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Professional digital competence
of pharmacy masters:
content, structure and transformation
of educational programs

Słowa kluczowe: rynek farmaceutyczny, edukacja farmaceutyczna, magister farmacji, kompetencje cyfrowe.

The transformation of the pharmaceutical industry is taking place in conditions of constant challenges and threats. For scientific and scientific-pedagogical workers, the challenge of the time is to ensure the compliance of the pharmaceutical education system with global economic and educational trends in order to meet the requirements of a modern human, the pharmaceutical market, the labor market, and the needs of the state. The shift in the emphasis affecting the potential for progress from technological processes to cooperation between humans and machines is gradually moving the economy and society from "Industry 4.0" to "Industry 5.0". Therefore, the today's graduate of a pharmaceutical educational establishment will work with health care programs available in "Industry 5.0" and aimed at patients, doctors, and pharmacists. The professional activity of the future Master of Pharmacy is currently taking place in conditions where logistics chains are changing, the production of medical products is carried out using automated management systems based on the principle of "production within the production" and electronic systems of databases containing clinical treatment protocols with a unified evidence base and where e-prescriptions with a monolithic database for doctors and pharmacists are being created[1]. The formation of a network-based interaction system of suppliers and partners, as well as the im-

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[1]   A. Adel. *Future of industry 5.0 in society: human-centric solutions, challenges and prospective research areas.* J Cloud Comp 11, 40 (2022). www.doi.org/10.1186/s13677-022-00314-5.

plementation of innovative business models in the pharmacy segment in the era of the digitalized economy and society requires the transformation of hard and soft skills in the professional activity of Masters of Pharmacy. Another urgent task for the pharmaceutical higher education system is the acquisition and improvement of digital competences, which are becoming more and more relevant for the pharmaceutical industry[2].

The problem of professional training of future specialists in the field of pharmacy has been fiercely debated by Ukrainian researchers. Focusing on theoretical and methodological principles of professional training aimed at pharmaceutical specialists in Ukraine from the 20th to the beginning of the 21st century), Valentyna Slipchuk[3] conducted a comparative analysis of the basic research concepts used in papers written by European and domestic authors. In her view, the "professional training of pharmaceutical industry specialists" is "a specially organized educational process for future specialists that enables them to acquire professional knowledge, abilities and skills, as well as necessary competencies that form the basis of professional activity in the field of health care, and also a scientific outlook andmotivation for the profession and ensure further continuous professional development in the pharmaceutical industry". She carried out a systematic analysis of trends in the transformation of professional training of pharmaceutical specialists in Ukraine during the 20th century up to 2017, in which general, special and specific tendencies are highlighted[4] [5].

In Liudmyla Romanishyna and Svitlana Marchyshyn's study on the development of the theory and practice of professional training of future pharmacists[6], the authors define the professional competence of a future pharmacist as a "systemic education covering a high level of readiness for the professional activity"[7]. According to them, its formation should be carried out on the basis of competence and praxeological approaches, which will make it possible to form a student's "integrated professional position based on the use of practical skills and skills of

[2]   N. Bilousova. *Transformation of "Industry 4.0" challenges into the possibility of professional development of a medical representative.* International Independent Scientific Journal. 2020. 2(18), pp. 14-18.

[3]   V. L. Slipchuk. Training of specialists of the pharmaceutical industry in Ukraine in the conditions of European integration. *Continuous education: theory and practice.* 2014. Issue. 3-4, p. 63-68.

[4]   Ibidem.

[5]   V. L. Slipchuk. *Trends in professional training of pharmaceutical industry specialists in Ukraine (XXth – the beginning of XXIst century)*: dissertation for obtaining of scientific degree "Doctor of Pedagogical Sciences": spec. 13.00.04 "Theory and Methodology of Professional Education" 2018, p. 551.

[6]   L. Romanyshyna, S. Marchyshyn. *Scientific approaches to improvement of the professional training of the future pharmacists in the "college-medical academy" system.* Bulletin of the National Academy of the State Border Guard Service of Ukraine. 2019. # 5. https://periodica.nadpsu.edu.ua/index.php/pedvisnyk/article/view/359/359.

[7]   Ibidem.

independent combination of the known methods of action and purposefully create new, alternative ways of solving the professional tasks"[8].

The topic of formation of professional competence of future pharmacists is covered in the scientific publication of Nataliya Dubel. Referring to the analysis of the qualification characteristics of professions in the field of health care, the researcher came to the conclusion that in order to train a competitive specialist successfully, it is necessary to form a number of general and specific competences in higher education applicants, which should correspond to the Global Framework of Competences of Pharmaceutical Specialists of the Educational Initiative of the International Pharmaceutical Federation (FIP Education Initiatives. Pharmacy Education Taskforce. A Global Competency Framework) and take into account the national features of training the higher pharmaceutical education students[9].

Iryna Protsiuk dedicated her scientific work to the formation of sociocultural competence of the future pharmacists in the process of humanitarian training in colleges. She presents a structure of sociocultural competence of future pharmacists, in which one of the components is information cognitive. This component, according to the researcher, characterizes the level of sociocultural awareness in the professional sphere and determines the totality of sociocultural knowledge of a professional, psychological, pedagogical, cultural, and social nature[10].

A team of authors headed by Alla Kotvitska analyses modern requirements for the professional competence of pharmaceutical personnel from the perspective of employers. The results of their study devoted to the correspondence between the competences established in the educational and professional programs entitled "Pharmacy", "Clinical Pharmacy" and "Technology of perfumery and cosmetic products" at the National Pharmaceutical University, suggest that "it is urgent to improve the training plans of higher education students", which first of all refers to the extra-credit additional study of foreign language training disciplines, and to the "in-depth study of managerial and economic disciplines"[11].

