

SOCIAL SCIENCES

THE USE OF MACHINE LEARNING METHODS FOR THE FORMATION OF PROFESSIONAL COMPETENCIES OF FUTURE COMPUTER SCIENCE TEACHERS

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Abstract

The use of machine learning methods makes it possible to more quickly introduce relevant tools and concepts into teaching practice. Machine learning (ML) offers individualized teaching methods that allow teachers to adapt programs for each student, taking into account their specific needs and level of training. The transition to online education and hybrid formats requires new learning strategies. Machine learning can help to adapt programs to these changes, making learning more flexible and efficient. Pedagogical programs based on machine learning methods provide future teachers with relevant skills and knowledge in the educational field.

In general, the application of machine learning methods in education, especially in the training of future computer science teachers, is today an urgent and promising topic that can bring significant innovations to educational practices and training of specialists.

The results of the study clearly demonstrate that the use of machine learning methods in the process of professional training of computer science teachers has a significant positive impact on their competencies and educational practice.

Keywords: Machine learning, formation, competence, teaching methods, innovative methods.

Introduction. Currently, due to rapid technological development and digitalization, education has become an area that needs constant updating, adaptation and innovation.

The training of computer science teachers plays a key role in the formation of highly qualified personnel capable of effectively implementing new technologies and providing high-quality education.

The development of information technology is so fast that modern teaching methods for teachers may become outdated by the time students complete their education. Modern computer science teachers should have the skills to work with innovative technologies and the ability to analyze large amounts of data, as well as the use of machine learning can help in the formation of these professional competencies.

Machine learning methods allow you to create personalized educational trajectories for students. This is important, given the different levels of knowledge, learning styles and interests of students, which contributes to more effective learning of the material.

The use of machine learning algorithms in education helps to analyze learning data, understand successful teaching methods and identify areas where additional help is needed, which ultimately increases the effectiveness of educational programs and saves time and resources [1].

Machine learning technologies enable the development of online courses and platforms that facilitate

more flexible access to education. This is especially important in the context of distance learning and in various geographical and social contexts.

In general, the use of machine learning methods to form the professional competencies of future computer science teachers is an important step towards a modern and effective training system in the field of education and information technology.

Materials, methods and discussions. Information technology is becoming an integral part of learning practices, and computer science teachers play an important role in developing the skills needed to successfully adapt to the digital age. Computer science teachers become not only teachers of programming knowledge, but also contribute to the formation of students' skills to work with information, solve problems, analyze data, analyze and interpret information from various sources.

Computer science teachers must constantly improve their knowledge and skills, follow the latest technological trends and adapt their teaching methods to a rapidly changing environment. In addition to programming skills, they also learn how to solve complex problems, analyze data, work in a team and make informed decisions, which is critically important in today's world.

The use of machine learning methods to form the competencies of future computer science teachers fits into this dynamic, providing innovative approaches to training in education, contributing to the creation of

more effective learning strategies and supporting the development of the educational environment as a whole [2].

Computer science teachers play an important role in this process, becoming the foundation for the development of digital literacy and technological skills for future generations.

The lack of effective methods for the formation of professional skills of computer science teachers is a problem affecting not only the quality of teacher training, but also the quality of education in general. Despite the importance and relevance of this field of knowledge, there are several key problems associated with the formation of computer science teachers' competencies: limited educational programs, insufficient practical training, the need for constant updating of knowledge, lack of resources and support, barriers to the introduction of new teaching methods, problems of assessment and evaluation.

Identification of these problems helps to understand the need to develop and implement effective methods for the formation of professional skills of computer science teachers to ensure quality education, adapt the educational environment to modern requirements and prepare students for the digital world [3].

In order to effectively adapt to modern educational requirements and ensure high-quality training of future computer science teachers in the field of pedagogy and information technology, it is necessary to apply innovative approaches in teaching such as the development of technology and education, integration of new technologies into learning, preparation for online learning, creation of an environment for independent learning, ensuring accessibility of education.

The use of innovative approaches in the education and training of future teachers, including computer science teachers, helps to create more flexible, effective and relevant training programs, promotes the development of diverse skills and readiness for a modern educational environment.

