DOI https://doi.org/10.30525/978-9934-26-330-9-11

STRUCTURING OF EDUCATIONAL COMPONENTS OF PHARMACY CURRICULA PROGRAMS IN THE COUNTRY OF THE EU AND UKRAINE IN SECTION OF THE SPECIALTY STANDARD

Krychkovska A. M., Hubytska I. I., Monka N. Ya.

INTRODUCTION

The Standard of Higher Education of the second (master's) level (hereinafter – the Standard) of the Field of Knowledge 22 "Health Care" of the specialty 226 "Pharmacy, Industrial Pharmacy" of the specializations 226.01 "Pharmacy" and 226.02 "Industrial Pharmacy" was approved and put into effect by the Order of the Ministry of Education and Science of Ukraine (MES) No. 981 of November 04, 2022[1]. According to this Standard, two specializations of one specialty provide for the training of students only at the master's level of education, however, previously a number of higher education institutions (HEIs) provided training at the first (bachelor's) and second (master's) levels of education. Accordingly, we conducted a retrospective analysis of the history of the creation of this specialty and paid special attention to the study of the background of the specialty 226.02 "Industrial Pharmacy".

Also, in order to create new appropriate educational programs for the specialization 226.02 Industrial Pharmacy of the master's level, in accordance with the requirements of the Standard, we analyzed the educational programs of four universities, including two foreign and two domestic[2, 3, 4, 5]. Domestic universities: Lviv Polytechnic National University (HEI[2]) and Danylo Halytsky Lviv National Medical University (HEI[3]). Foreign universities: Opole University (Poland) (HEI[4]) and Università di Pavia (Italy) (HEI[5]).

[1] Dutch Sketches: Apothecary's Notes Among Pharmacy Cases. 2018. URL: https://fp.com.ua/articles/gollandski-amalovky-notatky-aptekarya-pomizh-aptechnyh-sprav/

[2] https://lpnu.ua/sites/default/files/2021/program/15243/2020-opp-bakalavr-226.pdf

[3] Education Program "Pharmacy, industrial pharmacy". Danylo Halytsky Lviv National Medical Univeristy. URL: https://cutt.ly/mZA9beV

[4] Education Program "Pharmacy". University of Opole. URL: http://wch.uni.opole.pl/wp-content/uploads/Farmacja-siatka-2019.jpg

[5] Education Program. "Chemistry and Pharmaceutical Technology". The University of Pavia (Italy). URL: http://scienzedelfarmaco.unipv.it/wp-content/uploads/2021/06/Regolamento-CTF-2021-22-per-DR.pdf

1. A retrospective analysis of the emergence and introduction of the specialty 226 Pharmacy, industrial pharmacy in accordance with the regulatory legal acts

Traditionally, until 2015, higher education institutions subordinated to the Ministry of Health of Ukraine (MHU) trained personnel for the pharmaceutical industry with the qualification of pharmacist, and higher education institutions subordinated to the Ministry of Education and Science (MES) trained process engineers for pharmaceutical manufacturing plants[6]. With the introduction of a single specialty 226 "Pharmacy" in 2016, and with the renaming of the specialty to 226 "Pharmacy, Industrial Pharmacy" in 2017, the training of specialists for the pharmaceutical industry was carried out in HEIs of different subordination to the Ministry of Health and the Ministry of Education and Science[7]. The KROK assessment system was introduced in the HEIs subordinated to the Ministry of Health of Ukraine. In the HEIs subordinated to the Ministry of Education and Science of Ukraine, students performed and defended qualification works – bachelor's and master's.

However, in accordance with the Resolutions of the Cabinet of Ministers of Ukraine (CMU) on the "Procedure for the Unified State Qualification Exam for Master's Degree Applicants in the Field of Knowledge 22 "Healthcare", approved by the CMU Resolution of March 28, 2018, No 334, and the attached amendments (Resolution of the Cabinet of Ministers of Ukraine of April 14, 2021 No. 351) and Resolution of the Cabinet of Ministers of Ukraine of May 19, 2021. No. 497 "On Certification of Applicants for Degrees of Professional Higher Education and Degrees of Higher Education at the First (Bachelor's) and Second (Master's) Levels in the Form of a Unified State Qualification Exam") currently provides for the Unified State Qualification Exam (USQE) in the specialty 226 "Pharmacy, Industrial Pharmacy" in the form of STEP[8, 9].

---

[6] Krychkovska A. M., ParashchynZh.D.,Bolibrukh L. D., Zayarniuk N. L. Innovative technologies: implementation of the experience of EU countries to solve pharmacy issues in Ukraine. *The role of medical science in implementing innovative medical technologies in the EU countries and Ukraine* : Scientific monograph. Riga, Latvia : "Baltija Publishing", 2022. P. 138–161. DOI https://doi.org/10.30525/978-9934-26-199-2-8. URL: http://baltijapublishing.lv/omp/index.php/bp/catalog/book/212. C. 138–161.

[7] Increasing responsibility for falsification of medicinal products or circulation of falsified medicinal products (amendments to the article of the Criminal Code of Ukraine). Petition 22/049079-еп, 18.12.2018. URL: https://petition.president.gov.ua/petition/49079

[8] On the approval of the Procedure for conducting a unified state qualification exam for master's degree holders in the field of knowledge 22 "Health Care". Resolution of the Cabinet Ministry of Ukraine № 334 on 28.03.2018 (With additions introduced following the Regulations of the Cabinet Ministry of Ukraine № 308 on 03.04.2019 and № 351 on 14.04.2021). URL: gov.ua

[9] About the certification of holders of professional preliminary higher education degrees and higher education degrees at the first (bachelor's) and second (master's) levels in the form of a

Agreeing with the need to move to a system of knowledge quality assessment according to STEPS 1, 2, 3, it was necessary to ensure a smooth, adequate transition to this system and to coordinate the actions of the HEIs that found themselves in a similar situation: Lviv Polytechnic National University (Lviv), Kyiv National University of Technology and Design (Kyiv), Odesa Polytechnic State University (Odesa), Ukrainian State University of Chemical Technology (Dnipro). These are the HEIs of the Ministry of Education and Science of Ukraine, where two-level training of bachelors and masters was conducted. As a result of the introduction of the Standard, from the academic year 2023–2024, all the above-mentioned HEIs will begin the cross-cutting training of pharmacy students of the second (master's) level of higher education on the basis of complete general secondary education (CGSE)1.

