







RESEARCH ARTICLE

Are pharmacy graduates practice ready? A validation and assessment study of curricular effectiveness in a school of pharmacy in Lebanon

Fouad Sakr^{1,2,3,4} , Jihan Safwan^{1,2} , Iqbal Fahs¹ , Marwan Akel^{1,2,5} , Mariam Dabbous¹ , Mohamad Rahal¹ 

¹ School of Pharmacy, Lebanese International University, Beirut, Lebanon

² INSPECT-LB: Institut National de Santé Publique, d'Épidémiologie Clinique et de Toxicologie-Liban, Beirut, Lebanon

³ École Doctorale Sciences de la Vie et de la Santé, Université Paris-Est Créteil, France

⁴ UMR U955 INSERM, Institut Mondor de Recherche Biomédicale, Université Paris-Est Créteil, France

⁵ School of Education, Lebanese International University, Beirut, Lebanon

Keywords

Competency
Curricular effectiveness
Pharmacy education
Programme learning outcome
Validation

Correspondence

Fouad Sakr
Lebanese International University
Mussaitbeh
Salim Salam
Beirut
Lebanon
fouad.sakr@liu.edu.lb

Abstract

Background: This study aimed to validate the programme learning outcomes (PLOs) in a Lebanese pharmacy school. It also aimed to assess curricular effectiveness through self-reported assessments of recently graduated BPharm students and investigate if academic and sociodemographic characteristics impact learning outcomes' achievement. **Methods:** A cross-sectional study was conducted through an online questionnaire. The initial section of the questionnaire gathered data concerning academic and sociodemographic characteristics, while the second section centred around a scale-based self-declared assessment of the PLOs. **Results:** The validated BPharm PLOs encompassed six distinct domains, comprising a total of 20 competencies and 110 learning outcomes. All competencies were successfully extracted with factor analysis and appropriately loaded on their respective domains. The internal consistency of the competencies and domains was confirmed by Cronbach's alpha, with values ranging from 0.741 (good) to 0.957 (excellent). The graduates indicated their proficiency across all domains, with an average percentage grade ranging from 87.29% for professionalism to 87.55% for the approach to practice and care. **Conclusion:** The findings reveal a valid structure of the current PLOs with robust internal consistency. The high proficiency levels of graduates across all competency domains confirm the effectiveness and structural integrity of the curriculum.

Introduction

International and national educational trends reflect a growing preference for competency-based models in the training of healthcare professionals, particularly in nursing (Kaldan *et al.*, 2019), dentistry (Friedlander *et al.*, 2019), medicine (Frank *et al.*, 2010), and pharmacy (Bruno *et al.*, 2010; Nash *et al.*, 2015). The primary rationale behind adopting competency-focused educational frameworks in pharmacy is to design effective curricula that equip pharmacists with the necessary skills and knowledge to fulfil their societal

responsibilities, contributing to the improvement of healthcare services and enhancing patient safety (Hepler, 2004; van Mil *et al.*, 2004; Miller *et al.*, 2010; Atkinson *et al.*, 2016). Nevertheless, ensuring curriculum effectiveness is contingent upon curriculum evaluation, a process that identifies areas of success and those needing improvement (Kirwin *et al.*, 2019). This evaluation can be accomplished through the analysis of assessment data, collecting input from both students and faculty, conducting research studies, and monitoring classroom instruction. Once the evaluation findings are determined, they can inform adjustments

to the curriculum's content, instructional methods, professional development, and learning outcomes, ultimately providing better support to students in achieving the curriculum's specified goals (Britton *et al.*, 2008).

From a curricular perspective, pharmacy schools should clearly define and articulate the educational competencies and outcomes that graduates must achieve to satisfy both current and future healthcare needs using a needs-based educational approach (International Pharmaceutical Federation (FIP), 2022). The curriculum of the professional degree programme should actively support the preparation of graduates with the essential competencies necessary for entering pharmacy practice in any setting. It should empower them to take on leadership roles and become catalysts for transformation within the pharmacy field throughout their careers (Jungnickel *et al.*, 2009) by providing a solid foundation encompassing a comprehensive knowledge base in biomedical, pharmaceutical, social, behavioural, administrative, and clinical sciences. The curriculum should also offer a diverse range of pharmacy practice experiences to facilitate the integration, application, reinforcement, and advancement of the knowledge, skills, attitudes, behaviours, and values acquired through other curriculum components (Brazeau *et al.*, 2009). These competencies have a central role in moulding the formation of the programme learning outcomes (PLOs). These outcomes underscore the fundamental knowledge, skills, attitudes, and values needed to transform pharmacists into self-directed, lifelong learners, which is crucial for ongoing professional growth (Stupans, 2017).