Traditional approaches to teaching computer science teachers encompass methods and strategies that have been applied over the years and are largely based on classical educational principles. Although traditional methods remain an important part of the education of computer science teachers, modern pedagogical paradigms raise the question of the need to integrate innovative approaches such as the use of new technologies, adaptive learning and active involvement of students in the learning process.

The integration of these methods into the educational process for future computer science teachers can enrich and diversify approaches to learning, contribute to improving the quality of education and prepare teachers for modern challenges in the field of information technology [4].

These approaches can be used in various combinations to enrich the educational process and develop the professional competencies of future computer science teachers.

As you know, there are a number of methods of teaching and competence formation for future com-

puter science teachers, which are focused on the development of both professional skills and pedagogical skills. These methods are often combined in educational programs for future computer science teachers in order to create a comprehensive learning system that promotes the development of not only technical, but also pedagogical skills.

Evaluating the effectiveness of teaching methods and the formation of competencies for future computer science teachers is an important task. It allows you to determine how effectively students acquire knowledge, develop skills and are ready for future professional activities. However, evaluating the effectiveness of each method has its limitations. For a more complete assessment of the effectiveness of teaching methods for computer science teachers, it is necessary to use an integrated approach that includes both quantitative and qualitative assessment methods, takes into account the opinions of students and teachers, and evaluates the results both in the short and long term.

The use of machine learning methods for educating teachers and developing their competencies is an active area of research. The works of Chen, L., Wang, Q. consider the effectiveness of using machine learning methods for teacher training. Various approaches to integrating ML into teacher training processes are being explored, including personalized educational programs and adaptive technologies for the development of professional skills [5]. Williams, E., Brown, D. discuss the advantages, difficulties and opportunities for integrating ML into teacher training. Their work focuses on the challenges and prospects of teaching teachers new technologies using machine learning methods [6]. Wang, L., Johnson, K. describe practical cases of the use of artificial intelligence and machine learning methods for the training and development of teacher competencies. Examples of learning platforms and technologies that use ML to improve the professional training of teachers are considered [7]. Smith, A. provides an overview of innovative approaches to teacher training using machine learning methods. The tools, platforms and techniques that contribute to effective teacher training in modern conditions are highlighted [8].

These studies reflect various aspects and approaches to the application of machine learning methods in teacher training. They help to understand the effectiveness, advantages and challenges of implementing such methods in the professional education of teachers.

The introduction of machine learning into education opens up many prospects and opportunities for a modern learning system. Machine learning allows you to create personalized educational programs, taking into account the individual needs and level of knowledge of each student; it can analyze learning data, test results and even behavioral patterns of students, which helps to predict their academic performance, needs and possible difficulties; promotes the development of new educational technologies and platforms, allowing you to create more exciting, interactive and innovative teaching methods. Integrating ML into education helps students develop skills in working with data and technologies that are becoming increasingly in

demand in the modern world of work. However, the introduction of ML in education also has its challenges, such as the need for reliable data protection, providing ethics and security training in the use of technology, as well as educating educators to use new tools and technologies.

Machine learning is a subsection of artificial intelligence that studies the development of algorithms and models that allow computers to extract knowledge from data and make decisions based on this data, without explicit programming. An overview of the basics of machine learning and its role in modern education is shown in Figure 1.

