МРНТИ 14.35.07 DOI 10.48501/8406.2024.31.83.002

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INNOVATIVE APPROACHES TO THE FORMATION OF GRAPHIC COMPETENCE IN FUTURE SPECIALISTS IN THE FIELD OF ELECTRONICS AND TELECOMMUNICATIONS: PROBLEMS AND PROSPECTS

Abstract. The modern world is developing rapidly, and the field of electronics and telecommunications is no exception. In order for specialists in this field to work successfully in the face of constant technological change, they need not only a deep theoretical background but also a high level of graphic competence. It is a key skill for specialists, as it allows them to visualise complex concepts, develop schemes, design devices and systems, and create technical documentation.

The purpose of the article is to identify the main problems of forming graphic competence in future electronics and telecommunications specialists, to determine the prospects in this area and to develop innovative approaches to the formation of graphic competence in future electronics and telecommunications specialists to overcome existing contradictions.

The article considers current problems in the formation of graphic competence of future specialists in the field of electronics and telecommunications, in particular, the lack of modern teaching materials, insufficient technical equipment, low level of integration of interdisciplinary knowledge and qualifications of teachers, etc. Analysed and characterised innovative approaches and technologies that can be used to improve the learning process, such as virtual and augmented reality, online courses, interactive and project-based learning methods. Formed To provide recommendations for the implementation of innovative approaches in the educational process for the effective development of graphic competence in students. Opportunities for further development and improvement of curricula through cooperation with business and industry, teacher training and integration of interdisciplinary knowledge are outlined.

Prospects for further research are the development and implementation of methods for assessing the level of graphic competence of students, as well as the analysis of results for further improvement of curricula.

Key words: graphic competence, electronics and telecommunications specialists, higher education institutions, professional development, project-based learning, partnership with industry.

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Инновационные подходы к формированию графической компетентности у будущих специалистов в сфере электроники и телекоммуникаций: проблемы и перспективы

Аннотация. Современный мир стремительно развивается, и сфера электроники и телекоммуникаций не является исключением. Для того, чтобы специалисты этой отрасли могли успешно работать в условиях постоянных технологических изменений, им необходима не только глубокая теоретическая подготовка, но и высокий уровень графической компетентности. Она является ключевым навыком для специалистов, поскольку позволяет визуализировать сложные концепции, разрабатывать схемы, проектировать устройства и системы, а также создавать техническую документацию.

Цель статьи заключается в выявлении основных проблем формирования графической компетентности у будущих специалистов электроники и телекоммуникаций, определение перспектив в этой сфере и разработке инновационных подходов к формированию графической компетентности у будущих специалистов электроники и телекоммуникаций для преодоления имеющихся противоречий.

В статье рассмотрены текущие проблемы в формировании графической компетентности будущих специалистов в области электроники и телекоммуникаций, в частности отсутствие современных учебных материалов, недостаточное техническое оснащение, низкий уровень интеграции междисциплинарных знаний и квалификации преподавателей и тому подобное. Проанализированы и охарактеризованы инновационные подходы и технологии, которые могут быть использованы для улучшения процесса обучения, такие как виртуальная и дополненная реальность, онлайн-курсы, интерактивные и проектно-ориентированные методы обучения. Сформированы Предоставить рекомендации по внедрению инновационных подходов в учебный процесс для эффективного формирования графической компетентности у

студентов. Очерчены возможности для дальнейшего развития и совершенствования учебных программ через сотрудничество с бизнесом и индустрией, повышение квалификации преподавателей и интеграцию междисциплинарных знаний.

Перспективами дальнейшего исследования определены разработка и внедрение методик для оценки уровня графической компетентности студентов, а также анализ результатов для дальнейшего совершенствования учебных программ.

Ключевые слова: графическая компетентность, специалистов в области электроники и телекоммуникаций, высшие учебные заведения, совершенствование профессиональной подготовки, проектно-ориентированное обучение, партнерство с индустрией.

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Электроника және телекоммуникация саласындағы болашақ мамандардың графикалық құзыреттілігін қалыптастырудың инновациялық тәсілдері: мәселелер мен болашағы

Аннотация. Аннотация. Қазіргі әлем қарқынды дамып келеді, электроника мен телекоммуникация саласы да ерекшелік емес. Бұл саланың мамандары үздіксіз технологиялық өзгерістер жағдайында табысты жұмыс істей алуы үшін оларға терең теориялық дайындық қана емес, сонымен қатар жоғары графикалық құзыреттілік қажет. Бұл кәсіпқойлар үшін негізгі дағды, себебі ол күрделі концепцияларды, схемаларды жобалауды, құрылғылар мен жүйелерді жобалауға және техникалық құжаттаманы жасауға мүмкіндік береді.