[8]   L. Romanyshyna, S. Marchyshyn. *Scientific approaches to improvement of the professional training of the future pharmacists in the "college-medical academy" system.* Bulletin of the National Academy of the State Border Guard Service of Ukraine. 2019. # 5. https://periodica.nadpsu.edu.ua/index.php/pedvisnyk/article/view/359/359

[9]   N.I. Dubel. *Formation of professional competence of the future pharmacists at Ivano-Frankivsk National University.* Art of medicine. 2022. # 2. Pp. 124-129.

[10]   I. Ye. Protsiuk. *Formation of sociocultural competence of the future pharmacists in the process of humanitarian training in colleges:* abstr. diss. for scien. deg. Cand. of Ped. Scien: 13.00.04 – Theory and Methodology of Professional Education; Zhytomyr State University named after I. Franko. Zhytomyr, 2019. P. 20.

[11]   A. A. Kotvitska, Yu. S. Bratishko, A. V. Volkova, D. Yu. Tarasenko, O. V. Posylkina, A. B. Olkhovska. *Analysis of modern requirements of employers regarding functional duties and competences of pharmaceutical personnel.* Zaporizhzhia Medical Journal. 2020. Vol.22, #6. Pp. 847-857. www.doi.org/10.14739/2310-1210.2020.6.218472.

The integration of the Ukrainian pharmaceutical higher education system into the European educational space necessitates the study of trends in the professional training of pharmacy specialists in foreign universities. Bohdan Palasiuk examines the experience of professional training of masters of pharmacy in Austrian universities focusing on such features of the Austrian Master's program in pharmacy as synergy of academic and professional focusand practice-oriented scientific research aimed at the scientific organization of pharmaceutical activity[12].

At the same time, the problem of the content, structure of the professional digital competence of Masters of Pharmacy and the transformation of educational programs has not found its solution in the works of domestic researchers, although one of the flagship initiatives of the European program "Action Plan for Improving Health in Europe for 2020-2025" envisages digitalization of health care for the improvement of primary health care services, ensuring the rights and opportunities of citizens[13]. This plan is aimed at the development of effective partnership between organizations, scientific institutions, enterprises, and in particular, the pharmaceutical industry, which is developing today in tough competitive conditions.

Currently, scientists are focused on the implementation of the Pharma 4.0 Concept, developed by ISPE (The International Society for Pharmaceutical Engineering), which is based on the main ideas of the Industry 4.0 strategy for the pharmaceutical industry. Its key idea is to continuously improve quality and productivity, reduce costs and ensure supply stability throughout the entire product life cycle by reforming business processes through IT innovation and digitalization. According to this concept, Pharma 4.0 must not only comply with the goals and objectives of business, but also fulfill all the obligations of government decrees and regulatory requirements concerning the pharmaceutical industry.

In summary, it can be stated that the concept of Pharma 4.0 should be considered as the use of information technology (IT) opportunities throughout the product life cycle with the aim to create quality control processes based on the recommendations of the ICH-Q10 Pharmaceutical Quality System (PQS) [Pharmaceutical Quality Management System][14]. It is clear that IT skills are important for the realization of Pharma 4.0 and for the implementation of digitalization and the clear vision that includes a detailed understanding of pharmaceutical regula-

[12]   B.M. Palasiuk. *Professional training of Masters of Pharmacy in Austrian universities*. Medical Education. 2022. Pp. 47-50. =www.doi.org/10.11603/m.2414-5998.2022.3.13405

[13]   WHO *European Program of Work, 2020–2025 – United Action for Better Health in Europe (EPW)*, 2021, www.eurohealthnet.eu/wp-content/uploads/publications/2021/210224_event_policyandstrategymeeting_briefingwhoeuropeanprogrammeofwork.pdf

[14]   Yokogawa, *Co-innovating tomorrow. Pharma 4.0*. www.yokogawa.com/cis/industries/pharmaceutical/#Подробно__Pharma-4-0

tions, taking into account PQS. In order to take a proper place on the world stage in the development and implementation of measures aimed at strengthening the existing competitive advantages and creating new ones in the pharmaceutical market, each of its segments needs specialists of various profiles with the developed digital competence.

In view of the mentioned above, it is necessary to state that recently there has been an active digital transformation of the pharmaceutical industry, which included:

- widespread use of blockchain technology (enables the exchange of values, provides transparent communication between each stage of the production process and supply, creation of a system for simplifying audits and control by regulators) to ensure processing and protection of information in the system of supply management, pharmaceutical security and medicine development, shortening the terms of clinical trials, reducing costs for the release of new medicine, etc.;

- "machine learning" is introduced in order to optimize the work and the process of finding new medicine;

- artificial intelligence, Big Data, OLAP are used in the field of analytics and simulation modeling of medicine development technologies (may become standard practice by 2040)[15][16;]

- eHealth is introduced as a set of information services for doctors, patients and state bodies of the health care system, designed to systematize all medical information (unifies into a single information space various areas of health care: medical practice, management of health care facilities, medical law, pharmaceutical industry, information services for the patient)[17];

- an electronic prescription is being put into effect - a digital analogue of a paper prescription (it is created, stored and transferred by using the medical information system in the electronic health care system – EHCS)[18].

The draft strategy for the development of health care in Ukraine until 2030 refers to the implementation of a unified medical information space using a num-

[15]   N.A. Bilousova. *Professional training of medical representatives in pharmaceutical companies of the Federal Republic of Germany*. – Dissertation for obtaining the scientific degree of Candidate of Pedagogical Sciences, speciality 13.00.04 "Theory and Methodology of Vocational Education" (01 Education / Pedagogy). National Aviation University, MES Ukraine, Kyiv 2021. p. 218.

[16]   O.V. Posylkina, A.G. Lisna. *Scientific and practical approaches to managing the security and efficiency of pharmaceutical supply chains using digital technologies*. Social pharmacy in healthcare. 2019. Vol. 5., # 2. Pp. 43-54.

[17]   ЕМСІ. Що таке eHealth • Реєстрація та вхід в особистий кабінет е-Хелс – ЕМСІ.