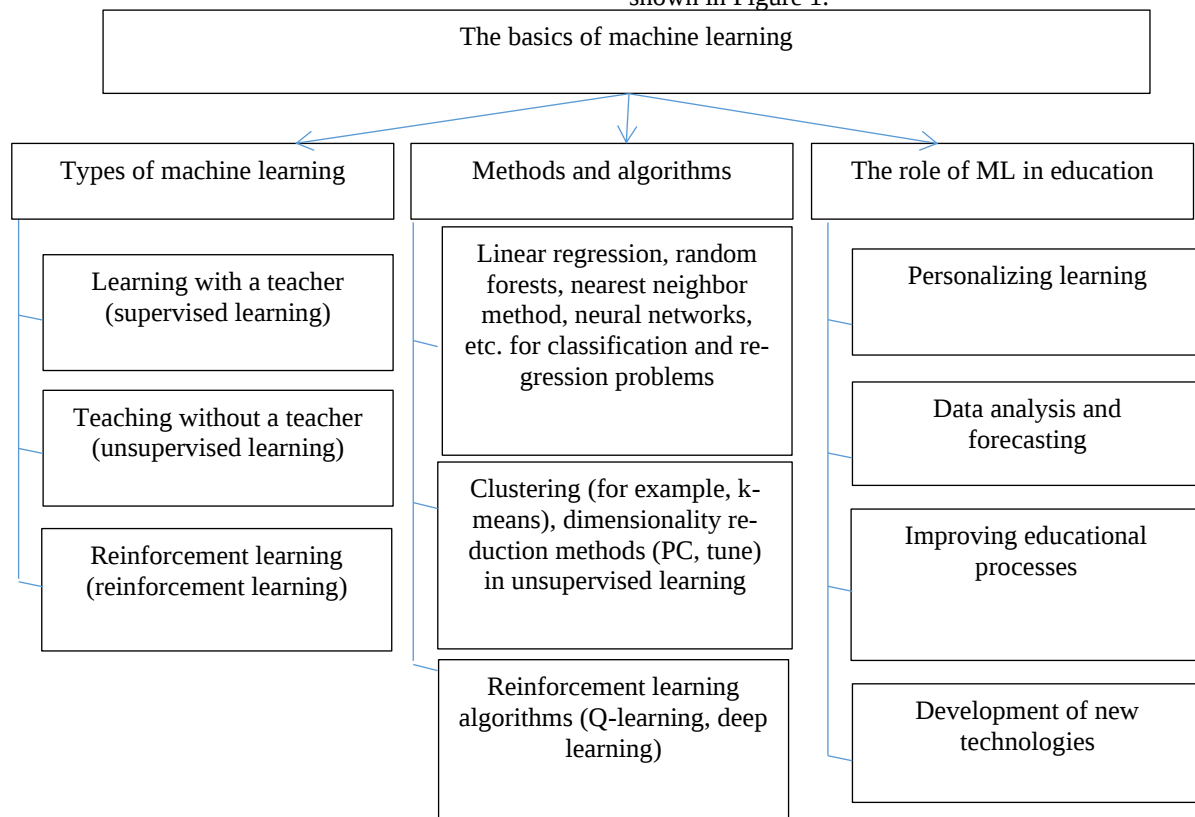


Figure 1. Overview of the basics of machine learning

Machine learning is a powerful tool in modern education, contributing to improving the quality of education, adapting the educational process to the needs of students and developing innovative approaches in education.

The use of machine learning algorithms in pedagogical practice brings innovations to educational processes and can improve the quality of learning [9]. The use of ML in pedagogy has great potential in the following areas: personalized learning, predicting academic performance, adaptive educational platforms, assessment and feedback, analysis of behavior and learning activity, decision support for teachers [10].

Here are some examples of the use of machine learning algorithms in teaching practice, demonstrating a variety of ways to use machine learning algorithms in education, allowing you to personalize learning, improve the adaptability of learning platforms, analyze data to predict student success and optimize evaluation and feedback processes.

For example, the Khan Academy platform uses machine learning algorithms to adapt educational materials to the level and needs of each student. This system provides customized recommendations on materials to study based on test scores and student progress.

Learning Analytics Prediction Engine machine learning algorithms can be used to predict student aca-

demic performance. This system helps to identify students who may face learning difficulties and provide recommendations to support them and improve learning outcomes.

ML algorithms are used to develop educational platforms capable of responding to students' actions and providing recommendations on materials based on their preferences and performance. The Duolingo platform system adapts exercises and tasks to each student's level of knowledge, taking into account their progress and mistakes.

The Gradescope application uses machine learning algorithms to automatically evaluate and provide feedback on students' work. This allows you to quickly evaluate work based on specified criteria and provide detailed feedback.

The Coursera platform can be used to analyze student behavioral data. They help identify educational patterns and provide guidance to teachers to improve the quality of courses.

However, it is important to take into account the limitations of the use of ML in pedagogical practice, such as the need to protect data, the correct use of algorithm results to avoid bias and compliance with ethical standards in education. Nevertheless, these technologies offer significant opportunities for the development of education and improvement of learning processes.