Мақаланың мақсаты – болашақ электроника және телекоммуникация мамандарының графикалық құзыреттілігін дамытудың негізгі мәселелерін анықтау, осы саладағы перспективаларды анықтау және бар қарамақайшылықтарды жеңу үшін болашақ электроника және телекоммуникация мамандары арасында графикалық құзыреттілікті дамытудың инновациялық тәсілдерін әзірлеу.

Мақалада электроника және телекоммуникация саласындағы болашақ мамандардың графикалық құзыреттілігін қалыптастырудың өзекті мәселелері, атап айтқанда, заманауи оқу материалдарының жетіспеушілігі, техникалық жабдықталуының жеткіліксіздігі, пәнаралық білім мен мұғалімнің біліктілігінің интеграциялану деңгейінің төмендігі және т.б. Виртуалды және толықтырылған шындық, онлайн курстар, интерактивті және жобалық-бағдарлы оқыту әдістері сияқты оқыту үдерісін жақсарту үшін қолданылатын инновациялық тәсілдер мен технологиялар талданып, сипатталады. Қалыптасқан Оқушылардың графикалық құзыреттілігін тиімді дамыту үшін оқу үдерісіне инновациялық тәсілдерді енгізу бойынша ұсыныстар беру. Кәсіпкерлік және өндіріспен ынтымақтасу, мұғалімдердің біліктілігін арттыру және пәнаралық білімдерді интеграциялау арқылы оқу бағдарламаларын одан әрі дамыту және жетілдіру мүмкіндіктері көрсетілген.

Әрі қарайғы зерттеулердің перспективалары студенттердің графикалық құзыреттілік деңгейін бағалау әдістерін әзірлеу мен енгізуді, сонымен қатар білім беру бағдарламаларын одан әрі жетілдіру нәтижелерін талдауды қамтиды.

Негізгі сөздер: графикалық құзыреттілік, электроника және телекоммуникация саласындағы мамандар, жоғары оқу орындары, кәсіби дайындықты жетілдіру, жобалық-бағдарлы оқыту, өндіріспен серіктестік

Introduction. At the moment, electronics can be considered a priority sector of the global economy, as its products are used not only in information and communication devices, but also in medicine, instrumentation, the military-industrial complex, mechanical engineering and other areas. The problem is that the powerful electronics and telecommunications industry in our country has been virtually destroyed due to economic difficulties and strong competitive pressure from China, Malaysia, Thailand and other Asian countries. Thus, the development of radio electronics requires significant state support, which will primarily be associated with the restoration of a powerful military-industrial complex that will ensure Ukraine's security against armed aggression in the future. Accordingly, the development of the industry is impossible without the training of competent, competitive specialists in the field of radio electronics and telecommunications with a high level of professional competence, including graphic skills.

The purpose of the article is to identify the main problems of forming graphic competence in future specialists in electronics and

telecommunications, to determine the prospects in this area and to develop innovative approaches to the formation of graphic competence in future specialists in electronics and telecommunications to overcome the existing contradictions.

The main part. In today's world, visualisation is playing an increasingly important role in various areas of life, including electronics and telecommunications. This is due to the fact that visual information is perceived and processed by humans much faster and easier than textual information. The relevance of this issue has been identified in a number of publications. For example, according to S. Dembitska and I. Kobylianska [10], computer-aided design (CAD) and 3D modelling systems are widely used in electronics and telecommunications. These tools allow creating drawings, diagrams and models of electronic components and devices. To use CAD and 3D modelling effectively, graphic skills are essential. K. Lyubedieva notes that the most dynamic industries are currently the Internet of Things (IoT) and robotics, which require specialists with graphic skills [12]. IoT devices and robots are equipped with displays that show information and graphic elements. Graphic skills are necessary to develop user interfaces for these devices. We agree with the opinion of L. Martseva that electronics and telecommunications specialists often need to visually explain complex technical concepts [13]. Graphic skills allow them to create drawings, diagrams, charts, and other visual materials that help in communication.