As for the background of the specialty at our university, the training of specialists in drug technology at Lviv Polytechnic National University (Lviv Polytechnic) was launched in 1951 at the Department of Technology of Biologically Active Compounds. During the period of the department's existence, professionals have graduated in the following specialties: technology of medicinal substances, technology of biologically active compounds, industrial pharmacy, chemical technology of pharmaceuticals, technology of pharmaceuticals. Since 2001, the Department of Technology of Biologically Active Compounds, Pharmacy and Biotechnology (TBCPB) has been training in the specialty "Technology of Pharmaceuticals" in the field of Pharmacy (bachelor's, engineering and master's degrees of full-time and part-time education).

Prior to the adoption of the CMU Resolution No. 266 of 29.04.2015 "On Approval of the List of Fields of Knowledge and Specialties for the Training of Higher Education Applicants", there were: Field of knowledge "Pharmacy" (1202), basic direction – 6.120201 "Pharmacy" (Bachelor's degree), on which the specialties were based: 7.12020101, 8.12020101 "Pharmacy" (7th Specialist, 8th Master); 7.12020102, 8.12020102 "Clinical Pharmacy"; 7.12020103, 8.12020103 "Technologies of Pharmaceuticals" at the National University of Pharmacy; 7.12020104, 8.12020104 "Technologies of Perfumes and Cosmetics". After the adoption of the above-mentioned Resolution of the Cabinet of Ministers of Ukraine, significant changes took place – the fields of knowledge and their corresponding specialties appeared: Field of Knowledge 22 "Health Care", specialty 226 "Pharmacy". Thus, taking into account the changes made in accordance with the CMU Resolutions: No. 674 of 27.09.2016 (Pharmacy), No. 53 of 01.02.2017

unified state qualification exam. Resolution of the Cabinet Ministry of Ukraine № 497 on 19.05.2021. URL: gov.ua

(Pharmacy, Industrial Pharmacy), No. 762 of 07.07.2021 – unchanged and No. 1392 of 16.12.2022 – unchanged, the training was carried out in the specialty 226 "Pharmacy, Industrial Pharmacy".

In accordance with the Resolution of the Cabinet of Ministers of Ukraine No. 334 "On Approval of the Procedure for Conducting the Unified State Qualification Exam for Master's Degree Applicants in the Field of Knowledge 22 "Healthcare" dated March 28, 2018, the procedure for conducting the Unified State Qualification Exam (USQE) for Master's Degree Applicants in the Field of Knowledge 22 "Healthcare" was approved[10]. The USQE is conducted within the established timeframe and in the form of written testing.

This Resolution also provides for requirements to the composition of test tasks, which should take into account the requirements of the state standard of higher education, ensure objectivity and reflect current trends in the relevant field of knowledge.The Resolution also establishes the procedure for organizing and conducting the USQE, determines the responsibility for its conduct, as well as the procedure for appeal and registration of exam results. Thus, the Resolution of the Cabinet of Ministers of Ukraine No. 334 dated March 28, 2018 aims to ensure standardization and objectivity of the process of assessing the level of knowledge, skills and abilities of applicants for a master's degree in the field of knowledge 22 "Healthcare". This will help ensure a high-quality level of training of healthcare professionals and establish uniform requirements for the level of knowledge and skills for master's degree candidates in this field.The Resolution of the Cabinet of Ministers of Ukraine No. 334 of March 28, 2018 is an important step in the development of the higher education system in Ukraine and will contribute to the quality of education and competitiveness of the national economy. The Resolution of the Cabinet of Ministers of Ukraine of May 19, 2021 No. 497 "On the Procedure for Certification of Applicants for Degrees of Professional Higher Education and Degrees of Higher Education at the First (Bachelor's) and Second (Master's) Levels in the Form of a Unified State Qualification Exam" establishes the procedure for conducting a unified state qualification exam (USQE) for applicants for higher education degrees at the first (bachelor's) and second (master's) levels[11, 12]. The Resolution is aimed at creating a unified system for assessing students' knowledge and skills, which will ensure the quality of higher education in accordance with European standards. The

[10] Система *ЛІГА:ЗАКОН* – усе законодавство України в одній системі. URL: https://ips.ligazakon.net/document/KP180334

[11] Osvita.ua Legislation Higher education On approval of the schedule of the unified state qualification exam at the second (master's) level of higher education in 2023 / https://osvita.ua/legislation/Vishya_osvita/88738/

[12] Osvita.ua Legislation Higher education https://osvita.ua/legislation/Vishya_osvita/88795/

Resolution defines the rules of the exam, including requirements for the preparation of tasks, evaluation of papers, the procedure for taking the exam, and liability for violation of the rules of the exam. To take the exam, an applicant must have a document confirming his or her educational level and specialty.

The Regulations set out the requirements for the preparation of exam tasks, which must correspond to the competencies that the applicant must acquire in the course of study. The tasks must be structured and have clearly defined evaluation criteria. Innovative methods of assessing knowledge and skills, including virtual laboratories, multimedia presentations, etc. may be used to conduct the exam. In case of unsuccessful completion of the USQE, a person is considered to have failed to fulfill the individual curriculum and is expelled from the institution of professional higher education in accordance with paragraph 4 of part one of Article 44 of the Law of Ukraine "On Professional Higher Education" or from the higher education institution in accordance with paragraph 4 of part one of Article 46 of the Law of Ukraine "On Higher Education"[13]. The deadline for students to retake the USQE is determined by the responsible state authorities after a certain period of time, in accordance with the established rules. There is also a procedure for appealing the results of the exam and reassessing the applicant's work.

