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Comparative Analysis of Pharmacy Education Programs: Curriculum and Academic Components in EU Countries and Ukraine

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Abstract

The research aimed to compare the academic components of pharmacy education programs between higher education institutions in Ukraine and various EU countries, with a focus on their development. The research examined pharmacy programs offered by universities in Ukraine, Italy, Poland, Sweden, and Germany, using methods such as analytical-comparative analysis, content analysis, systematic review, meta-analysis, logical reasoning, decomposition, and modeling. The study highlighted both similarities and differences in aspects such as the title, structure, content, and workload across pharmacy education programs in Ukraine and the EU. The research also defined key criteria for the distinctiveness and orientation of these programs, reflecting unique training approaches for different levels of qualification. It emphasized the role of European integration processes in shaping the educational framework for pharmacy in Ukraine, especially regarding students' learning in this area. The results suggest that the findings can serve as a basis for refining and adapting pharmacy education programs in Ukraine, facilitating their alignment with EU standards under the Bologna Process, and contributing to the development of a unified European higher education system.

Keywords: Higher education institution, Pharmacy education, Education programs, Curriculum, Learning process, Academic component

Introduction

Across the European Union, there exist 28 different pharmaceutical systems, which show significant variance not just in practice but also in the legal frameworks that govern the pharmaceutical sector [1-5]. A notable example is the Netherlands, where pharmaceutical practice is guided by a liberal regulatory system, distinguishing it from other countries [6]. In contrast, Ukraine has a more regulated approach to its pharmaceutical practices. A similar case can be seen in the Arab Republic of Egypt, where strict regulation against counterfeit drugs is enforced, including severe penalties such as the death sentence. The Egyptian model has influenced other countries to adopt stricter pharmaceutical regulations [7]. The diversity in legislative frameworks underscores the need for research into the training processes for pharmaceutical professionals at higher education institutions (HEIs).

This study is focused on comparing the academic components (AC) of pharmacy education programs (EPs) at HEIs in Ukraine and the EU, as well as exploring the development experiences of these programs.

In Ukraine, several challenges exist in the training of pharmaceutical specialists. Educational programs are offered by HEIs under different authorities—the Ministry of Health of Ukraine (MH) and the Ministry of Education

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and Science of Ukraine (MES)—but both provide education for the same specialty: 226 pharmacy, and industrial pharmacy. This dual governance structure results in significant variations in the education and certification systems across institutions. However, legislative reforms aimed at addressing these discrepancies were underway in 2021-2022 [8-12]. The ongoing conflict in Ukraine has delayed these planned reforms, preventing the establishment of a cohesive system for training pharmaceutical professionals.

This research includes a comparative analysis of pharmacy education programs in various countries to assess the opportunity for Ukrainian students to pursue studies and professional development abroad. It also examines how Ukrainian pharmacy professionals might integrate into European pharmaceutical systems, particularly in light of the migration patterns caused by the ongoing Russian-Ukrainian war.

Materials and Methods

The study aimed to analyze and compare pharmacy education programs across different higher education institutions (HEIs) in Ukraine, Poland, Italy, Sweden, and Germany. The research focused on programs from Lviv Polytechnic National University (HEI-1) and Danylo Halytsky Lviv National Medical University (HEI-2) in Ukraine, alongside those from the University of Opole (HEI-3) in Poland and the University of Pavia (HEI-4) in Italy. The selection of the Ukrainian institutions was based on the need to examine differences in pharmacy education under two different governmental authorities, the Ministry of Health (MH) and the Ministry of Education and Science (MES). The foreign institutions were chosen for their similar foundational approach to pharmacy education. The study utilized a variety of research methods, including analytical-comparative analysis, content analysis, systematic and meta-analysis, logical modeling, and decomposition techniques.

Results and Discussion

This study carried out a comparative analysis of educational programs (EPs) in pharmacy available at selected higher education institutions (HEIs) across Ukraine and several European Union member states. The review included information obtained from official sources of Uppsala University, Sweden [13], Heinrich Heine University Düsseldorf, Germany [14], Lviv Polytechnic National University, Ukraine [15, 16], Danylo Halytsky Lviv National Medical University, Ukraine [17], University of Opole, Poland [18], and the University of Pavia, Italy [19].