[18]   Medical care. Электронный рецепт - Украина www.medplatforma.com.ua.

ber of digital technologies, such as Big Data and artificial intelligence technologies at all levels, including the private sector. At the same time, the need to provide "the effective mechanisms for the development and support of digital competencies of users of electronic medical technologies by patients, doctors and pharmacists" is emphasized. The analytical part of the document, focuses on the low level of formation of digital competences of medical workers, the insufficient level of provision of health care institutions with high-speed Internet connection and, accordingly, the development of the national medical information infrastructure, in particular, the personnel capacity and the level of formation of digital competence of health care workers, and the state of computerization of healthcare facilities[19].

Therefore, the work in the modern pharmaceutical industry and in the field of medical services requires from the future pharmacists well-developed digital literacy, which currently constitutes a challenge for the national system of higher pharmaceutical education. Thus, the training of Masters of Pharmacy, who are able to work with the constantly evolving digital technologies, is timely. This puts forward appropriate requirements for digital literacy of both education seekers and scientific-pedagogical staff, who must interact on a partnership basis using digital tools, software and cloud services in order to achieve educational goals.

Published in the research report of the Federation of International Pharmacy (FIP), the global overview of digitalization of health care in pharmaceutical education indicates the need to introduce digitalization of health care into educational programs of professional training of pharmacists as a separate educational discipline. Of course, this requires appropriate training of the subjects of the educational process. In this regard, in the recommendations of the above-mentioned document, it is proposed to develop the educational program based on the results of the diagnosis of the formation level of digital competence among both teachers and students. It can be included in the curriculum of professional training of medical/pharmaceutical workers as an optional subject[20].

The concept of "digital competence" is a well-researched phenomenon that occurs in studies of both Ukrainian and foreign scientists. (Valeryi Bykov and Maria Leshchenko[21], Liudmyla Havrylova and Yana Topolnyk[22], Eugenia

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[19]   Ministry of Health of Ukraine, *Healthcare developing strategy 2030. Vision of the future. Project.* Бачення майбутнього._2023, www.moz.gov.ua/uploads/ckeditor/Стратегія/UKR%20Health%20 Strategy%20Feb%2024.2022.pdf

[20]   International Pharmaceutical Federation (FIP). *FIP Digital health in pharmacy education.* The Hague: International Pharmaceutical Federation. 2021. www.fip.org/file/4958.

[21]   V. Bykov, M. Leshchenko. *Digital humanistic pedagogy: relevant problems of scientific research in the field of using ICT in education*. Information Technologies and Learning Tools, 53, 2016, pp.1-17.

[22]   L. Havrilova, Y. Topolnyk *Digital culture, digital literacy, digital competence as modern educational phenomena*. Information Technologies and Learning Tools, 61(5), 2017, pp. 1-14 (in Ukrainian).

Smyrnova-Trybulska, Josef Malach, Kateřina Kostolányová, Nataliia Morze, and Piet Kommers)[23].

In this paper digital competence will be understood as the "competence that includes confident, critical, responsible use and interaction with digital technologies for learning, work, and participation in society. It includes information and digital literacy, communication and collaboration, digital content creation, security and problem-solving"[24].

Another document prepared by the Pharmaceutical Group of the European Union (PGEU) on the digitalization of health care refers to the need of introducing educational and professional programs in undergraduate and postgraduate education (formal and informal), technologies and approaches to the use of artificial intelligence in higher education establishments and directly in the practical environment (pharmaceutical production, pharmacies, pharmaceutical companies, etc.)[25] with the support of the state, the pharmaceutical industry, public organizations and associations. Thus, the digital education action plan of the EU for the coming decade envisages the use of the digital potential of education and training systems, increasing the level of digital literacy skills of the population, creation of a reliable ecosystem of educational content and tools within the Erasmus, Digital Europe, Horizon Europe programs[26].

It should be noted that the pharmaceutical education in Europe is regulated and complies with the Directive 2005/36/EC – "the profession of a pharmacist"[27]. It was developed and adopted in accordance with the changes taking place in the pharmaceutical industry in the context of the scientific and technological progress of Pharma 4.0. The analysis of this document shows that in 31 EU countries (27 EU member states, three member states of the European Economic Area, and Switzerland) the introduction of IT and digital technology disciplines into edu-

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[23]   E. Smyrnova-Trybulska, N. Morze, J. Malach, T. Noskova., P. Kommers. *Report on the implementation of workpackage 6: "implementation of methodology" in the framework of the IRNET project.* International Journal of Research in E-learning (3 (2)), 2017, pp.11- 137.

[24]   European Commission (2018). *Proposal for a Council Recommendation on Key Competences for Lifelong Learning {SWD (2018) 14 final}.* www.eur-lex.europa.eu/resource. html?uri=cellar:395443f6-fb6d-11e7-b8f5-01aa75ed71a1.0001.02/DOC_1&format=PDF.

[25]   Pharmaceutical Group of the European Union. *Position Paper on Digital Health.* 2021. www.pgeu.eu/wp-content/uploads/2021/06/PGEU-Position-Paper-on-Digital-Health.pdf.

[26]   European Commission (2020). Roadmap. *Digital Education.* www.ec.europa.eu/info/law/better-regulation/have-your-say/initiatives/12453-Digital-education-action-plan-update-_en.

[27]   European Commission, 2022. Directorate-General for Internal Market, Industry, Entrepreneurship and SMEs (European Commission) *Mapping and assessment of developments for one of the sectoral professions under Directive 2005/36/EC the profession of pharmacist.* Luxembourg: Publications Office of the European Union, 2022. www.op.europa.eu/en/publication-detail/-/publication/1990d6c1-a40f-11ec-83e1-01aa75ed71a1.

cational and professional programs is supported. It is also necessary to note that in most of these countries today such disciplines are optional (at the choice of the students)[28].