In addition, the Resolution establishes liability for violation of the exam rules, including incorrect preparation of tasks, illegal use of auxiliary materials and other violations. The organization and conduct of the qualifying examination is based on the following principles: academic integrity; objectivity; transparency and publicity; intolerance to corruption and corruption-related acts. The qualification examination programs are developed by specialty/group of specialties and the corresponding level of education based on the standards of professional higher education of the corresponding level and specialty.

The programs may be developed by the responsible state authorities or, by their decision, by scientific and methodological commissions of the Scientific and Methodological Council of the Ministry of Education and Science, specially formed working groups, higher education institutions, and other legal entities.Thus, according to this Resolution, the List of specialties for which certification of applicants is mandatory from 2021 in the form of the ECQE includes specialties of industry 22 "Healthcare", in particular, 226 Pharmacy, Industrial Pharmacy – the level of professional higher education and the second (master's) level.

[13] Laws of Ukraine. On Higher Education. Article 46. Expulsion, interruption of studies, renewal and transfer of higher education students. https://kodeksy.com.ua/pro_viwu_osvitu/statja-46.htm

It should be noted that in accordance with the Resolution of the Cabinet of Ministers of Ukraine No. 334 dated March 25, 2018, the decision to award a specialist, master's degree or other qualification is made by the examination board on the basis of successful completion of all certification forms. Accordingly, when ordering documents on higher education, starting in 2021, the Unified State Electronic Database on Education (USEDE) will be blocked from checking whether applicants who receive a master's (specialist's) degree in certain specialties of the field of knowledge "22 Healthcare" have positive results of passing KPOK 1 and/or KPOK 2 (licensed integrated exam). The control over the availability of the six components of the ECQE is entrusted to the HEI.

We also investigated the interrelation of the CMU Resolutions, namely: CMU Resolution No. 334 of March 28, 2018 and CMU Resolution No. 497 of May 19, 2021. These resolutions – CMU Resolution No. 334 of March 28, 2018 and CMU Resolution No. 497 of May 19, 2021 – are related in that they both concern the Unified State Qualification Examination (USQE) for applicants for higher education degrees.CMU Resolution No. 334 of March 28, 2018 establishes the procedure for conducting the USQE for applicants for a master's degree in the field of knowledge "Healthcare". In turn, the Resolution of the Cabinet of Ministers of Ukraine No. 497 of May 19, 2021 establishes the procedure for certification of applicants for professional higher education and higher education degrees at the first (bachelor's) and second (master's) levels in the form of the ECQE.

Thus, these resolutions regulate the method of state certification of higher education students through the Unified State Qualification Exam. CMU Resolution No. 497 defines the general requirements for certification of applicants for bachelor's and master's degrees, and CMU Resolution No. 334 defines special requirements for the USQE for applicants for a master's degree in healthcare.

2. Analysis of educational components of educational programs of Ukraine and EU countries

In order to create curricula for the specialization 226.02 "Industrial Pharmacy", namely the educational and professional program (EPP) (300 ECTS credits) and the educational and scientific program (ESP) (360 ECTS credits), we have studied the educational components of the programs of four HEIs, including two domestic and two foreign universities.

In the study, we analyzed the curriculum of the National University "Lviv Polytechnic" of the bachelor's and master's degree programs of the educational program of specialty 226 "Pharmacy, Industrial Pharmacy"[14], as

[14] Education Program "Pharmacy, industrial pharmacy". Lviv Polytechnic National University. http://directory.lpnu.ua/majors/ICCT/6.226.00.00/8/2022/ua/full

well as the curriculum of the Danylo Halytsky Lviv National Medical University of the master's degree program in the same specialty[3]. Among the foreign HEIs, the curriculum of the Master's degree program of a long cycle (5.5 years) of the University of Opole (Republic of Poland) in Pharmacy was considered[4]. The peculiarity of this plan is that after the tenth semester and the defense of the master's thesis within the curriculum (eleventh semester), a six-month practice in pharmacies (33 ECTS credits) is conducted, the completion of which is necessary to obtain a permit to practice the profession of pharmacist.

Another HEI studied was the Università di Pavia (Italy) with an educational plan for students majoring in Chemistry and Pharmaceutical Technology[5]. The study there lasts 5 years (300 ECTS credits). The curriculum is designed to provide training in basic chemical, chemical-pharmaceutical and technological-pharmaceutical disciplines related to biomedical and pharmacological educational components. The training course also includes experimental work (30 ECTS), in addition to the mandatory professional training in a pharmacy, also 30 ECTS to be performed in a pharmacy open to the public or in a hospital (maximum period of 3 months).

In order to conduct a comparative analysis of the educational components of the EP of the four mentioned HEIs, we grouped these components by the degree of coincidence of the names of disciplines within the autumn and spring semesters by year of study. The names of disciplines, the number of ECTS credits for each discipline, and the total number of disciplines and ECTS credits by year of study were identified and presented in tables 1–5.

Table 1

Quantitative ratios of academic components in Pharmacy education programs in HEIs of Ukraine and EU countries

Study year	HEI-1*	HEI-2*	HEI-3*	HEI-4*
1 year	12	19	17	10
2 year	12	15	15	7
3 year	14	13	11	7
4 year	16	11	12	9
5 year	14	15	16	3
6 year	3			
Totally	71	69**	71	36
Average (per year)	14.2	14.5	14.2	7.2

* HEI-1 – Lviv Polytechnic National University, Ukraine (4-years Bachelor's degree programs and 2-years Masters degree programs); HEI-2 – DanyloHalytskyLviv National Medical University, Ukraine; HEI-3 – University of Opole, Poland; HEI-4 – University of Pavia, Italy.

