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Оксана КОНДУР,
доктор педагогічних наук, професор, декан педагогічного факультету,
Прикарпатський національний університет імені Василя Стефаника (м. Івано-Франківськ, Україна)

Oksana KONDUR,
Doctor of Pedagogical Sciences, Professor, Dean of the Pedagogical Faculty,
Vasyl Stefanyk Precarpathian National University (Ivano-Frankivsk, Ukraine)
oksana.kondur@pnu.edu.ua
ORCID ID 0000-0001-9342-1127

Роман КОНДРАТ,
аспірант кафедри початкової освіти та освітніх інновацій,
Прикарпатський національний університет імені Василя Стефаника (м. Івано-Франківськ, Україна)

Roman KONDRAT,
PhD Student, Department of Elementary Education and Educational Innovations,
Vasyl Stefanyk Precarpathian National University (Ivano-Frankivsk, Ukraine)
roman.kondrat.23@pnu.edu.ua
ORCID ID 0009-0004-3250-1042

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ФОРМУВАННЯ ЦИФРОВОЇ КОМПЕТЕНТНОСТІ В МАЙБУТНІХ ФАХІВЦІВ

Анотація. У статті розглядається актуальні питання формування цифрової компетентності у майбутніх гірничих інженерів в умовах цифровізації гірничої промисловості. Проаналізовано поняття, структуру та специфіку цифрової компетентності, а також сучасні технологічні тренди в галузі, серед яких - роботизація, штучний інтелект, Інтернет речей та цифрові двійники.

Особлива увага приділяється методології формування цифрових навичок через інтеграцію сучасних технологій у навчальний процес, співпрацю з виробничими підприємствами та безперервне професійне навчання. Запропоновано практичні рекомендації щодо вдосконалення освітніх програм, створення партнерств між університетами та компаніями, а також впровадження сучасної матеріально-технічної бази.

Обгрунтовано важливість комплексного підходу до підготовки фахівців, здатних працювати в умовах високотехнологічного виробництва.

Ключові слова: цифрова компетентність, гірничі інженери, освітні програми, професійна підготовка, професійний розвиток, технологічні тренди, майбутні фахівці.

FORMATION OF DIGITAL COMPETENCE IN FUTURE SPECIALISTS

Abstract. The The article deals with topical questions of forming digital competence in future mining engineers in the context of digitalization of the mining industry. The concept, structure and specifics of digital competence, as well as modern technological trends in the industry, including robotization, artificial intelligence, the Internet of Things and digital twins, are analyzed.

Particular attention is paid to the methodology of forming digital skills through the integration of modern technologies into the educational process, cooperation with manufacturing enterprises and continuous professional training. Practical recommendations for improving educational programs, establishing partnerships between universities and companies, and introducing modern material and technical facilities are proposed.

The importance of an integrated approach to training specialists capable of working in high-tech production is substantiated.

Keywords: digital competence, mining engineers, educational programs, professional training, professional development, technological trends, future specialists.

INTRODUCTION

The problem formulation. In today's world, digital transformation affects all industries, and the mining sector is no exception. The development of digital competence in future mining engineers is becoming an actual task of their professional training.

Analysis of recent research and publications. The issue of digital competence in the professional training of engineers was studied by S. Dimitrova, N. Girya, V. Burlayenko, O.Tryfonova,Y.Bordiian, V.Matsko, L.Cherednyk.

The problems of professional training of specialists in the mining industry were studied by O. Gerasymchuk; S. Gryshchenko, V. Morkun, S. Semerikov, O. Derevyanko, V. Ternopilska, T. Medvedovska, O. Rusanova, T. Shargun and others. The role of digital technologies in the training of future engineers was studied by V. Tkachuk, Y. Yechkalo, S. Khotskina, O. Markova, and V. Khotskina. The article describes «that the digitalization of all spheres of human activity has led to a significant increase in the requirements for the training of modern engineers». (Tkachuk 2023) According to the authors, virtual reality and augmented reality are the safest and most effective way to solve this problem. Let's consider the features of using these technologies, as well as examples of successful implementation of immersive technologies in the educational process.

THE AIM AND RESEARCH TASKS – to carry out a comprehensive analysis of the specifics of forming the digital competence of future mining engineers in the process of their professional training.

RESEARCH METHODS: method of analysis and synthesis, systematic, method of generalization.

RESULTS OF THE RESEARCH

The modern mining industry is on the verge of a global technological revolution that is fundamentally changing the traditional understanding of production processes. The Fourth Industrial Revolution, known as Industry 4.0, is introducing fundamentally new approaches to the management, production and development of the industry. The main driver of these changes is digitalization, which covers all aspects of mining production.

The following digital tools are used in the mining industry today:

GEOVIA Surpac - the world's most popular software for geology and mining planning in open pits and underground wells, as well as for supporting exploration projects. It guarantees efficiency and accuracy through ease of use, powerful 3D graphics and workflow automation;

AutoCAD is a 2D and 3D computer-aided design system.