In foreign publications, in particular [1-6], it is proved that graphic skills not only contribute to the development of professional competence of future specialists in the field of electronics and telecommunications, but also help to develop such personal qualities as creativity, analytical thinking and spatial representation. These qualities are valuable not only for electronics and telecommunications specialists, but also for people of any profession. Therefore, the development of graphic competence in future electronics and telecommunications specialists is an extremely important task. This will allow them to gain competitive advantages in the labour market and successfully build their careers.

Based on the analysis of scientific developments on the research problem, we believe that the need for fundamental graphic training of future specialists is undeniable and is due to several important aspects (Fig. 1).

Technology integration	• Modern electronics and telecommunications are largely based on the design and visualisation of complex circuits, devices, and systems. Graphics skills allow professionals to design, model, and analyse these systems more effectively
Interdisciplinary approach	• With the rapid development of technology and increasing demands on product quality, specialists need to have knowledge of various disciplines, including graphic design. This ensures better communication between different departments and facilitates the integration of new technologies
Competitiveness in the labour market	• Professionals with a high level of graphic competence are more in demand in the labour market because they can offer comprehensive solutions, from design to implementation and testing. This increases their chances of employment and career growth
Innovative potential	• Graphic competence promotes creative thinking and an innovative approach to solving technical problems. It allows professionals to find new, more efficient ways to implement projects and introduce new technologies
Standardisation and quality	• The ability to create accurate and understandable graphic materials is essential to meeting international quality standards. This is especially important in electronics and telecommunications, where high accuracy and compliance are critical

Fig. 1. The relevance of developing graphic competence in future electronics and telecommunications specialists

Therefore, the identified requirements for the formation of graphic competence in future specialists in electronics and telecommunications and their implementation in the educational

process require a balanced approach and the identification of innovative approaches to the formation of graphic competence in future specialists in electronics and telecommunications.

The analysis of scientific publications and own experience allowed us to identify the existing problems in the effective formation of graphic competence of future specialists in electronics and telecommunications. These include:

1. Lack of modern teaching materials. A number of educational institutions use outdated textbooks and materials that do not meet the current requirements of the industry. This results in students not receiving up-to-date knowledge and skills that do not meet the current requirements of employers. This can lead to difficulties in finding a job or the need for retraining.

2. Insufficient technical equipment. Lack of access to modern software and equipment complicates the learning process. Without the opportunity to work with the latest tools, students cannot gain the necessary experience [7].

3. Low level of integration of interdisciplinary knowledge. Graphic competence requires knowledge from different disciplines such as programming, design and engineering. The lack of integration of this knowledge in the curriculum limits students' opportunities. The inability of students to integrate knowledge can lead to the fact that students will not be able to solve real professional problems [11].

4. Insufficient qualification of teachers. Currently, higher technical education is facing a problem when teachers of professional disciplines are mostly theorists who do not have relevant experience in the industry or do not have modern teaching methods. This issue is defined in publications [8-9].

Solving these problems requires significant work by all stakeholders. Some of the ways proposed by us and partially implemented at Vinnytsia National Technical University are shown in Fig. 2.