** The total sum of courses does not correspond to the arithmetic sum because some are studied during several semesters.

According to Table 1, we can state that in the first year of study, the number of ECTS credits per semester and per year in the four HEIs is the same, but the number of disciplines differs significantly. Thus, in HEI1 and HEI4 it is 11 and 9 educational components, respectively, and in HEI2 and HEI3 the number of educational components is much higher and amounts to 22 and 16 per year, respectively. The same trend of coincidence of the ECTS credit ratio is observed in the following years of study, however, the number of educational components is equalized in three HEIs, except for HEI2, where the number of components is much higher in quantitative terms (Tables 2–5).

Table 2

List of first-year academic components in Pharmacy education programs in HEIs of Ukraine and EU countries

The list of academic components (ECTS)			
HEI-1*	**HEI-2***	**HEI-3***	**HEI-4***
1	2	3	4
I semester			
Higher mathematics 1 (6 ECTS)	Higher mathematics and statistics (2 ECTS)	Mathematics (3 ECTS)	Mathematical analysis (6 ECTS)
Foreign language (professional-oriented) 1 (3 ECTS)			English language and translation (3 ECTS)
History of statehood and culture of Ukraine (3 ECTS)			
Chemistry 1 (general and inorganic chemistry) (5 ECTS)	General and inorganic chemistry (4 ECTS)	General and inorganic chemistry (12 ECTS)	General and inorganic chemistry (9 ECTS)
Chemistry 2 (organic chemistry) (9 ECTS)			
Introduction to the profession and the basics of professional hygiene (4 ECTS)		History of pharmacy (2 ECTS)	
	Human Anatomy (3 ECTS)		

Table 2 (continuance)

1	2	3	4
	Biology with essential genetics (3 ECTS)	Biology and genetics (4ECTS)	
	Ukrainian language (professional-oriented) (3 ECTS)		
	Latin (1.4 ECTS)	Latin 1 (2 ECTS)	
	Philosophy (3 ECTS)	History of philosophy (1 ECTS)	
	Biological physics and physical methods of analysis (2 ECTS)	Biophysics (3 ECTS)	Experimental physics (6 ECTS)
	Bioethics (0.5 ECTS)		
	Elective courses (3+3 ECTS)		
		Information technologies (2 ECTS)	Computer science (6 ECTS)
		Intellectual property protection (1 ECTS)	
A total of academic components (ESTC) at the I semester			
6 (30 ECTS)	11 (27.9 ECTS)	9 (30 ECTS)	5 (30 ECTS)
II semester			
Higher mathematics 2 (6 ECTS)	Higher mathematics and statistics (2 ECTS)	Statistics (2 ECTS)	
Foreign language (professional-oriented) 2 (3 ECTS)	Foreign language (professional-oriented) (3 ECTS)		
Ukrainian language (professional-oriented) (3 ECTS)			
Physics (7 ECTS)	Biological physics and physical methods of analysis (2.5 ECTS)		

Table 2 (continuance)

1	2	3	4
Physical and colloid chemistry (7 ECTS)			
Chemical methods of substances analysis (4 ECTS)			
	History of Ukraine and Ukrainian culture (3 ECTS)		
	Latin (1.6 ECTS)	Latin 2 (2 ECTS)	
	General and inorganic chemistry (5 ECTS)		
	Ethics and deontology in pharmacy (2 ECTS)		
	Physiology (4 ECTS)		Physiology (6 ECTS)
		Analytical chemistry 1 (6 ECTS)	Analytical chemistry (6 ECTS)
		Organic chemistry 1 (7 ECTS)	Organic chemistry (9 ECTS)
		Human Anatomy (2 ECTS)	Human anatomy (6 ECTS)
		Botany (7 ECTS)	Pharmaceutic biology (5 ECTS)
	Introductory practice on the organization and economics in pharmacy (1.5 ECTS)		
	Propaedeutic practice on drugs technology in pharmacy (1.5 ECTS)		
	Elective courses (3+3 ECTS)	Elective courses (2+2 ECTS)	

Table 2 (ending)

1	2	3	4
A total of academic components (ECTS) at the II semester			
6 (30 ECTS)	12 (32.1 ECTS)	8 (30 ECTS)	5 (32 ECTS)
Total academic components for a first year (ECTS)			
12 (60 ECTS)	19** (60 ECTS)	17 (60 ECTS)	10 (62 ECTS)

* HEI-1 – Lviv Polytechnic National University, Ukraine; HEI-2 – DanyloHalytskyLviv National Medical University, Ukraine; HEI-3 – University of Opole, Poland; HEI-4 – University of Pavia, Italy.

** The total sum of courses does not correspond to the arithmetic sum because some are studied during 1 and 2 semesters.

Table 3

List of second-year academic components in Pharmacy education programs in HEIs of Ukraine and EU countries

The list of academic components (ECTS)			
HEI-1*	**HEI-2***	**HEI-3***	**HEI-4***
1	2	3	4
III semester			
Biology and physiology with fundamentals of anatomy (7 ECTS)		Human physiology (4 ECTS)	
Foreign Language (professional-oriented) 3 (3 ECTS)	Foreign Language (professional-oriented) (2 ECTS)		
Microbiology (7 ECTS)		Microbiology (6 ECTS)	
Physical and chemical methods of analysis of substances (4 ECTS)			
Latin (3 ECTS)			
Methods of organic synthesis (6 ECTS)	Organic chemistry (4 ECTS)	Organic chemistry 2 (8 ECTS)	Organic chemistry 2 (10 ECTS)
	Analytical chemistry (4 ECTS)		
	Physical and colloid chemistry (2.4 ECTS)	Physical chemistry (8 ECTS)	Physical chemistry (9 ECTS)

Table 3 (continuance)