According to the mentioned Directive, a health care professional is considered to be a medical doctor, nurse, dentist, midwife, pharmacist, or other health care professional, as regulated by Article 3 (1) (a)[29]. However, Ukrainian legislation does not provide for a clear definition of the term "professional in the field of health care". In search of the essence of this concept, one can turn to the Guide to the qualification characteristics of the professions of employees in the "health care" industry[30], referring in particular to the section "Professionals". This section is divided according to the areas of the specialists training: professionals in the field of treatment, dentistry, pharmacy, and medical and preventive work in the field of medicine. It includes professions that require from an employee a diploma at the second (master) level. We should note that in Ukraine, nurses, midwives, pharmacist assistants who have a medical education at the first (bachelor) level are considered medical personnel. Additionally, they need to acquire a high level of digital competence, as they participate in the e-Health program.

As stated in the topic of our research, we need to refer to the European Digital Competence Framework DigComp 2.1 for citizens. It singles out five main competencies for the digital literacy of society, as shown in Table 1[31]. In accordance with this document, the Description of the digital competence framework for citizens of Ukraine was developed, and the corresponding changes were made[32], which are reflected in the Report on eSkills for professionals[33]. The object of this documnt is a number of digital competencies of healthcare professionals and their implemen-

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[28]   Ibidem.

[29]   Directive 2005/36/EC of the European Parliament and of the Council of 7 September 2005 on the recognition of professional qualifications. www.eur-lex.europa.eu/LexUriServ/LexUriServ. do?uri=OJ:L:2005:255:0022:0142:en:PDF.

[30]   Ministry of Health of Ukraine (2002, March). *Handbook of qualification characteristics.* Issue 78. www.zakon.rada.gov.ua/rada/show/va117282-02#Text.

[31]   S. Carretero Gomez, R. Vuorikari. Y. Punie. *DigComp 2.1: The Digital Competence Framework for Citizens with eight proficiency levels and examples of use*, EUR 28558 EN, Publications Office of the European Union, Luxembourg, 2017, ISBN 978-92-79-68006-9 (pdf),978-92-79-68005-2 (print),978-92-79-74173-9 (ePub), doi:10.2760/38842 (online),10.2760/836968 (print),10.2760/00963 (ePub), JRC106281.

[32]   Ministry of Digital Transformation of Ukraine (2021). *The framework description of digital competence for the citizens of Ukraine.* www.thedigital.gov.ua/storage/uploads/files/news_post/2021/3/ mintsifra-oprilyudnyue-ramku-tsifrovoi-kompetentnosti-dlya-gromadyan/OP%20ЦК.pdf.

[33]   L. Keane, R. Moore, M. Cleary, L. Mosch, B. Atienza-Carbonell, F. Machleid, J. Balciunas. T6.3 contributors. *D6.3 - Report on eSkills for Professionals WP6 - Enhancing Continuity of Care Version 1.0, 25/03/2020. eHAction. Joint Action supporting the eHealth Network.* www.ehaction.eu/ wp-content/uploads/2020/08/03.06.2020_eHN-adopted_eHAction-D6.3_Report-on-eSkills-for-Professionals_v1.0.pdf.

tation in medical / pharmaceutical education of higher education establishments of the third-fourth level of accreditation as continuous professional development, which is illustrated in Table 1.

Table 1. Comparative analysis of the components of the framework of digital competences for citizens and specialists in the medical/pharmaceutical industry in the EU member states and in Ukraine according to Carretero Gomez, S., Vuorikari, R. and Punie, Y.,[34] Ministry of Digital Transformation of Ukraine[35], Linda Keane, Rebecca Moore, Mary Cleary, Lina Mosch, Beatriz Atienza-Carbonell, Felix Machleid, Justinas Balciunas[36] and Cabinet of Ministers of Ukraine[37], Ministry of Education and Science of Ukraine[38].

Digital competences	EU	Ukraine	EU (health care)	Ukraine (health care)	Implementation into educational and professional programs for the preparation of Masters of Pharmacy 226 Pharmacy, Industrial Pharmacy, %
Basics of computer literacy		✔		✔	92
Information literacy	✔	✔		✔	88
Communications and cooperation	✔	✔		✔	88
Creation of digital content	✔	✔	✔	✔	84
Communication and interaction in the digital society	✔	✔	✔	✔	84

34   S. Carretero Gomez, R. Vuorikari, Y. Punie. *DigComp 2.1: The Digital Competence Framework for Citizens with eight proficiency levels and examples of use*, EUR 28558 EN, Publications Office of the European Union, Luxembourg, 2017, ISBN 978-92-79-68006-9 (pdf),978-92-79-68005-2 (print),978-92-79-74173-9 (ePub), doi:10.2760/38842 (online),10.2760/836968 (print),10.2760/00963 (ePub), JRC106281.

35   Ministry of Digital Transformation of Ukraine (2021). *The framework description of digital competence for the citizens of Ukraine.* www.thedigital.gov.ua/storage/uploads/files/news_post/2021/3/mintsifra-oprilyudnyue-ramku-tsifrovoi-kompetentnosti-dlya-gromadyan/OP%20ЦК.pdf.

36   L. Keane, R. Moore, M. Cleary, L. Mosch, B. Atienza-Carbonell, F. Machleid, J. Balciunas, T6.3 contributors. *D6.3 - Report on eSkills for Professionals WP6 - Enhancing Continuity of Care Version 1.0, 25/03/2020. eHAction. Joint Action supporting the eHealth Network.* www.ehaction.eu/wp-content/uploads/2020/08/03.06.2020_eHN-adopted_eHAction-D6.3_Report-on-eSkills-for-Professionals_v1.0.pdf.

37   Cabinet of Ministers of Ukraine (2020, December). *Concept of development of electronic healthcare.* www.zakon.rada.gov.ua/laws/show/1671-2020-p#n8.

38   Ministry of Education and Science of Ukraine (2022, December). *"On the approval of the Standard of higher education for the speciality 226 Pharmacy, Industrial Pharmacy for the second (master's) level".* www.mon.gov.ua/storage/app/media/vishcha-osvita/zatverdzeni%20standarty/2022/11/11/226-Farmatsiya.promyslova.farmatsiya.mahistr-981-04.11.2022.pdf.