At the University of Opole in Poland, the pharmacy program spans 5.5 years and culminates in a Master's degree. The first phase emphasizes foundational subjects—such as multiple branches of chemistry, biophysics, biological sciences, mathematics, and informatics—creating a strong base for subsequent professional training. As students progress, they delve into applied pharmaceutical sciences, including pharmaceutical technology, toxicology, pharmacokinetics, and biotechnology. The curriculum also mandates courses in Latin, modern languages, the history of pharmacy, ethics, and humanities. Practical placements take place in both community and hospital settings during summer breaks after the third and fourth academic years. Students are encouraged to explore optional modules related to pharmaceutical and chemical disciplines in later years. Upon submission and defense of the Master's thesis, a six-month pharmacy internship (worth 33 ECTS) is required for licensure.

Similarly, the University of Pavia in Italy offers a long-cycle Master's program in "Chemistry and Pharmaceutical Technology," which mirrors the structure and purpose of those at Danylo Halytsky Lviv National Medical University and the University of Opole. This multidisciplinary program is tailored to develop proficiency in areas related to the research, manufacturing, and quality assurance of pharmaceutical, food, and cosmetic products. Early coursework focuses on essential scientific fields, combining knowledge from chemistry, biology, and quantitative disciplines to instill a methodical, problem-solving mindset. The program culminates in two significant experiential components: a 30 ECTS research thesis and a mandatory six-month internship (30 ECTS) in either a public or hospital pharmacy. This comprehensive trajectory ensures graduates understand the complete lifecycle of a drug—from molecular concept to patient distribution.

All institutions assessed offer full-time programs aligned with the Bologna Process, ensuring compatibility and coherence across European higher education systems. HEI-1 (Lviv Polytechnic National University) is unique among those reviewed in offering both a Bachelor's and a Master's level pathway in Industrial Pharmacy. The remaining institutions—HEI-2 (Danylo Halytsky Lviv National Medical University), HEI-3 (University of

Opole), and HEI-4 (University of Pavia)—deliver integrated, single-cycle Master's degrees. The University of Pavia's EP notably aligns in educational scope and content with the curriculum of Lviv Polytechnic National University, positioning it as the closest European counterpart.

Regarding credit distribution, HEI-1 through HEI-3 maintain a standardized ECTS allocation of 60 per academic year and 30 per semester. HEI-4 varies slightly, with yearly credits ranging from 54 to 66 and semester allocations between 24 and 36. At Lviv Polytechnic National University, the Bachelor's program encompasses four academic years (eight semesters), totaling 240 ECTS, while the Master's pathway spans 1.5 years (three semesters) and comprises 90 ECTS. In contrast, the single-cycle programs at HEI-2 through HEI-4 extend over five years (ten semesters) and accumulate 300 ECTS credits, integrating both generalist and specialist coursework into a unified trajectory.

Findings indicate that each EP is systematically organized to facilitate the acquisition of defined learning outcomes. Curricula are broken into structured modules or course units designed to develop theoretical knowledge, technical competencies, and professional values essential to pharmacy practice. While there is variability in the number of components offered each term (ranging from three to nineteen), the overall volume of coursework is comparable across institutions, except HEI-4, which includes a total of 36 academic subjects throughout the program **(Table 1)**.

Table 1. Quantitative ratios of AC in pharmacy EPs in HEIs of Ukraine and EU countries

Study year	HEI-1*	HEI-2*	HEI-3*	HEI-4*
1st year	12	19	17	10
2nd year	12	15	15	7
3rd year	14	13	11	7
4th year	16	11	12	9
5th year	14	15	16	3
6th 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-year Bachelor's Degree programs and 2-year Master's Degree programs); HEI-2: Danylo Halytsky Lviv 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.

A comparative assessment was conducted on the academic components (AC) within the four educational programs (EPs) offered by the aforementioned HEIs, focusing on shared subject matter, course duration, and whether subjects were compulsory. The evaluation categorized the ACs into three distinct groups based on the extent of their alignment: those exhibiting strong resemblance were placed in **Table 2**, those showing moderate correlation were organized in **Table 3**, and **Table 4** listed the unique components that set individual programs apart through distinctive qualitative features.