1	2	3	4
	Information technologies in pharmacy (1.8 ECTS)		
	Pharmaceutical botany (2.2 ECTS)		
	Pathological physiology (2.5 ECTS)		General pathology (5 ECTS)
	First preliminary aid with the introductory medical practice (3 ECTS)		
	Elective course (3 ECTS)	Elective courses (2+2 ECTS)	
			Pharmacology (5 ECTS)
A total of academic components (ECTS) at the III semester			
6 (30 ECTS)	9 (24.9 ECTS)	6 (30 ECTS)	4 (29 ECTS)
IV semester			
Biological chemistry and molecular biology (8 ECTS)		Biochemistry (9 ECTS)	General biochemistry (12 ECTS)
Informatics (3 ECTS)	Information technologies in pharmacy (2.2 ECTS)		
Philosophy (3 ECTS)			
Medical botany (6 ECTS)	Pharmaceutical botany (2.8 ECTS)		Applied biochemistry (6 ECTS)
Toxicological chemistry (4 ECTS)			
	Analytical chemistry (4 ECTS)	Analytical chemistry 2 (7 ECTS)	
	Organic chemistry (4 ECTS)		

Table 3 (ending)

1	2	3	4
	Physical and colloid chemistry (2.6 ECTS)		
	Microbiology and essential immunology (3 ECTS)	Immunology (2 ECTS)	Microbiology and clinical microbiology (8 ECTS)
	Hygiene in pharmacy and ecology (3 ECTS)		
	Pathological physiology (2.5 ECTS)		
	First aid in emergency situations (2 ECTS)		
	Field practice in pharmaceutical botany (3 ECTS)		
		Psychology and sociology (1 ECTS)	
		Professional ethics (2 ECTS)	
		Foreign language 1 (3 ECTS)	
Elective courses of general training (6 ECTS)	Elective courses (3+3 ECTS)	Elective courses (2+2+2 ECTS)	
A total of academic components (ECTS) at the IV semester			
6 (30 ECTS)	12 (35.1 ECTS)	9 (30 ECTS)	3 (26 ECTS)
Total academic components for a second year (ECTS)			
12 (60 ECTS)	15** (60 ECTS)	15 (60 ECTS)	7 (55 ECTS)

*HEI-1 – Lviv Polytechnic National University, Ukraine; HEI-2 – DanyloHalytskyLviv National Medical University, Ukraine; HEI-3 – University of Opole, Poland; HEI-4 – University of Pavia, Italy.

** The total sum of courses does not correspond to the arithmetic sum because some are studied during 3 and 4 semesters.

Table 4

List of third-year academic components in Pharmacy education programs in HEIs of Ukraine and EU countries

The list of academic components (ECTS)			
HEI-1*	**HEI-2***	**HEI-3***	**HEI-4***
V semester			
Drugs technology in pharmacy (6 ECTS)	Technology of drugs (2 ECTS)	Technology of drugs 1 (5 ECTS)	
Engineering and computer graphics (4 ECTS)			
Processes and devices of pharmaceutical manufacturing (5 ECTS)			
Regulatory support of pharmaceutical industries (3 ECTS)			
Basic of laboratory and functional diagnostics (3 ECTS)			
Pharmacokinetics (3 ECTS)			
	Pharmaceutical chemistry (3 ECTS)	Pharmaceutical chemistry 1 (8 ECTS)	Pharmaceutical chemistry 1 (9 ECTS)
	Biological chemistry (3 ECTS)		
	Computer simulation in pharmacy (3 ECTS)		
	Pharmacology (4 ECTS)		
	Pharmacognosy (4 ECTS)	Pharmacognosy (9 ECTS)	
	Microbiology and essential immunology (2 ECTS)		
		Foreign language 2 (4 ECTS)	

Table 4 (continuance)

1	2	3	4
		Molecular biology (2 ECTS)	
			Pharmaceutical analysis 1 (9 ECTS)
			Pharmacotherapy (6 ECTS)
			Toxicology (6 ECTS)
Processes and devices of pharmaceutical manufacturing, course project (3 ECTS)			
Educational practice in botany (3 ECTS)			
	Elective course (3 ECTS)	Elective course (2 ECTS)	
A total of academic components (ECTS) at the V semester			
8 (30 ECTS)	8 (24 ECTS)	6 (30 ECTS)	4 (30 ECTS)
VI semester			
Pharmaceutical chemistry (7 ECTS)	Pharmaceutical chemistry (4 ECTS)	Pharmaceutical chemistry 2 (9 ECTS)	
Pharmacognosy (5 ECTS)	Pharmacognosy (5 ECTS)		
Fundamentals of labor protection and life safety (3 ECTS)			
Chemistry and technology of medical compounds (7 ECTS)			
	Technology of drugs (5 ECTS)	Technology of drugs 1 (6 ECTS)	Pharmaceutical technology and legislation (9 ECTS)
	Biological chemistry (3 ECTS)		
	Pharmacology (5 ECTS)		Experimental pharmacology (12 ECTS)

Table 4 (ending)

1	2	3	4
	Law and legislation in pharmacy (2 ECTS)		
	Basics of organization of population and military medical provision (1 ECTS)		
	Medicine of extreme conditions (2 ECTS)		
Drugs technology in pharmacy, course project (2 ECTS)			
		Pathological physiology (5 ECTS)	
	Industrial practice in pharmacognosy (3 ECTS)	Practice in public pharmacies (6 ECTS)	
Elective course of professional training (6 ECTS)	Elective courses (3+3 ECTS)	Elective courses (2+2 ECTS)	Elective courses (3 ECTS)
A total of academic components (ECTS) at the VI semester			
6 (30 ECTS)	11 (36 ECTS)	6 (30 ECTS)	3 (24 ECTS)
Total academic components for a third year (ECTS)			
14 (60 ECTS)	13** (60 ECTS)	11** (60 ECTS)	7 (54 ECTS)

*HEI-1 – Lviv Polytechnic National University, Ukraine; HEI-2 – DanyloHalytskyLviv National Medical University, Ukraine; HEI-3 – University of Opole, Poland; HEI-4 – University of Pavia, Italy.