Creation of a safe environment	✔	✔	✔	✔	76
Digital problem-solving and lifelong learning	✔	✔	✔	✔	56
Clinical practice and application of the digital technologies			✔	✔	12
Data analysis of knowledge formation			✔	✔	12
Application of the system and technology			✔	✔	12

Therefore, the list of the basic competences, which are mandatory for the citizens of the EU and Ukraine, has been completed with specific competences that should be mastered by specialists in the pharmaceutical and medical fields. The competences in question are: clinical practice and application of digital technologies, data analysis of knowledge formation, application of system and technology. It should be noted that only 12% of educational and professional programs for training Masters of Pharmacy in the speciality 226 Pharmacy, Industrial Pharmacy provide for the formation of these competences in domestic establishments of higher education through the development and implementation of educational disciplines[39]. At the same time, it should be noted that currently not enough attention is paid to the formation of such an important competence as solving problems in the digital environment and lifelong learning.

The study of the educational and professional programs of 25 Ukrainian universities, where professional training is carried out at the second (master's) level in the specialty 226 Pharmacy, Industrial Pharmacy, shows that 72% of the educational and professional programs include educational disciplines aimed at the formation of digital competence, whereas only 8% of educational and professional programs provide for industrial practice, the content of which includes information and digital technologies.

The Concept of the Development of Electronic Health Care, approved by the Cabinet of Ministers of Ukraine, defines the ways and stages of introducing the conceptual and reference framework of digital competences of medical workers,

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[39]   Ministry of Education and Science of Ukraine (2022, December). "On the approval of the Standard of higher education for the speciality 226 Pharmacy, Industrial Pharmacy for the second (master's) level". www.mon.gov.ua/storage/app/media/vishcha-osvita/zatverdzeni%20 standarty/2022/11/11/226-Farmatsiya.promyslova.farmatsiya.mahistr-981-04.11.2022.pdf.

and the "development of information culture, digital literacy, cyber security and cyber hygiene of medical/pharmaceutical workers and patients". This document emphasizes also the need to strengthen the development of systems for processing the big data, artificial intelligence and acquiring new knowledge. It is assumed that such steps will lead to full integration of the requirements for digital competencies of medical/pharmaceutical specialists in professional standards and, accordingly, certain changes in the system of training and advanced training, attestation, certification and integration into the global medical information space[40].

Our further scientific research focused on the experience of developing educational programs in European universities. In particular, at the German University of Mainz, the "Medicine in the digital age" educational programs, developed as part of the "Curriculum 4.0" project, are based on a competence approach. Changes to the educational programs are made by scientists based on the results of their research. The content analysis of educational and professional programs for students of the Faculty of Medicine, conducted by Sebastian Kuhn, Nathalie Muller, Elisa Kirchgassner, Lisa Ulzheimer and Kim Deutsch[41], may serve here as an example. On its basis, proposals were made in order to supplement the educational programs with topics that are the most relevant for the formation of digital competences. The study of the use of artificial intelligence was intensified and time was allocated for the necessary practical classes and lectures. To conduct them, the researchers suggested the involvement of external lecturers, and patients as co-teachers. Such an approach, in their opinion, will contribute to the development of skills in the "application of technologies in the field of digital medicine" and make the course of digital programs for health care, treatment approaches and "decision support systems" more attractive[42]. A similar opinion is held by the American scientist Vijaya Colachalama, who believes that the inclusion of content with artificial intelligence in educational and professional programs is currently becoming an integral part of the digital society[43]. The contrary view that "time constraints, low level of technical skills, non-compliance of the infrastructure with the modern requirements of the technological development of the pharmaceutical industry, lack of institutional strategies"[44] in the profes-

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[40] Cabinet of Ministers of Ukraine (2020, December). *Concept of development of electronic healthcare.* www.zakon.rada.gov.ua/laws/show/1671-2020-p#n8.

[41] S. Kuhn, N. Müller, E. Kirchgässner, L. Ulzheimer, K. Deutsch. (2020). *Digital skills for medical students -qualitative evaluation of the curriculum 4.0 "Medicine in the digital age".* GMS Zeitschrift für medizinische Ausbildung. 37. www.doi.org/10.3205/zma001353.

[42] Ibidem.

[43] B. V. Kolachalama. *Machine learning and pre-medical education.* Artificial Intelligence in Medicine. Volume 129. 2022. www.doi.org/10.1016/j.artmed.2022.102313.

[44] D. O'Doherty, M. Dromey, J. Lougheed. et al. *Barriers and solutions to online learning in medical education – an integrative review. BMC Med Educ* 18, 130 (2018). /www.doi.org/10.1186/s12909-018-1240-0.

sional training of pharmacists, expressed by Irish scientists Diane O'Doherty, Marie Dromey, Justan Lougheed, and Ailish Hannigan[45], makes the content of a number of educational disciplines uninteresting and outdated, which negatively affects its quality and, accordingly, the competitiveness of educational and professional programs in medical education. In turn, Rafaella Silva, Dyego Araujo, Pedro Menezes, Eugenio Neves, and Divaldo Lyra[46] emphasize that "the use of technology without any clearly defined pedagogical objectives does not guarantee the attainment of the desired educational goals"[47]. Therefore, the content of educational disciplines must be carefully selected with taking into account the results of scientific research, and meet the main tasks of professional training of specialists in the field of pharmacy.