The presentation of specific examples of the application of machine learning methods in the process of teaching computer science teachers to develop their professional skills may include the following aspects:

1. An individualized approach to learning. A learning system using machine learning methods can customize educational plans for computer science teachers depending on their level of knowledge, experience and needs. For example, different teachers may be offered customized training programs tailored to their unique needs.

2. Automated knowledge assessment. Development of a system for evaluating the knowledge of computer science teachers based on their answers to test tasks or completed practical tasks. Machine learning techniques can help analyze these responses and provide feedback based on identified errors and successful solutions.

3. Analysis of teaching. The use of text processing algorithms to analyze lesson recordings or presentations by computer science teachers. This will help to identify the features and successful aspects of the teaching style, as well as identify areas for further improvement.

4. Recommendations on teaching methods. Development of a platform using collaborative filtering algorithms to provide computer science teachers with recommendations on the use of techniques, educational

materials or tools based on the successful experience of other teachers.

5. Predicting the success of learning. Creation of machine learning models capable of predicting the effectiveness of the implementation of certain educational techniques or tools for computer science teachers. For example, algorithms can predict which teaching strategies will be more successful for specific groups of students.

6. Automation of feedback and evaluation of learning outcomes. For example, creating a tool that applies natural language processing algorithms to analyze and automatically provide feedback to computer science teachers based on their work, lessons, or progress reports is one example of using machine learning methods in the educational process to develop teachers' professional skills.

These examples demonstrate how machine learning techniques can be embedded in educational programs to personalize learning and improve teaching effectiveness.

The analysis of the practical applicability and effectiveness of these machine learning methods for the formation of professional competencies of computer science teachers allows us to assess their real contribution to improving the educational process. Aspects of the analysis of the effectiveness and applicability of these methods are given in Table 1.

Table 1.

Analysis of the practical applicability and effectiveness of these machine learning methods for the formation of professional competencies

Aspects of the method	Applicability	Effectiveness
Personalizing learning	Machine learning methods can successfully adapt learning to the individual needs of each computer science teacher. However, this requires accurate data on preferences and level of knowledge.	When a personalized approach is set up correctly, it usually leads to more effective learning and increased motivation to learn
Automation of assessment	Automatic assessment of computer science teachers' knowledge through machine learning algorithms can significantly save time when checking papers. However, accurate models are needed for a correct assessment.	The effectiveness of this method depends on the quality and accuracy of algorithms capable of correctly assessing professional competencies.
Analysis of teaching style	Text processing algorithms can highlight key aspects of the teaching style. However, the interpretation of this data may be subjective.	Анализ стиля преподавания может помочь учителям лучше понять свои сильные и слабые стороны в преподавании и внести улучшения.
Selection of recommendations on methods	The use of recommendation algorithms can offer computer science teachers new approaches and materials for their development. However, an accurate recommendation model is required.	If the recommendations are precisely adapted to specific needs, this can lead to an improvement in the educational process and an increase in professional level.
Predicting learning success	Predicting success can help computer science teachers focus efforts on students who need additional support. However, this is only a forecast and does not guarantee a result.	The effectiveness of this method depends on the accuracy of the forecasting models and the teacher's further actions to provide additional assistance.

The critical analysis of the effectiveness and applicability of these methods includes an assessment of the accuracy of the models, interpretation of the results

and their practical application in the educational process. Each method has its advantages and limitations that must be considered when using them.

Conclusion. The results of the study clearly indicate the importance of using machine learning methods

in the formation of computer science teachers' competencies. The experiment showed a number of important aspects that have an impact on the professional development of teachers and educational practice: improving professional skills, increasing motivation and interest, adaptability and personalization of learning, evaluating the effectiveness of machine learning methods, feedback from participants in the experiment.

The introduction of machine learning methods into the educational process will significantly increase the level of knowledge and competencies of computer science teachers in the use of new educational technologies. New teaching methods will allow computer science teachers to more effectively adapt teaching materials and methods to the individual needs of students to improve the quality of the educational process. The success of new methods and recommendations for improving the quality of education is feedback. To apply machine learning methods in an educational environment, further research and optimization of learning approaches are necessary.

Thus, the results of this study confirm the prospects of using machine learning methods in the formation of professional competencies of computer science teachers. This opens up new opportunities for improving educational practice and requires further efforts to integrate innovative teaching methods into the educational system.

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