** The total sum of courses does not correspond to the arithmetic sum because some are studied during 5 and 6 semesters.

Table 5

List of fourth-year academic components in Pharmacy education programs in HEIs of Ukraine and EU countries

The list of academic components (ECTS)			
HEI-1*	**HEI-2***	**HEI-3***	**HEI-4***
1	2	3	4
VII semester			
Organization and economics in pharmacy (3 ECTS)	Organization and economics in pharmacy (2.6ECTS)		
Basic of pharmacology (4 ECTS)		Pharmacology and pharmacodynamics (8 ECTS)	
Basic of clinical pharmacy (4 ECTS)	Clinical pharmacy and pharmaceutical care (2.8 ECTS)		
Basic of pharmacotherapy (4 ECTS)	Pharmacotherapy with pharmacokinetics (3 ECTS)		
Technology of drugs from natural raw materials and phytotherapy (5 ECTS)			
Equipment and design of pharmaceutical industries (5 ECTS)			
	Management and marketing in pharmacy (2.8 ECTS)		
	Pharmaceutical chemistry (3.23 ECTS)		Pharmaceutical chemistry 2 (9 ECTS)
	Technology of drugs (2.27 ECTS)	Technology of drugs 2 (4 ECTS)	Pharmaceutical technology (9 ECTS)

Table 5 (continuance)

1	2	3	4
	Toxicological and forensic chemistry (2.6 ECTS)		
			Pharmaceutical analysis 2 (9 ECTS)
		Synthesis and technology of biological active compounds (6 ECTS)	
		Bromatology (6 ECTS)	
		Pharmaceutical biotechnology (2 ECTS)	
Pharmacognosy, course project (2 ECTS)			
Equipment and design of pharmaceutical industries, course project (3 ECTS)			
	Elective courses (3+3 ECTS)	Elective courses (2+2 ECTS)	Elective courses (3+3 ECTS)
A total of academic components (ESTC) at the VII semester			
8 (30)	9 (25,3 ECTS)	7 (30 ECTS)	5 (33 ECTS)
VIII semester			
Management, marketing and pharmaceutical commodity science (4 ECTS)	Management and marketing in pharmacy (3.2 ECTS)		
Organization and economics in pharmacy, course project (2 ECTS)	Organization and economics in pharmacy (4.4ECTS)		

Table 5 (continuance)

1	2	3	4
Physical methods of drugs' analysis (4 ECTS)			
Basics of emergency medical care (3,5 ECTS)			
	Health care management (3 ECTS)		
	Clinical pharmacy and pharmaceutical care (3.2 ECTS)		
	Pharmaceutical chemistry (3.77 ECTS)		Applied pharmaceutical chemistry (9 ECTS)
	Technology of drugs (3.73 ECTS)	Technology of drugs 2 (4 ECTS)	Industrial manufacturing of medicinal products (9 ECTS)
	The study of pharmaceutical and medical commodities (4 ECTS)		
	Toxicological and forensic chemistry (3. ECTS)	Toxicology (6 ECTS)	
		Pharmacology and pharmacodynamics (7 ECTS)	
		Pharmacotherapy and scientific information on drugs (3 ECTS)	
		Drugs of natural origin (2 ECTS)	

Table 5 (ending)

1	2	3	4
			Pharmaceutical analysis 3 (6 ECTS)
			Synthesis of drugs (6 ECTS)
Drugs technology in pharmacy (industrial practice) (1.5 ECTS)	Industrial practice in the technology of drugs (6 ECTS)		
Technological practice (industrial practice) (1.5 ECTS)			
Practice on the topic of the bachelor's degree qualification project (4.5 ECTS)			
		Practice in hospital pharmacies (6 ECTS)	
Performing of the bachelor's degree qualification project (9 ECTS)			
		Elective courses (2 ECTS)	
A total of academic components (ESTC) at the VIII semester			
8 (30 ECTS)	9 (34.7 ECTS)	7 (30 ECTS)	4 (30 ECTS)
Total academic components for a fourth year (ECTS)			
16 (60 ECTS)	11** (60 ECTS)	12** (60 ECTS)	9 (63 ECTS)

* HEI-1 – Lviv Polytechnic National University, Ukraine; HEI-2 – DanyloHalytskyLviv National Medical University, Ukraine; HEI-3 – University of Opole, Poland; HEI-4 – University of Pavia, Italy.

** The total sum of courses does not correspond to the arithmetic sum because some are studied during 7 and 8 semesters.

Table 6

List of academic components offered in the fifth year of long-cycle Pharmacy Master's Degree programs and first-second years of Pharmacy Master's Degree programs in HEIs of Ukraine and EU countries

The list of academic components (ECTS)			
HEI-1*	**HEI-2***	**HEI-3***	**HEI-4***
1	2	3	4
I semester	**IX semester**		
Economics of chemical and pharmaceutical enterprises (4 ECTS)			
Modeling and design of chemical and pharmaceutical enterprises in the GMP system (6 ECTS)			
Scientific aspects of ecology of chemical and pharmaceutical industries (4 ECTS)			
Scientific aspects of technology of veterinary and biomedical drugs (7 ECTS)			
Industrial technology of pharmaceutical manufacturing 1 (6 ECTS)		Technology of drugs 3 (5 ECTS)	
Occupational and civil safety (3 ECTS)			

Table 6 (continuance)