Table 2. The AC (ECTS) in pharmacy EPs in HEIs of Ukraine and EU countries

HEI-1	HEI-2	HEI-3	HEI-4
Disciplines of chemical direction			
Chemistry 1 (general and inorganic chemistry) (5 ECTS)	General and inorganic chemistry (9 ECTS)	General and inorganic chemistry (12 ECTS)	General and inorganic chemistry (9 ECTS)
Chemistry 2 (organic chemistry) (9 ECTS)	Organic chemistry (8 ECTS)	Organic chemistry (15 ECTS)	Organic chemistry (19 ECTS)
Pharmaceutical Chemistry (7 ECTS)	Pharmaceutical Chemistry (14 ECTS)	Pharmaceutical Chemistry (17 ECTS)	Pharmaceutical Chemistry (18 ECTS) Applied pharmaceutical chemistry (9 ECTS)
Toxicological chemistry (4 ECTS)	Toxicological and forensic chemistry (5.6 ECTS)	Toxicology (6 ECTS)	Toxicology (6 ECTS)
Physical and colloid chemistry (7 ECTS)	Physical and colloid chemistry (5 ECTS)	Physical chemistry (8 ECTS)	Physical chemistry (9 ECTS)

Chemical methods of substances analysis (4 ECTS) Physical and chemical methods of analysis of substances (4 ECTS)	Analytical Chemistry (8 ECTS)	Analytical Chemistry (13 ECTS)	Analytical Chemistry (6 ECTS)
Biological chemistry and molecular biology (8 ECTS)	Biological Chemistry (6 ECTS)	Biochemistry (9 ECTS)	General Biochemistry (12 ECTS) Applied Biochemistry (6 ECTS)
Methods of organic synthesis (6 ECTS)		Synthesis and technology of biologically active compounds (6 ECTS)	Synthesis of drugs (6 ECTS)
Disciplines of pharmaceutical direction			
Introduction to the profession and the basics of professional hygiene (4 ECTS)	Hygiene in pharmacy and ecology (3 ECTS)		
	Ethics and deontology in pharmacy (2 ECTS) Bioethics (0.5 ECTS)	Professional ethics (2 ECTS)	
Medical Botany (6 ECTS)	Pharmaceutical Botany (5 ECTS)	Botany (7 ECTS)	Pharmaceutics biology (5 ECTS)
Pharmacognosy (5 ECTS)	Pharmacognosy (9 ECTS)	Pharmacognosy (9 ECTS)	
Drugs technology in pharmacy (6 ECTS)	Technology of drugs (13 ECTS)	The technology of drugs 1 (24 ECTS)	Pharmaceutical technology and legislation (9 ECTS) Pharmaceutical technology (9 ECTS) Industrial manufacturing of medicinal products (9 ECTS)
Basic of clinical pharmacy (4 ECTS)	Clinical pharmacy and pharmaceutical care (9 ECTS)	Clinical Pharmacy (3 ECTS) Applied pharmacy with pharmaceutical care (6 ECTS)	
Regulatory support of pharmaceutical industries (3 ECTS)	Law and legislation in pharmacy (2 ECTS)	Pharmaceutical legislation (3 ECTS)	
	Pharmaceutical Biotechnology (3 ECTS)	Pharmaceutical Biotechnology (2 ECTS)	
	Biopharmacy (3 ECTS)	Biopharmacy (3 ECTS)	
Disciplines of linguistic direction			
Foreign language (professional-oriented) (9 ECTS)	Foreign language (professional-oriented) (5 ECTS)	Foreign language (7 ECTS) Foreign language electorate (2 ECTS) New foreign language course (2 ECTS)	English language and translation (3 ECTS)

Latin (3 ECTS)	Latin (3 ECTS)	Latin (4 ECTS)	
Disciplines of mathematic direction			
Higher mathematics (12 ECTS)	Higher mathematics and statistics (4 ECTS)	Mathematics (3 ECTS) Statistics (2 ECTS)	Mathematical analysis (6 ECTS)
Informatics (3 ECTS)	Information technologies in pharmacy (4 ECTS)	Information technologies (2 ECTS)	
Physics (7 ECTS)	Biological physics and physical methods of analysis (4.5 ECTS)	Biophysics (3 ECTS)	Experimental physics (6 ECTS)
Disciplines of biological direction			
Microbiology (7 ECTS)	Microbiology and essential immunology (5 ECTS)	Immunology (2 ECTS) Microbiology (6 ECTS)	Microbiology and clinical microbiology (8 ECTS)
Biology and physiology with fundamentals of anatomy (7 ECTS)	Physiology (4 ECTS) Human Anatomy (3 ECTS) Biology with essential genetics (3 ECTS)	Human physiology (4 ECTS) Human Anatomy (2 ECTS) Biology and genetics (4 ECTS)	Physiology (6 ECTS) Human Anatomy (6 ECTS)
	Pathological physiology (5 ECTS)	Pathological physiology (5 ECTS)	General pathology (5 ECTS)
Disciplines of clinical direction			
Basic of pharmacotherapy (4 ECTS) Pharmacokinetics (3 ECTS)	Pharmacotherapy with pharmacokinetics (3 ECTS)	Pharmacotherapy and scientific information on drugs (3 ECTS) Pharmacokinetics (3 ECTS)	Pharmacotherapy (6 ECTS)
Basic of pharmacology (4 ECTS)	Pharmacology (9 ECTS)	Pharmacology and pharmacodynamics (15 ECTS)	Pharmacology (5 ECTS) Experimental pharmacology (12 ECTS)
Basics of emergency medical care (3,5 ECTS)	First preliminary aid with the introductory medical practice 3 ECTS) First aid in emergencies (2 ECTS)	Qualified first aid (2 ECTS)	
Disciplines of humanitarian direction			
Philosophy (3 ECTS)	Philosophy (3 ECTS)	History of Philosophy (1 ECTS)	
History of statehood and culture of Ukraine (3 ECTS)	History of Ukraine and Ukrainian culture (3 ECTS)		
Disciplines of scientific-professional direction			

