN Journal Of Sociology*, 2024, vol. 24(2), pp. 335-353. DOI: 10.22363/2313-2272-2024-24-2-335-353

Авторы**Мамаева Екатерина Александровна**

(Россия, Киров)

Старший преподаватель кафедры цифровых технологий в образовании

Вятский государственный университет

E-mail: mamaevakathy@gmail.com

ORCID ID: 0000-0002-7721-8820

Ляпунов Дмитрий Юрьевич

(Россия, Киров)

Кандидат философских наук, доцент кафедры

прикладной математики и информатики

Вятский государственный университет

E-mail: usertydf@gmail.com

ORCID ID: 0009-0009-3883-1902

Шилова Зоя Вениаминовна

(Россия, Москва)

Доцент, кандидат педагогических наук,

доцент кафедры высшей математики

Институт кибербезопасности и цифровых технологий

МИРЭА – Российский технологический университет

Доцент кафедры ФН-12

Московский государственный технический университет имени

Н.Э. Баумана (национальный исследовательский университет)

Доцент кафедры математики

Московский политехнический университет

E-mail: zoya@soi.su

ORCID ID: 0000-0003-1715-2513

Шадрина Наталья Николаевна

(Россия, Москва)

Кандидат физико-математических наук,

доцент кафедры высшей математики

МИРЭА – Российский технологический университет

E-mail: shadrinann8@yandex.ru

ORCID ID: 0000-0002-3923-6497

Scopus Author ID: 47061974600

Authors**Ekaterina A. Mamaeva**

(Russia, Kirov)

Senior Lecturer, Department of Digital Technologies in Education

Vyatka State University

E-mail: mamaevakathy@gmail.com

ORCID ID: 0000-0002-7721-8820

Dmitry Yu. Lyapunoff

(Russia, Kirov)

PhD in Philosophy,

Associate Professor at the Department of Applied Mathematics and

Informatics

Vyatka State University

E-mail: usertydf@gmail.com

ORCID ID: 0009-0009-3883-1902

Zoia V. Shilova

(Russia, Moscow)

Cand. Sci. (Educ.),

Associate Professor, Department of Higher Mathematics,

Institute for Cybersecurity and Digital Technologies

MIREA – Russian Technological University

Associate Professor, Department of FN-12

Bauman Moscow State Technical University (BMSTU)

Associate Professor, Department of Mathematics

Moscow Polytechnic University

E-mail: zoya@soi.su

ORCID ID: 0000-0003-1715-2513

Natalia N. Shadrina

(Russia, Moscow)

PhD in Physical and Mathematical Sciences,

Associate Professor, Department of Higher Mathematics,

MIREA – Russian Technological University

E-mail: shadrinann8@yandex.ru

ORCID ID: 0000-0002-3923-6497

Scopus Author ID: 47061974600

Вклад авторов**Мамаева Е. А.:** концептуализация, методология, создание рукописи и ее редактирование, руководство исследованием, администрирование проекта**Ляпунов Д. Ю.:** формальный анализ, проведение исследования, визуализация**Шилова З. В.:** верификация данных, проведение исследования, создание черновика рукописи**Шадрина Н. Н.:** ресурсы, программное обеспечение, проведение исследования© Мамаева Е. А., Ляпунов Д. Ю., Шилова З. В.,
Шадрина Н. Н., 2025

Авторы заявляют об отсутствии конфликта интересов

Author's contribution**Ekaterina A. Mamaeva:** Conceptualization, Methodology, Writing - Review & Editing, Supervision, Project administration**Dmitry Yu. Lyapunoff:** Formal analysis, Investigation, Visualization**Zoia V. Shilova:** Validation, Investigation, Writing - Original Draft**Natalia N. Shadrina:** Software, Investigation, Resources© Ekaterina A. Mamaeva, Dmitry Yu. Lyapunoff,
Zoia V. Shilova, Natalia N. Shadrina, 2025

The author's declared no conflicts of interest