1	2	3	4
	Management and marketing in pharmacy (3 ECTS)		
	Good practices in pharmacy (3 ECTS)		
	The resource study of medicinal plants (3 ECTS)		
	Biopharmacy (3 ECTS)	Biopharmacy(3 ECTS)	
	Technology of cosmetics (3 ECTS)		
	Social pharmacy (3 ECTS)		
	Quality assessment system in pharmacy (3 ECTS)		
	Clinical pharmacy and pharmaceutical care (3 ECTS)	Applied pharmacy with pharmaceutical care (6 ECTS)	
	Certification of medicines (3 ECTS)	Pharmaceutical legislation (3 ECTS)	
	Pharmaceutical biotechnology (3 ECTS)		
		Qualified first aid (2 ECTS)	
		Pharmacokinetics (3 ECTS)	
		Foreign language lectorate (2 ECTS)	
		Methodologies of investigations 1 (4 ECTS)	

Table 6 (continuance)

1	2	3	4
			Food chemistry (6 ECTS)
			Traineeship (30 ECTS)
		Elective courses (2 ECTS)	
A total of academic components (ESTC) at the I (IX) semesters			
6 (30 ECTS)	10 (30,0)	9 (30 ECTS)	2 (36 ECTS)
II semester	**X semester**		
Modeling and design of chemical and pharmaceutical enterprises in the GMP system, course project (3 ECTS)			
Industrial equipment of chemical and pharmaceutical enterprises (3 ECTS)			
Quality control of medicines (3 ECTS)			
Industrial technology of pharmaceutical manufacturing 2 (4 ECTS)			
Technology of biologically active substances, biomedical polymers and nanostructures (5 ECTS)			

Table 6 (continuance)

1	2	3	4
Technology and application of medical cosmetics (4 ECTS)			
	Methodology of scientific investigations based on the subject of Master's degree project (15 ECTS)	Master's workshop (3 ECTS)	
	Industrial practice in clinical pharmacy (1 ECTS)	Specialized practice (10 ECTS)	
	Industrial practice in pharmaceutical chemistry (5 ECTS)		
	Industrial practice in organization and economics in pharmacy (5 ECTS)		
	Industrial practice in management and marketing in pharmacy (4 ECTS)		
		Pharmacoepidemiology (3 ECTS)	
		New foreign language course (2 ECTS)	
		Methodologies of investigations 2 (6 ECTS)	
		Pharmacoeconomics (3 ECTS)	
		Clinical Pharmacy (3 ECTS)	

Table 6 (ending)

Elective course (general) (3 ECTS)			
Elective course (professional oriented) (5 ECTS)			
			Final exam (30 ECTS)
A total of academic components (ESTC) at the II (X) semesters			
8 (30 ECTS)	5 (30 ECTS)	7 (30 ECTS)	1 (30,0)
Total academic components for a first (fifth) year (ECTS)			
14 (60 ECTS)	15 (60 ECTS)	16** (60 ECTS)	3 (66 ECTS)
III semester			
Practice on the topic of the master's degree qualification project (9 ECTS)			
Performing of the master's degree qualification project (16.5 ECTS)			
Defense of the master's degree qualification project (4.5 ECTS)			
A total of academic components (ESTC) at the III semester			
3 (30 ECTS)			
Total academic components for a second year (ECTS)			
3 (30 ECTS)			

* HEI-1 – Lviv Polytechnic National University, Ukraine; HEI-2 – DanyloHalytskyLviv National Medical University, Ukraine; HEI-3 – University of Opole, Poland; HEI-4 – University of Pavia, Italy.

** The total sum of courses does not correspond to the arithmetic sum because some are studied during 9 and 10 semesters.

Table 7

Assessment of coincidence of academic disciplines in HEIs of Ukraine and EU countries

	% of coincidence regarding others HEIs (amount of academic disciplines)				% of coincidencein total by program (amount of academic disciplines)
	HEI-1	HEI-2	HEI-3	HEI-4	
HEI-1		32.39 % (23)	28.17 % (20)	15.49 % (11)	52.11 % (37)
HEI-2	33.33 % (23)		37.68 % (26)	21.74 % (15)	62.22 % (45)
HEI-3	30.98 % (22)	42.25 % (30)		27.17 % (20)	70.42 % (25)
HEI-4	33.33 % (12)	55.55 % (20)	61.11 % (22)		83.33 % (30)

HEI-1 – Lviv Polytechnic National University, Ukraine; HEI-2 – DanyloHalytskyLviv National Medical University, Ukraine; HEI-3 – University of Opole, Poland; HEI-4 – University of Pavia, Italy.

Thus, the regrouping of educational components within academic semesters by the name of the discipline allowed us to establish that most components have the same name or a similar name and, accordingly, similar content and content of educational components of four different HEIs. If we make such a regrouping within the academic year, we will see even more coincidences. The subject of our further research will be the definition of universal (basic) lists of educational components for two separate specializations 226. 01 “Pharmacy” and 226.02 “Industrial Pharmacy” of the specialty 226 “Pharmacy, Industrial Pharmacy”, which can be used to guide the creation of new educational programs.

It should also be noted that one of the tasks declared in the Strategic Development Plan of Lviv Polytechnic National University until 2025 is to improve teaching and learning processes, which involves optimizing the content of educational programs and minimizing the number of their components. The review of educational programs and the process of their optimization is part of the annual procedure for improving educational programs and will be the subject of our further research.

CONCLUSIONS

1. A meta-analysis of EPs of HEIs of Ukraine and EU countries for learning specialists for the pharmacy branch was conducted.

2. The EPs of four HEIs, including two Ukrainian and two in the EU, were selected for comparative analysis. The educational components were analyzed

by similarity and affinity, by the number of disciplines and ECTS credits, and by academic years and semesters of study.

3. It was established that the fundamental educational components of the EPs of the four HEIs are similar and almost do not differ by the names; however, they can be learned in different semesters of one year or different academic years (courses). At the same time, each HEI has original components, which not found in other universities, making EPs unique and distinctive.

4. The comparative analysis of the components of the EPs made it possible to observe their similarities and establish the possibility of continuing the education of students in foreign HEIs, as well as the integration of pharmacy specialists into foreign education systems, which became especially relevant due the Russian-Ukrainian war and the migration processes of the population of Ukraine to EU countries.