In Lebanon, five universities offer pharmacy education, one public and four private, with various pharmacy programmes (Safwan *et al.*, 2022; Sakr *et al.*, 2022). Oversight of all universities falls under the authority of the Ministry of Education and Higher Education (MEHE). The MEHE is responsible for granting licenses, monitoring educational standards, and approving curricula (Zeitoun *et al.*, 2020). Nevertheless, there is currently no accessible national competency framework to guide pharmacy schools in shaping their curricula (Sacre *et al.*, 2022). As a result, universities typically design their curricula based on the competency framework established by international accreditation authorities (Boyle & Myford, 2013). Given this context, Lebanese universities may graduate pharmacists with variations in their knowledge, skills, and attitudes.

The School of Pharmacy (SOP) at the Lebanese International University (LIU) is a private school offering a 5-year Bachelor of Pharmacy (BPharm) programme that includes two years of pre-professional study,

followed by three professional years. The professional BPharm programme is available at the university's two main campuses in Beirut and Beqaa, while the pre-professional programme is also offered at six remote campuses scattered across Lebanon. The curriculum of the LIU-SOP is carefully designed to align with the school's mission, address national healthcare and pharmaceutical needs, and produce globally competitive graduates. This curriculum equips students with the necessary skills to practice pharmacy in various settings, allowing them to potentially contribute to the pharmacy profession throughout their careers (Dabbous *et al.*, 2022). These competencies are developed in accordance to both the national educational standards established by the MEHE and those recommended by the Lebanese Order of Pharmacists (OPL) and based on standards set by the Accreditation Council for Pharmacy Education (ACPE) (Accreditation Council for Pharmacy Education, 2015), outcomes outlined by the Center for the Advancement of Pharmaceutical Education (CAPE) (Medina *et al.*, 2013), and guidelines provided by the International Pharmaceutical Federation (FIP) (International Pharmaceutical Federation (FIP), 2022). Accordingly, the BPharm curriculum is structured around these competencies, ensuring that learning foundations and principles are progressively established, reinforced, and expanded upon through a combination of didactic, simulation and practical courses.

Given the absence of a uniform competency-based education model in Lebanon, each pharmacy school has autonomously created its set of PLOs to align with national laws and accreditation prerequisites, warranting the validation and evaluation of PLOs and competencies at the school level to confirm their accomplishment and identify any variables that might limit their attainment. This study aimed to validate the LIU BPharm programme's learning outcomes and the corresponding competencies and domains. It also examined the effectiveness of the curriculum by measuring the achievement of these PLOs through self-reported assessments involving freshly graduated BPharm students and whether it is influenced by the academic and sociodemographic characteristics of students and campuses.

Methods

Study design and participants

A cross-sectional research assessment took place between May 21 and June 21, 2023, via an online survey constructed using Google Forms. This approach aimed to streamline the survey's dissemination among

recently graduated students from the BPharm programme. The survey was made accessible through Google Classroom, one of the official communication and interaction platforms for the SOP with its students and new graduates, to involve graduates across the Beirut and Beqaa campuses, thereby ensuring a nearly complete response rate. It was sent by the assessment committee of LIU-SOP to show that it is a formal evaluation. Prior to completing the survey, participants were provided with details on the study and its various components, including its voluntary nature and confirmation regarding the confidentiality of the data collection process.

Questionnaire and variables

The questionnaire was formulated in English, given that English serves as the instructional language at LIU and is widely understood by all graduates. It consisted of two sections. The initial section gathered data concerning academic and sociodemographic characteristics, while the second section centred around a scale-based self-declared assessment of the SOP PLOs. These PLOs encompassed six distinct domains, each comprising a collection of corresponding competencies.

Academic and sociodemographic characteristics

In this section, graduates were queried about their general academic information, including their final grade point average (GPA) on a scale of 4, the primary campus where they completed their professional pharmacy studies (Beirut or Beqaa), and the initial campus they attended for pre-pharmacy years, considering that LIU has eight campuses across various districts of Lebanon. The evaluation of academic attributes also encompassed inquiries about any previous higher education degrees attained before joining the LIU-SOP and any aspirations for postgraduate studies. This section further delved into the sociodemographic aspects of the graduates, including age, gender, and an assessment of their financial situation with respect to covering the SOP expenses.