Micromine is an all-in-one solution for the mining industry that covers the entire cycle: from geological exploration and 3D modeling to mining management control, planning, and data management.

Today, traditional mechanical systems are giving way to intelligent systems, where artificial intelligence, machine learning, and automation systems are becoming not just supporting tools but full-fledged participants in the production process.

The industry's technological upgrade is moving in new directions, which must be taken into account in the professional training of future engineers. For example, thanks to robotization and automation of production processes, modern mining companies are introducing autonomous transportation systems where magnitude trucks and drilling rigs operate without direct human intervention. Such automated systems improve production efficiency by 20-30%.

Modern engineers use artificial intelligence as a tool for predicting and optimizing. Neural networks are able to analyze huge amounts of geological data, predict potential risks, and optimize production routes. Machine learning makes it possible to create systems that diagnose equipment in advance, which significantly reduces the risk of emergencies and minimizes unplanned downtime.

The Internet of Things (IoT) is transforming production sites into highly intelligent ecosystems. Sensor networks provide real-time monitoring of equipment, control the parameters of the production environment, and allow for instant response to the slightest deviation. This is not just a control technology, but a full-fledged production risk management system.

A special place is occupied by digital twins - virtual copies of physical objects and processes. With the help of sophisticated computer models, mining engineers can simulate various production scenarios, test new approaches and optimization solutions long before they are actually implemented.

Leading global companies predict that the main economic effect of digitalization will be a 10-30% reduction in production costs, increased equipment productivity, and improved production safety.

According to M. Stupnyk, V. Morkun, Z. Bakum, and V. Tkachuk, «improving the efficiency of mining enterprises in a market economy, increasing production and financial performance requires the development, mastering, and implementation of modern information technologies» and «accordingly, informatization of the process of training a future mining engineer is an urgent task today» (Stupnyk et al., 2016, p. 40). After all, the technological transformation of the industry leads to the dominance of automated production complexes, integrated systems with artificial intelligence, and augmented reality technologies. Such technological innovations put forward requirements for the mandatory formation of digital competence in mining students in the process of their professional training.

One of the broadest interpretations of the definition of «digital competence» was proposed by A. Ferrari, who believes that it is «a set of knowledge, skills, attitudes (including abilities, strategies, values and awareness) required to use information and communication technologies and digital media to perform tasks; solve problems; communicate; manage information; collaborate; create and share content; and construct knowledge effectively, efficiently, appropriately, critically, creatively, independently, flexibly, ethically, reflectively for work, leisure, collaboration, learning, socizlizing, consuming, and empowerment» (Ferrari, 2011)

We consider digital competence in a narrower sense as an integral characteristic that includes the ability of a person to confidently, critically and safely use information and communication technologies for work, study, professional and personal development.

For mining engineers, digital competence has specific features. It consists of the following: a deep understanding of digital mining technologies; skills in working with specialised software; and the ability to digitally model and analyse production processes.

Obviously, higher education institutions that train engineers need to adapt their curricula to the requirements of the labour market by introducing courses in digital technologies, programming, and working with industry-specific applications.

The use of virtual simulators, 3D modelling and modernly equipped laboratories is effective in developing students' practical skills. For example, simulating the operation of a mine in a digital environment helps to understand how hardware and software interact.

Practical training can be supplemented with internships at enterprises, where students can work with software and equipment used in the industry.

In general, the formation of an effective digital competence system for mining engineers is a complex, multifaceted process that requires an integrated approach and interaction between educational institutions, manufacturing enterprises and government institutions.

We see the development of digital competence of mining engineers as a strategic direction:

- transformation of educational programmes, updating their content to meet modern technological challenges based on the following principles: integration of practical digital modules into basic disciplines; introduction of interdisciplinary courses; development of flexible educational paths; active use of simulators and virtual trainers;
- partnership with technology companies, as the effectiveness of digital competence formation directly depends on close cooperation between HEIs and leading technology companies and manufacturing enterprises based on the following mechanisms: application of elements of dual education; involvement of leading experts in teaching activities; joint research projects;
- technological support, as the effective formation of digital competence is impossible without a modern material and technical base, which needs to be filled with modern computer equipment, specialised software, equipment for virtual and augmented reality; high-speed Internet access available to students.

Since digital competence is dynamic and requires constant updating, it is necessary to create a flexible system of professional development and retraining. It may consist of various forms of training, such as short-term intensive courses, online training programmes; corporate digital skills academies; international certification programmes, coaching and mentoring programmes. At the same time, it should be noted that the specifics of the industry require special improvement of the digital competence of mining engineers. Therefore, technical higher education institutions should take on the mission of continuous digital education.

CONCLUSIONS AND PROSPECTS OF FURTHER RESEARCH

So, the formation of digital competence in future mining engineers is a complex process that requires the integration of theoretical knowledge, practical skills and modern technologies in education. Educational institutions should become a platform for training specialists ready for the challenges of the digital age. Recommendations include updating curricula, engaging industry practitioners in teaching, and expanding access to digital tools. This is the only way we can prepare mining engineers who will meet the requirements of the times and contribute to the development of the industry.

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