	Methodology of scientific investigations based on the subject of Master's degree project (15 ECTS)	Methodologies of investigations (10 ECTS)
Disciplines of economic direction		
Organization and economics in pharmacy (3 ECTS)	Organization and economics in pharmacy (7 ECTS)	
Management, marketing, and pharmaceutical commodity science (4 ECTS)	Management and marketing in pharmacy (9 ECTS)	

Table 3. The AC (ECTS) in pharmacy EPs in HEIs of Ukraine and EU countries in an average level of similarity

HEI-1	HEI-2	HEI-3	HEI-4
Quality control of medicines (3 ECTS) Physical methods of drugs analysis (4 ECTS)	Certification of medicines (3 ECTS) Quality assessment system in pharmacy (3 ECTS)		Pharmaceutical analysis (24 ECTS)
Engineering and computer graphics (4 ECTS)	Computer simulation in pharmacy (3 ECTS)		Computer science (6 ECTS)
Technology of drugs from natural raw materials and phytotherapy (5 ECTS)	The resource study of medicinal plants (3 ECTS)	Drugs of natural origin (2 ECTS)	
		Bromatology (6 ECTS)	Food Chemistry (6 ECTS)
Performing the Bachelor's degree qualification project (9 ECTS) Performing the Master's degree qualification project (16.5 ECTS) Defense of the master's degree qualification project (4.5 ECTS)		Master's workshop (3 ECTS)	Final exam (30 ECTS)

Table 4. Original disciplines for HEIs

HEIs	Directions of disciplines
HEI-1	**Disciplines of the linguistic direction:** • Ukrainian language (professional-oriented) (3 ECTS) **Disciplines of the engineering and technical direction:** • Processes and devices of pharmaceutical manufacturing (5 ECTS) • Modeling and design of chemical and pharmaceutical enterprises in the GMP system (6 ECTS) • Equipment and design of pharmaceutical industries (5 ECTS) • Industrial equipment of chemical and pharmaceutical enterprises (3 ECTS) • Industrial technology of pharmaceutical manufacturing (10 ECTS) • Scientific aspects of the ecology of chemical and pharmaceutical industries (4 ECTS) **Disciplines of the economic direction:** • Economics of chemical and pharmaceutical enterprises (4 ECTS) **Disciplines of clinical direction:**

	• Basic laboratory and functional diagnostics (3 ECTS) **Disciplines of pharmaceutical direction:** • Technology of biologically active substances, biomedical polymers, and nanostructures (5 ECTS) • Scientific aspects of the technology of veterinary and biomedical drugs (7 ECTS) **Disciplines of chemical direction:** • Chemistry and technology of medical compounds (7 ECTS) **Disciplines of professional direction:** • Occupational and civil safety (3 ECTS) • Fundamentals of labor protection and life safety (3 ECTS)
HEI-2	**Disciplines of linguistic direction:** • Ukrainian language (professional-oriented) (3 ECTS) **Disciplines of clinical direction:** • Basics of organization of population and military medical provision (1 ECTS) • Medicine of extreme conditions (2 ECTS) **Disciplines of pharmaceutical direction:** • The study of pharmaceutical and medical commodities (4 ECTS) • Good practices in pharmacy (3 ECTS) • Social pharmacy (3 ECTS) **Disciplines of professional direction:** Healthcare management (3 ECTS)
HEI-3	**Disciplines of humanitarian direction:** • Psychology and sociology (1 ECTS) **Disciplines of biological direction:** • Molecular biology (2 ECTS) **Disciplines of pharmaceutical direction:** • History of pharmacy (2 ECTS) • Pharmacoeconomics (3 ECTS) • Pharmacoepidemiology (3 ECTS) • Intellectual property protection (1 ECTS)