Programme learning outcomes, competencies and domains

The LIU BPharm PLOs encompass six domains covering a total of 20 competencies. In Domain 1, a single competency labelled "*Learner*" is associated with Foundational Knowledge. Domain 2 (Pharmaceutical Care) includes three competencies: Assessment of Medicines, Compounding of Medicines, and Dispensing. Three competencies are identified in Domain 3 (Essentials for Practice and Care): Patient-Centred Care,

Medication Use Systems Management, and Promotor and Care Provider. Domain 4 (Approach to Practice and Care) covers seven competencies: Problem-Solver, Educator, Advocate, Collaborator, Scholar, Cultural Sensitivity, and Communicator. Domain 5 (Professionalism) comprises three competencies: Practices Professionally, Practices Legally, and Practices Ethically. Finally, Domain 6 (Personal and Professional Development) includes three competencies: Self-Awareness, Leadership and Management, and Innovation.

The attainment of PLOs was assessed for each competency, with respondents using a 5-point Likert scale from 1 (strongly disagree) to 5 (strongly agree), providing a means for graduates to self-declare the extent to which they had achieved each PLO of the BPharm programme.

Ethical aspects

The study protocol received approval from the Ethics and Research Committee of the LIU-SOP (Approval number: 2023RC-123-LIUSOP). The study adhered to the ethical guidelines set forth in the Declaration of Helsinki. Comprehensive details regarding the subject matter and various dimensions of the study were presented in the initial segment of the questionnaire. Prior to engaging in the survey, participants provided their explicit written consent. Strict measures were taken to guarantee the preservation of respondent anonymity and the confidentiality of their information throughout the data collection process.

Statistical analysis

The data analysis utilised IBM SPSS Statistics software version 26. Initially, a factor analysis employing the principal component analysis method was executed to evaluate the self-assessment of PLOs in relation to competencies and domains. Each analysis provided the Kaiser-Meyer-Olkin (KMO) coefficient, Bartlett's test for sphericity, and the total percentage of variance explained as reported metrics. Pearson correlation coefficients were computed for structural validity assessment, elucidating the correlation between domains within their respective competencies and their correlation with other domains and the entirety of the PLOs. Additionally, Cronbach's alpha values were computed for each competency to gauge internal consistency and reliability.

Subsequently, a descriptive analysis was performed, employing frequencies and percentages for categorical measures and means and standard deviations (SD) for continuous variables. Standardised means over 100 were calculated for competencies and domains to

facilitate comparison. Bivariate analysis was then used to compare the mean scores of each competency domain with the academic and sociodemographic characteristics of the graduates. This analysis utilised independent sample *t*-test for the comparison of two groups, one-way ANOVA for the comparison among multiple groups, and Pearson correlation for assessing associations between continuous variables. In all instances, the significance level was established at $p < 0.05$.

Results

Academic and sociodemographic characteristics

A total of 141 recent BPharm graduates took part in this study. The average age of the participants was 23.60 (± 2.83), and their average final GPA stood at 3.31 (± 0.32) out of 4. A large proportion of these graduates (80.1%) were female, while 72.3% were from the Beirut campus, and 31.9% pursued pre-professional pharmacy studies at the Beirut campus. Around two-thirds (66.7%) managed to cover their SOP expenses without resorting to loans or borrowing. Regarding further educational achievements, most participants (89.4%) had not acquired any other university degrees before joining the SOP. Furthermore, about 43% did not have definite plans for postgraduate studies. Table I presents graduates' detailed academic and sociodemographic characteristics.

Validation of the programme learning outcomes

Content validity

The validated BPharm PLOs encompassed six distinct domains, comprising a total of 20 competencies and 110 learning outcomes. In Domain 1 (Foundational Knowledge), 8 PLOs were clustered within the learner competency. Moving on to Domain 2 (Pharmaceutical Care), 20 PLOs spread across the areas of medicine assessment, medicine compounding, and medicine dispensing. The third domain (Essentials for Practice and Care) encompassed 23 PLOs grouped into patient-centred care, medication use systems management, and promoter and care provider. Within the fourth domain (Approach to Practice and Care), a total of 33 PLOs were present, falling under the categories of problem solver, educator, advocate, collaborator, scholar, cultural sensitivity, and communication. The fifth domain (Professionalism) consisted of 16 PLOs grouped into the realms of professional practices, legal practices, and ethical practices. Lastly, the sixth domain (Personal and Professional Development) featured 10 PLOs categorised as self-awareness, leadership and management, and innovation.