The gradual implementation of IT technologies in the pharmaceutical industry requires the gradual inclusion into the educational and professional programs of educational disciplines aimed at the development of relevant practical abilities and skills, the formation of digital competences in order to improve the quality of patient care[48]. Lorainne Tudor Car, Bhone Myint Kyaw, Rishi S Nannan Panday[49] and others analyzed 34 studies conducted in the United States (20/34, 59%) and published their results during the period between 2010 and 2019, where they analyzed different digital learning courses. This allowed them to find that the digital healthcare courses were mostly optional (20/34, 59%). Some of them were integrated into current educational and professional programs (24/34, 71%) and focused mainly on medical informatics (17/34, 50%). Most of the training courses were attended by medical students from the first to the third year (17/34, 50%). The duration of the courses ranged from one hour to three academic years. It is worth noting that the majority of studies (22/34, 65%) refer to the use of mixed education in the professional training of medical specialists. Some studies (6/34, 18%) provided examples of training courses that were taught entirely digitally using online modules, self-paced learning, massive open online courses and virtual patient simulations[50].

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[45]   Ibidem.

[46]   R. d.O.S. Silva, D.C.S.A. de Araújo, P.W. dos Santos Menezes et al. *Digital pharmacists: the new wave in pharmacy practice and education*. Int J Clin Pharm 44, pp. 775–780 (2022). www.doi. org/10.1007/s11096-021-01365-5.

[47]   Ibidem.

[48]   Ibidem.

[49]   Tudor Car L, Kyaw BM, Nannan Panday RS, van der Kleij R, Chavannes N, Majeed A, Car J. *Digital Health Training Programs for Medical Students: Scoping Review*. JMIR Med Educ. 2021 Jul 21;7(3):e28275. www.doi.org/10.2196/28275. PMID: 34287206; PMCID: PMC8339984.

[50]   Ibidem.

Finnish scientists Mira Hammarén, Erika Jarva, and Kristina Mikkonen[51] studied the methods of developing digital competence among representatives of different generations in the field of health care. They found out that in order to reduce the "digital gap" in the development of digital competences between generations in the field of health care, reverse mentoring methods can be applied[52].

Unfortunately, today in Ukraine, we could not find comprehensive studies on the problem of forming the digital competence of future specialists in the field of pharmacy. Some publications present rather "narrow" aspects of this problem. Thus, in the study of domestic scientists Tetiana Reva, Inna Kucherenko, Iryna Nizhenkovska and others[53], the results of the study of the level of formation of the digital component of Masters of Pharmacy professional competence and the ability of students to apply it in blended learning, are provided. The authors paid attention to the formation of skills in the use of gadgets and IT in independent testing.

We analyzed the results of the study "Mapping and assessment of developments for one of the sectoral professions under Directive 2005/36/EC the profession of pharmacist. Luxembourg: Publications Office of the European Union, 2022", in which a comparison of national educational programs of higher education establishments aimed at theoretical and practical training of pharmacists in the EU countries and Switzerland, was carried out. Particular attention was paid to the compliance of educational programs with scientific and technical progress, in particular, to the formation of digital competences of the future specialists. This document evaluates the updated content of educational disciplines in accordance with pharmaceutical practice that has faced new technological realities. It refers to information management and data storage, portable diagnostics, intelligent delivery systems, digital therapeutics, genome sequencing, artificial intelligence and blockchain, which are becoming part of clinical practice. In this regard, the introduction of knowledge and skills in IT and digital technologies into the educational process is being revised with the aim of forming digital competencies in graduates of pharmaceutical faculties[54].

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[51]   M. Hammarén, E. Jarva, K. Mikkonen, M. Kääriäinen, O. Kanste. *Scoping review of intergenerational learning methods for developing digital competence and their outcomes. Finnish Journal of EHealth and EWelfare*, *14* (4), 2022, pp. 364–379. www.doi.org/10.23996/fjhw.122044.

[52]   Ibidem.

[53]   R. Tetiana, K. Inna, N. Iryna, S. Natalia, K. Liudmyla, B. Olexandr, C. Oksana, K. Alina. *Digital Component of Professional Competence of Masters of Pharmacy in the Framework of Blended Learning. Archives of Pharmacy Practice, 12* (1), 2021, pp. 98-102. www.doi.org/10.51847/avsEptmZsN.

[54]   Directorate-General for Internal Market, Industry, Entrepreneurship and SMEs (European Commission) *Mapping and assessment of developments for one of the sectoral professions under Directive 2005/36/EC the profession of pharmacist,* Luxembourg 2022, www./op.europa.eu/en/publication-detail/-/publication/1990d6c1-a40f-11ec-83e1-01aa75ed71a1(access: 20 march 2023).

A detailed study of this document prompted us to study the educational and professional programs of Ukrainian establishments of higher pharmaceutical education in order to find out the state of formation of digital competences of the future pharmacy specialists. For this purpose, we used the data of the Unified State Electronic Database on Education. The analysis of the data has shown that 25 establishments of higher education provide professional training of Masters of Pharmacy in the specialty 226 Pharmacy, industrial pharmacy in Ukraine. It was found out that 64% of the educational and professional programs implemented include the educational discipline "Information Technologies in Pharmacy", 56% of them "Computer Modeling in Pharmacy", 28% – "European Standard of Computer Literacy", 4% – "Web Design in Pharmacy",8% – "Nanotechnologies and Nanomaterials in Pharmacy", 4% – "Automated Systems for Managing the Technological Processes of the Industry", 8% – "Production Practice on Pharmaceutical Information", 4% – "Fundamentals of Computational Chemistry and Molecular Modeling". To sum up, we should note that in educational and professional programs, attention is mostly paid to the formation of basic digital competences, which are computer and information literacy, communication and cooperation, creation of digital content, communication and interaction in a digital society, and creating a safe environment.

At the same time, there are reasons to criticize the inattention in the development of educational and professional programs to the formation of such relevant competences as clinical practice and the use of digital technologies, data analysis of knowledge formation, and application of systems and technologies. Educational disciplines, which provide for their formation in the process of master's studies, make up only 12%. Such competence as solving problems in the digital environment and lifelong learning is provided for in only 56% of educational and professional programs.

According to experts' assessment, specialists capable of designing and implementing new information and digital technologies, taking into account new challenges, with an established readiness for professional activity in the conditions of a digital society, will be in demand on the modern labor market in the next two or three years. Their formation is possible "through the implementation of high-quality educational programs, research and social projects", integration into the "European educational and research space", dynamic development of "institutions and academic communities based on the principles of academic freedom, university autonomy, integrity and inclusiveness" (Cabinet of Ministers of Ukraine, 2022)[55].