5. The rationality of the vector of European integration processes in HEIs concerning the modeling of the learning process of students of specialty "Pharmacy, industrial pharmacy" in Ukraine has been proven.

SUMMARY

In Ukraine, the Ministry of Education and Science of Ukraine (MES) Order No. 981 of November 4, 2022 approved and put into effect the Standard of Higher Education of the second (master's) level of the Field of Knowledge 22 "Health Care" of the specialty 226 "Pharmacy, Industrial Pharmacy" with specializations 226. 01 "Pharmacy" and 226.02 "Industrial Pharmacy".

Accordingly, with the introduction of the Standard, the requirements for admission, levels of complete higher education, terms and scope of the educational process are changing, new forms of certification of future pharmacy specialists are being introduced. The first step towards the creation of new appropriate educational programs that provide for end-to-end training at the master's level was a retrospective analysis of the emergence and introduction of the specialty 226 Pharmacy, Industrial Pharmacy in accordance with the regulations. Particular attention was paid to the specialization 226.02 Industrial Pharmacy, since this specialization provides training for professionals to support the industrial sector of pharmacy in Ukraine. In addition, in order to create new appropriate educational programs for the specialization 226.02 Industrial Pharmacy at the master's level in accordance with the requirements of the Standard, we analyzed the educational programs of four higher education institutions, including two foreign and two domestic universities: Opole University (Republic of Poland), Università di Pavia (Italy), Lviv Polytechnic National University (Lviv, Ukraine), Danylo Halytsky Lviv National Medical University (Lviv, Ukraine).

Bibliography

1. Dutch Sketches: Apothecary's Notes Among Pharmacy Cases. 2018. URL: https://fp.com.ua/articles/gollandski-amalovky-notatky-aptekarya-pomizh-aptechnyh-sprav/

2. Освітньо-професійна програма «Фармація, промислова фармація». URL: https://lpnu.ua/sites/default/files/2021/program/15243/2020-opp-bakalavr-226.pdf

3. Education Program "Pharmacy, industrial pharmacy". Danylo Halytsky Lviv National Medical Univeristy. URL: https://cutt.ly/mZA9beV

4. Education Program "Pharmacy". University of Opole. URL: http://wch.uni.opole.pl/wp-content/uploads/Farmacja-siatka-2019.jpg

5. Education Program. "Chemistry and Pharmaceutical Technology". The University of Pavia (Italy). URL: http://scienzedelfarmaco.unipv.it/wp-content/uploads/2021/06/Regolamento-CTF-2021-22-per-DR.pdf

6. Krychkovska A. M., Parashchyn Zh.D.,Bolibrukh L. D., Zayarniuk N. L. Innovative technologies: implementation of the experience of EU countries to solve pharmacy issues in Ukraine. The role of medical science in implementing innovative medical technologies in the EU countries and Ukraine : Scientific monograph. Riga, Latvia : "Baltija Publishing", 2022. P. 138–161. https://doi.org/10.30525/978-9934-26-199-2-8. URL: http://baltijapublishing.lv/omp/index.php/bp/catalog/book/212. С.138–161.

7. Increasing responsibility for falsification of medicinal products or circulation of falsified medicinal products (amendments to the article of the Criminal Code of Ukraine). Petition 22/049079-еп, 18.12.2018.

URL: https://petition.president.gov.ua/petition/49079

8. On the approval of the Procedure for conducting a unified state qualification exam for master's degree holders in the field of knowledge 22 "Health Care". Resolution of the Cabinet Ministry of Ukraine № 334 on 28.03.2018 (With additions introduced following the Regulations of the Cabinet Ministry of Ukraine № 308 on 03.04.2019 and № 351 on 14.04.2021). URL: gov.ua

9. About the certification of holders of professional preliminary higher education degrees and higher education degrees at the first (bachelor's) and second (master's) levels in the form of a unified state qualification exam. Resolution of the Cabinet Ministry of Ukraine № 497 on 19.05.2021. URL: gov.ua

10. LIGA:ZAKON system – all Ukrainian legislation in one system. https://ips.ligazakon.net/document/KP180334

11. Osvita.ua Legislation Higher education On approval of the schedule of the unified state qualification exam at the second (master's) level of higher education in 2023 https://osvita.ua/legislation/Vishya_osvita/88738/

12. Osvita.ua Legislation Higher education. URL: https://osvita.ua/legislation/Vishya_osvita/88795/

13. Laws of Ukraine. On Higher Education. Article 46. Expulsion, interruption of studies, renewal and transfer of higher education students. URL: https://kodeksy.com.ua/pro_viwu_osvitu/statja-46.htm

14. Education Program "Pharmacy, industrial pharmacy". Lviv Polytechnic National University. URL: http://directory.lpnu.ua/majors/ICCT/6.226.00.00/8/2022/ua/full

Information about the authors:

Krychkovska Aelita Myronivna,
https://orcid.org/0009-0006-0783-7059
Candidate of Pharmaceutical Sciences,
Associate Professor at the Department of Technology of Biologically Active Compounds, Pharmacy and Biotechnology
Lviv Polytechnic National University
12, Stepana Bandery str., Lviv, 79013, Ukraine

Hubytska Iryna Ivanivna,
https://orcid.org/0000-0002-2552-0171
Candidate of Chemical Sciences,
Associate Professor at the Department of Technology of Biologically Active Compounds, Pharmacy and Biotechnology
Lviv Polytechnic National University
12, Stepana Bandery str., Lviv, 79013, Ukraine

Monka Nataliia Yaroslavivna,
https://orcid.org/0000-0002-4373-2987
Candidate of Chemical Sciences,
Assistant Professor at the Department of Biologically Active Compounds Technology, Pharmacy and Biotechnology
Lviv Polytechnic National University
12, Stepana Bandery str., Lviv, 79013, Ukraine