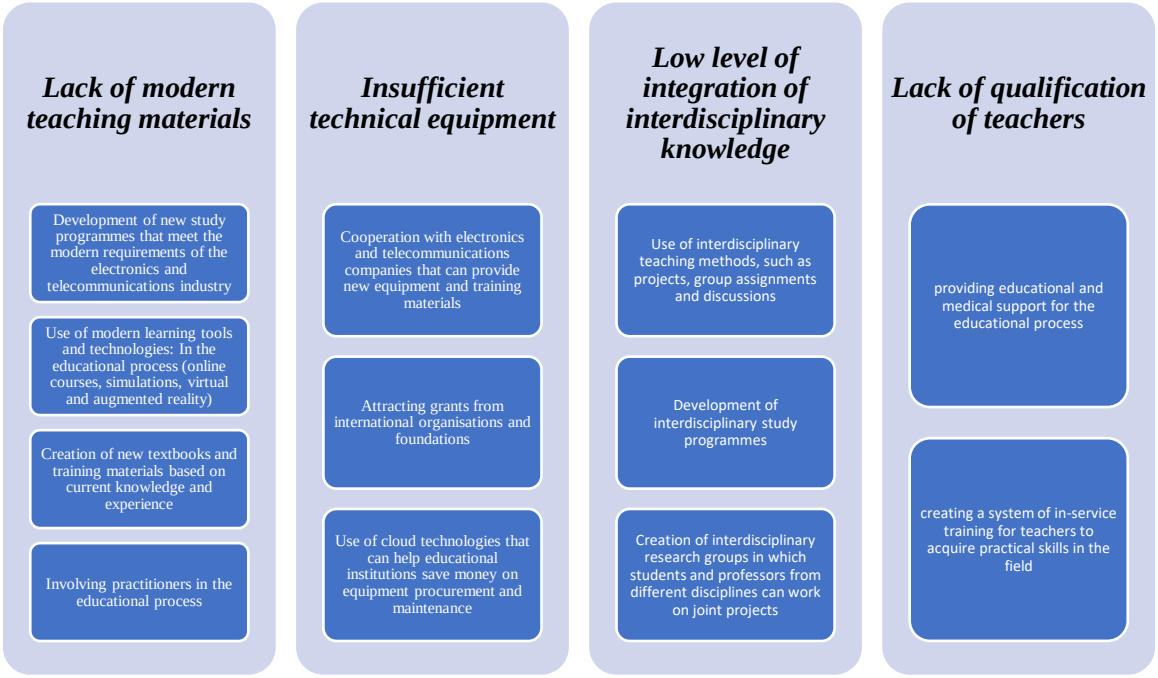

Fig. 2. Ways to solve the problem of effective formation of graphic competence of future electronics and telecommunications specialists

Since the limited scope of this publication does not allow us to dwell on all these aspects in detail, we will describe the innovative approaches to the development of graphic competence in future electronics and telecommunications specialists that we propose:

1. The use of new teaching technologies:

– virtual and augmented reality (VR/AR): VR/AR technologies can be used to create interactive environments in which students can visualise and explore electronic components, devices and systems;

– 3D printing, which is used to create physical prototypes of electronic devices, allowing students to better understand their structure and function;

– online courses and platforms that are used to provide students with access to learning materials and interactive graphics assignments anytime and anywhere.

2. Problem-based learning:

– Project-based learning. Learning graphic skills by working on real projects related to electronics and telecommunications has significant prospects. In particular, the Technician-Engineer scientific and technical club has been operating effectively at VNTU for five years. The club members have won three times at the All-Ukrainian competitive research projects. The club is one of the activities of the student NGO Radiolance Foundation, which was established in 2017.

– Case studies that can help students understand how graphic skills are used in real professional situations.

– Cooperation with companies in the electronics and telecommunications industry can help students gain practical experience with graphic skills.

3. Individualisation of learning:

– Personalised curricula according to the needs and interests of each student.

– The use of adaptive learning technologies that can automatically adjust the complexity of learning materials to the level of each student.

– Mentoring and coaching from experienced professionals can help students develop their graphic arts skills.

4. Development of soft skills, such as

– Creativity. Graphic skills are often used to create innovative solutions.

– Communication. Graphic skills can be used to communicate complex technical concepts effectively.

– Teamwork. Graphic skills are often used to work on collaborative projects.

Conclusion. The formation of graphic competence in future specialists in electronics and telecommunications is an extremely urgent task that requires the introduction of innovative approaches to teaching. The main problems, such as the lack of modern educational materials, insufficient technical equipment, low level of integration of interdisciplinary knowledge and insufficient qualifications of teachers, can be overcome through the use of the latest technologies, development of online courses, interactive and project-based learning methods, as well as partnerships with businesses and advanced training of teaching staff.

Innovative approaches to teaching, such as the use of virtual and augmented reality, integration of interdisciplinary knowledge, active cooperation with industrial partners and continuous professional development of teachers, contribute to the formation of highly qualified, competitive specialists capable of meeting the challenges of the modern technological era. The implementation of these approaches will ensure high-quality training of specialists who will not only have the necessary professional competencies but also be able to implement innovative solutions in the field of electronics and telecommunications. This will contribute to the overall development of the industry and increase its competitiveness in the global market. Only by working together can we create the conditions for high-quality training of electronics and telecommunications specialists who have the necessary knowledge, skills and competencies to work successfully in this dynamic industry.

We consider the development and implementation of methods for assessing the level of graphic competence of students, as well as the analysis of the results for further improvement of curricula to be prospects for further research. In particular, creating integrated educational programmes that combine different disciplines, such as graphic design, programming and electronics, to develop students‘ comprehensive knowledge and skills and studying the impact of project-based learning on the development of students’ graphic skills and their ability to solve real-world technical problems.

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