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[55]   Cabinet of Ministers of Ukraine (2022, February). *On the approval of the Higher Education Development Strategy for 2022-2032,* www.kmu.gov.ua/npas/pro-shvalennya-strategiyi-rozvitku-vishchoyi-osviti-v-ukrayini-na-20222032-roki-286-.

Conclusion

The modern pharmaceutical industry needs specialists with a high level of development of digital literacy, which is currently a challenge for the national system of higher pharmaceutical education. Based on the results of the analysis of regulatory documents adopted at the international and domestic levels, it was discovered that the levels of digital competence formation should be diagnosed in pharmaceutical education students using the European digital competence framework DigComp 2.1 for citizens and the Description of the Digital Competence Framework for citizens of Ukraine.

On the basis of the analysis of educational and professional programs for the training of specialists for the pharmaceutical industry, introduced in domestic establishments of higher education, educational disciplines were identified, in the process of study of which the formation of basic digital competences takes place, for the most part: computer and information literacy, communication and cooperation, creation of digital content, communication and interaction in the digital society; creation of a safe environment. It was established that only 12% of educational disciplines are aimed at forming such currently relevant competencies for Masters of Pharmacy as clinical practice and application of digital technologies, data analysis of knowledge formation, and system and technology application.

According to the recommendations presented in the Report on eSkills for the WP6 professionals, a number of digital competences of healthcare professionals were introduced, which should be included in educational and professional programs for the professional training of healthcare professionals in third- and fourth-level higher education establishments accreditation and continuous professional development. Aside from that, it was speculated about the ways of implementing the high-quality educational and professional programs aimed at forming digital competences among Masters of Pharmacy.

Bibliography

Access to European Union law, *Directive 2005/36/EC of the European Parliament and of the Council of 7 September 2005 on the recognition of professional qualifications*, www.eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=OJ:L:2005:255:0022:0142:en:PDF (access: 12.02.2023).

Adel A., *Future of industry 5.0 in society: human-centric solutions, challenges and prospective research areas*, www.doi.org/10.1186/s13677-022-00314-5 (access: 09.02.2023).

Bilousova N., *Transformation of "Industry 4.0" challenges into the possibility of professional development of a medical representative,* «International Independent Scientific Journal», 2020, pp. 14-18.

Bilousova N., *Professional training of medical representatives in pharmaceutical companies of the Federal Republic of Germany*, Kyiv 2021.

Bykov V., Leshchenko M., *Digital humanistic pedagogy: relevant problems of scientific research in the field of using ICT in education*, «Information Technologies and Learning Tools», 2016, pp. 1-17.

Cabinet of Ministers of Ukraine, *Concept of development of electronic healthcare,* https://zakon.rada.gov.ua/laws/show/1671-2020-p#n8 (access: 11.02.2023).

Cabinet of Ministers of Ukraine, *On the approval of the Higher Education Development Strategy for 2022-2032,* https://www.kmu.gov.ua/npas/pro-shvalennya-strategiyi-rozvitku-vishchoyi-osviti-v-ukrayini-na-20222032-roki-286- (access: 11.02.2023).

Carretero Gomez S., Vuorikari R. and Punie Y., *DigComp 2.1: The Digital Competence Framework for Citizens with eight proficiency levels and examples of use*, https://publications.jrc.ec.europa.eu/repository/handle/JRC106281 (access: 12.02.2023).

Dubel N.I., *Formation of professional competence of the future pharmacists at Ivano-Frankivsk National University,* 2022, pp. 124-129.

EMCI, *What is e-Health*, www.emci.ua/iak-pidkliuchytysia-do-ehealth/ (access: 14.02.2022).

European Commission, *Proposal for a Council Recommendation on Key Competences for Lifelong Learning {SWD (2018) 14 final}.* www.eur-lex.europa.eu/resource.html?uri=cellar:395443f6-fb6d-11e7-b8f5-01aa75ed71a1.0001.02/DOC_1&format=PDF (access: 16.02.2023).

Hammarén M., Jarva E., Mikkonen K., Kääriäinen M., Kanste O., *Scoping review of intergenerational learning methods for developing digital competence and their outcomes,* «Finnish Journal of EHealth and EWelfare», 2022, pp. 364–379.

Havrilova L., Topolnyk Ya., *Digital culture, digital literacy, digital competence as modern educational phenomena*, «Information Technologies and Learning Tools», 2017, pp. 1-14.

International Pharmaceutical Federation (FIP), *FIP Digital health in pharmacy education,* www.fip.org/file/4958 (access: 19.02.2023).

Kotvitska A., Bratishko Yu. S., Volkova A. V., Tarasenko D. Yu., Posylkina O. V., Olkhovska A. B., *Analysis of modern requirements of employers regarding functional duties and competences of pharmaceutical personnel*, www.doi.org/10.14739/2310-1210.2020.6.218472 (access: 07.02.2023).

Keane L., Moore R., Cleary M., Mosch L., Atienza-Carbonell B., Machleid F., Balciunas J., T6.3 contributors, *D6.3 - Report on eSkills for Professionals WP6 - Enhancing Continuity of Care Version 1.0, 25/03/2020. eHAction. Joint Action supporting the eHealth Network.* http://ehaction.eu/wp-content/uploads/2020/08/03.06.2020_eHN-adopted_eHAction-D6.3_Report-on-eSkills-for-Professionals_v1.0.pdf (access: 22.02.2023).

Kuhn S., Müller N. Kirchgässner E.,Ulzheimer L., Deutsch K, *Digital skills for medical students -qualitative evaluation of the curriculum 4.0 "Medicine in the digital age"*, www.pubmed.ncbi.nlm.nih.gov/33225052/ (access: 19.02.2023).