A total of 16 instances were identified across the four HEIs where academic components overlapped completely in terms of both subject content and assigned ECTS credits. Additionally, 13 overlaps were observed among three institutions, while 9 cases were noted between two HEIs. Notably, HEI-3 and HEI-4 exhibited the highest degree of alignment in their curricula, with 70.42% and 83.33% similarity rates, respectively. When evaluating programs from Ukrainian HEIs against those of EU institutions, the most pronounced parallelism was seen in HEI-1 and HEI-4, showing resemblance rates of 28.17% and 30.98%.

It is important to highlight that the majority of these overlaps relate to foundational disciplines typically offered during the initial academic years. These include core scientific subjects such as general chemistry, mathematics, statistics, and biophysics. In contrast, overlaps in specialized pharmaceutical and clinical areas—such as pharmacotherapy, botany, drug technology, and pharmacology—were less frequent but still evident.

As students progress into advanced academic years, the volume of curricular components tends to be fairly consistent across three of the four HEIs. HEI-4, however, deviates from this pattern by offering a considerably reduced number of academic subjects in the later stages of study. Despite this, no direct relationship was identified between the distribution of ECTS credits and the total number of subjects in the upper years across the institutions.

Each higher education institution maintains distinctive features in its educational programs through unique subjects that are not shared by others, which contributes to the individuality of its EPs. Among these, HEI-1 stands out for having the most distinct and specialized curriculum content, reflecting the targeted training required for professionals with specific qualifications and academic degrees, as detailed in **Table 4**.

The Pharmacy programs across the studied HEIs are uniformly organized into four core educational blocks: (1) compulsory subjects, (2) elective modules, (3) hands-on training, and (4) course projects. These components are distributed across two cycles—basic/general studies and professional specialization. At HEI-1, the elective segment includes offerings from both cycles, allowing students to select from a university-wide catalog of courses. Furthermore, the program's structure includes two professional specialization paths, one of which is selected by the student, facilitating focus within the broader field of pharmacy.

Experiential learning forms an essential pillar of these educational programs. Through internships and practical sessions, students acquire workplace-relevant skills and gain exposure to professional environments, helping them align academic knowledge with career trajectories. A defining feature of these Pharmacy EPs is that while theoretical knowledge is delivered during scheduled coursework, skill development is emphasized through real-world engagement during industrial placements.

Presently, many HEIs recognize the critical role of practical components within their curricula to ensure graduates possess the personal, academic, and technical proficiency demanded by contemporary employment markets.

Practical training serves multiple purposes: it consolidates classroom-acquired knowledge, fosters the development of job-specific competencies, introduces students to evolving technological practices, and promotes independent learning. Throughout these practical sessions, students are expected to collect and organize information autonomously, apply theoretical principles to concrete scenarios, familiarize themselves with industry-standard technologies, collaborate within professional teams, and practice self-evaluation. Moreover, practical training is instrumental in gauging students' levels of professional readiness—allowing them to reflect on their competencies and recognize areas in need of further development, which aligns with the expectations of modern employers.

At present, institutions of higher education employ a variety of strategies for integrating practical training into academic programs. In most cases, practice-based experiences are dispersed across multiple academic years following the educational programs (EPs). However, HEI-2 and HEI-4 adopt a different model, concentrating practical activities in the final academic year, directly preceding both the Master's thesis defense and graduation examinations. This model provides students with the opportunity to evaluate their professional preparedness and adjust their skills accordingly, enhancing their potential for post-graduation success.

HEI-1 introduces a distinct educational component in the form of a course project, which is a pivotal element of independent student activity focused on addressing professional, technical, or research-oriented challenges. These projects are typically initiated following the completion of the theoretical portion of a course or its relevant section, ensuring that students possess a sufficient knowledge base to execute the tasks independently.

The alignment of EP structure with labor market demands reflects a broader correlation between the design of educational programs and the increasing necessity for highly qualified professionals across various sectors.

Pharmacy education has emerged as a critical avenue for fostering human capital and enabling upward social mobility. It equips students with a combination of advanced technical and transferable skills essential for thriving in a knowledge-based economy and contributing meaningfully to society. Therefore, the strategic design and accessibility of EPs that improve career prospects and earning potential are a central priority for higher education institutions across all tiers.