Medical care, *E-prescribe*, www.medplatforma.com.ua/article/ru/2178-kak-vypisat-elektronnyy-retsept-v-ukraine-rus (access: 22.02.2023).

Ministry of Digital Transformation of Ukraine, *The framework description of digital competence for the citizens of Ukraine,* www.thedigital.gov.ua/storage/uploads/files/news_post/2021/3/mintsifra-oprilyudnyue-ramku-tsifrovoi-kompetentnosti-dlya-gromadyan/OP%20ЦК.pdf (access: 23.02.2023).

Ministry of Education and Science of Ukraine, *On the approval of the Standard of higher education for the speciality 226 Pharmacy, Industrial Pharmacy for the second (master's) level*, www.mon.gov.ua/storage/app/media/vishcha-osvita/zatverdzeni%20standar-ty/2022/11/11/226-Farmatsiya.promyslova.farmatsiya.mahistr-981-04.11.2022.pdf (access: 25.02.2023).

Ministry of Health of Ukraine, *Handbook of qualification characteristics*, www.zakon.rada. gov.ua/rada/show/va117282-02#Text (access: 25.02.2023).

Ministry of Health of Ukraine, *Healthcare developing strategy 2030. Vision of the future. Project,* www.moz.gov.ua/uploads/ckeditor/Стратегія/UKR%20Health%20Strategy% 20Feb%2024.2022.pdf (access: 27.02.2023).

Ministry of Health of Ukraine, *On making changes to the Procedure for conducting attestation of doctors*, www.moz.gov.ua/article/ministry-mandates/nakaz-moz-ukraini-vid-09092022-1640-pro-vnesennja-zmini-do-porjadku-provedennja-atestacii-likariv?preview=1 (access: 25.02.2023).

O'Doherty D., Dromey M., Lougheed J. et al., *Barriers and solutions to online learning in medical education – an integrative review*, www.doi.org/10.1186/s12909-018-1240-0 (access: 27.02.2023).

Palasiuk B.M., *Professional training of Masters of Pharmacy in Austrian universities*, «Medical Education», 2022, pp. 47-50.

Pharmaceutical Group of the European Union. *Position Paper on Digital Health*, www. pgeu.eu/wp-content/uploads/2021/06/PGEU-Position-Paper-on-Digital-Health.pdf (access: 01.03.2023).

Posylkina O. V., Lisna A. G., *Scientific and practical approaches to managing the security and efficiency of pharmaceutical supply chains using digital technologies*, Social pharmacy in healthcare, 2019, pp. 43-54.

Protsiuk I. Ye., *Formation of sociocultural competence of the future pharmacists in the process of humanitarian training in colleges,* Zhytomyr, 2019.

Publications Office of the European Union, *Mapping and assessment of developments for one of the sectoral professions under Directive 2005/36/EC the profession of pharmacist,* www.op.europa.eu/en/publication-detail/-/publication/1990d6c1-a40f-11ec-83e1-01 aa75ed71a1 (access: 14.02.2023).

Roadmap. *Digital Education.* www.ec.europa.eu/info/law/better-regulation/have-your-say/initiatives/12453-Digital-education-action-plan-update-_en (access: 03.03.2023).

Romanyshyna L., Marchyshyn S., *Scientific approaches to improvement of the professional training of the future pharmacists in the "college-medical academy" system*, www.peri-odica.nadpsu.edu.ua/index.php/pedvisnyk/article/view/359/359 (access: 05.03.2023).

Reva T., Kucharenko I., Nizhenkovska I., Stuchynska N., Konovalova L., Burmaka O., Chkalo O., Koval A., *Digital Component of Professional Competence of Masters of Pharmacy in the Framework of Blended Learning, https://archivepp.com/article/dig-ital-component-of-professional-competence-of-masters-of-pharmacy-in-the-frame-work-of-blended-learning*, access: 07.03.2023.

Reva T., Kucherenko I., Nizhenkovska I., Stuchinska N., et al., *Digital Component of Professional Competence of Masters of Pharmacy in the Framework of Blended Learning,*

www.archivepp.com/article/digital-component-of-professional-competence-of-mas-ters-of-pharmacy-in-the-framework-of-blended-learning (access: 07.03.2023).

Silva, R.d.O.S., de Araújo, D.C.S.A., dos Santos Menezes, P. W. et al., *Digital pharmacists: the new wave in pharmacy practice and education*, www.doi.org/10.1007/s11096-021-01365-5 (access: 07.03.2023).

Slipchuk V. L., *Training of specialists of the pharmaceutical industry in Ukraine in the con-ditions of European integration*, «Continuous education: theory and practice»*,* 2014, pp. 63-68.

Slipchuk V.L., *Trends in professional training of pharmaceutical industry specialists in Ukraine (XXth – the beginning of XXI century),* Kyiv, 2018.

Smyrnova-Trybulska E., Morze N., Malach J., Noskova T., Kommers P., *Report on the im-plementation of workpackage 6: "implementation of methodology" in the framework of the IRNET project.* «International Journal of Research in E-learning», 2017, pp. 11- 137.

Tudor Car L., Kyaw BM, Nannan Panday R.S., van der Kleij R., Chavannes N., Majeed A., Car J., *Digital Health Training Programs for Medical Students: Scoping Review*, www.mededu.jmir.org/2021/3/e28275 (access: 07.03.2023).

Vijaya B. Kolachalama, *Machine learning and pre-medical education,* www.doi.org/10.1016/j.artmed.2022.102313 (access: 09.03.2023).

WHO, *European Program of Work, 2020–2025 – "United Action for Better Health in Eu-rope" (EPW),* www.eurohealthnet.eu/wp-content/uploads/publications/2021/210224_event_policyandstrategymeeting_briefingwhoeuropeanprogrammeofwork.pdf   (ac-cess: 10.03.2023).

Yokogawa, *Co-innovating tomorrow. Pharma 4.0,* www.yokogawa.com/cis/industries/pharmaceutical/#Подробно__Pharma-4-0 (access: 11.03.2023).