By reorganizing academic disciplines according to semester schedules and their respective titles, it became possible to identify overlapping elements in terms of structure, thematic content, and instructional load across the four HEIs. Even greater alignment would likely be observed if this comparative reorganization were extended to encompass full academic years. Through this method, a total of 16 instances of full alignment in educational components across all institutions were revealed. These complete matches diminish progressively with each academic year: four occurrences in the first year, and three each in the second and third years. Furthermore, six components were found to be structurally and contextually alike across all four institutions but are scheduled for instruction during different academic periods. A notable level of partial overlap in educational components is also present across two or three of the institutions analyzed **(Table 5)**.

Table 5. Assessment of coincidence of AC in HEIs of Ukraine and EU countries

	% of coincidence regarding other HEIs (amount of AC)				% of coincidence in total by program (amount of AC)
	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)

The limited overlap of educational components across various higher education institutions (HEIs) should not be viewed negatively. This diversity reflects the unique nature and specific focus of each HEI's educational program, catering to distinct fields of expertise and professional qualifications. This difference offers a chance for Ukrainian HEIs to adapt their programs, aligning them more closely with European Union education standards under the Bologna Agreement, which aims to create a unified educational area across Europe.

The findings from this analysis will serve as the basis for establishing a common set of core educational components for two specializations within the field of "Pharmacy, Industrial Pharmacy" in Ukraine: 226.01 "Pharmacy" and 226.02 "Industrial Pharmacy." These guidelines will aid in shaping comprehensive educational programs for both Bachelor's and Master's levels in these fields.

A key element in the strategic development plan of Lviv Polytechnic National University (HEI-1) for the years leading up to 2025 is the enhancement of the educational process through the optimization of program content and the reduction of unnecessary components. The revision of academic programs is carried out annually, considering feedback from employers, alumni, and emerging educational trends. This procedure follows the university's regulation on developing, approving, and updating educational programs [20]. The most recent significant updates to the curriculum were made in 2014, following the enactment of the new Law on Higher Education and an updated list of specialties [21].

In 2018, the Ministry of Education and Science (MES) of Ukraine introduced new standards for higher education, prompting a further review of educational programs. A comparison with European institutions revealed that their programs typically involve fewer educational components, which improves both the quality of education and the student's ability to engage in independent study. Based on these observations, the methodological committee at Lviv Polytechnic National University (HEI-1) developed a new curriculum for first-year students in the 226 "Pharmacy, Industrial Pharmacy" specialty. This updated curriculum, introduced in 2021, reduced the number of academic components to just 5–6 per semester.

Additionally, following the rector's order, Lviv Polytechnic National University (HEI-1) increased the number of mathematical courses in the basic training block. Several disciplines were combined, including "Biological Chemistry and Molecular Biology," "Physical and Colloidal Chemistry," and "Biology and Physiology with Basic Anatomy." The courses "Hygiene" and "Introduction to the Profession: History of Pharmacy" were also merged into a new subject titled "Introduction to the Profession and Basic Professional Hygiene."

The methodological committee of Lviv Polytechnic National University (HEI-1) regularly collects feedback from students and graduates about their experience with courses and the overall educational program. This feedback helps assess the best timing and format for specific courses and provides insights into the practical applications of subjects. Annually, the list of elective courses is reviewed, taking into account the students' suggestions regarding content and delivery methods.

The analysis of educational components from four different HEIs provides valuable information that will guide the development of an optimized and standardized list of essential courses for the training of specialists in "Pharmacy, Industrial Pharmacy" at both Bachelor's and Master's levels.

Conclusion

1. A comprehensive meta-analysis was conducted to compare the Educational Programs (EPs) for pharmacy specialists in higher education institutions (HEIs) across Ukraine and EU countries.

2. The study revealed that while the core educational components of the EPs from four different HEIs are generally similar in content and terminology, their distribution across academic semesters or years may vary. Additionally, each HEI offers exclusive components that differentiate its EPs.
3. The comparative analysis of these EPs highlighted several similarities and underscored the potential for students to continue their education in international institutions. This is particularly relevant in light of the migration trends from Ukraine to EU countries, influenced by the ongoing Russian-Ukrainian war, facilitating the integration of Ukrainian pharmacy professionals into European educational systems.
4. The analysis supports the effectiveness of the European integration process in Ukrainian HEIs, especially concerning the training of students in the field of "Pharmacy, industrial pharmacy."

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