Table I: Graduates' academic and sociodemographic characteristics

Variable	Frequency or mean	% or SD
Gender		
Male	28	19.9
Female	113	80.1
Age	23.60	2.83
Final GPA	3.31	0.32
Main campus during professional years of pharmacy		
Beirut	102	72.3
Beqaa	39	27.7
Campus during pre-professional pharmacy study		
Akkar	15	10.6
Beirut	45	31.9
Beqaa	40	28.4
Mount Lebanon	9	6.4
Nabatieh	4	2.8
Saida	7	5
Tripoli	12	8.5
Tyre	9	6.4
Borrowing money or loans to pay for SOP expenses		
No	94	66.7
Yes	47	33.3
University degrees earned before admission to the SOP		
BS or BA degree	9	6.4
Did not earn any university degree prior to admission to SOP	126	89.4
Master's degree	6	4.3
Future plans for additional academic degrees		
Not sure	45	31.9
No, there are no plans for further education in the coming year	16	11.3
Yes, Master's programme	49	34.8
Yes, MBA programme	3	2.1
Yes, Pharm.D. programme	27	19.1
Yes, Ph.D. programme	1	0.7

GPA = grade point average; SOP = school of pharmacy; BS = bachelor of science; BA = bachelor of arts; MBA = master of business administration; Pharm.D. programme = additional one academic year for doctor of pharmacy; Ph.D. = doctor of philosophy

Factor analysis

Factor analysis was employed to validate the construct of the PLO domains. Through Promax rotation, all competencies were successfully extracted and appropriately loaded on their respective domains. Each competency was loaded onto a single factor, and none of the variables exhibited low factor loadings (< 0.3), inadequate communalities (< 0.3), or excessive correlation with one another ($r > 0.9$). The Kaiser-Meyer-Olkin (KMO) measures, which assess the sample adequacy, demonstrated satisfactory values for all models, spanning from 0.500 to 0.934. Furthermore,

Bartlett's test of sphericity yielded significant results ($p < 0.001$), indicating the suitability of the data for factor analysis. The explained variance percentage varied

across the models, ranging from 67.12% to 90.67%. The detailed factor analysis results of the PLOs are presented in Table II.

Table II: Factor analysis with Promax rotated component matrix and internal consistency of the programme learning outcomes

Domain/ competency	Programme learning outcomes	Loading	Cronbach's alpha
Domain 1: Foundational knowledge			
1.1. Learner	1.1.3. Assess patient's laboratory tests and diagnostics in accordance with established standards, counsel and monitor patient use of non-prescription drugs and medicinal herbs.	0.913	0.944
	1.1.6. Apply knowledge in foundational sciences to make therapeutic decisions, evaluate advances in medicine, support health and wellness initiatives, and operate contemporary pharmacy services.	0.891	
	1.1.2. Understand and assess knowledge related to patient care.	0.879	
	1.1.5. Demonstrate a satisfactory knowledge of medication dispensing, storage, supply, administration, compatibility, adverse drug effects, and basic compounding.	0.869	
	1.1.7. Appraise scientific literature related to drugs and disease to enhance clinical reasoning.	0.858	
	1.1.4. Recite in-depth knowledge of pharmacology and pharmacotherapy and the scientific/clinical evidence that forms the basis for rational drug therapy.	0.846	
	1.1.8. Practice community pharmacy, dispense prescriptions accurately and safely, and demonstrate social/behavioral and economic skills along with administrative capabilities.	0.819	
	1.1.1. Recall extensive knowledge of medicine (e.g., pathophysiology, microbiology and mechanisms of diseases/disorders, clinical signs, symptoms, diagnostic tests, and natural history of disease).	0.716	
Kaiser-Meyer-Olkin (KMO) = 0.917; Bartlett's test of sphericity $p < 0.001$; Percentage of variance explained 72.39%			
Domain 2: Pharmaceutical care			
2.1. Assessment of medicines	2.1.2. Identify medicine-medicine interactions; medicine-disease interaction; medicine-food interaction.	0.892	0.741
	2.1.1. Know the physiochemical and biochemical properties of medications.	0.892	
Kaiser-Meyer-Olkin (KMO) = 0.500; Bartlett's test of sphericity $p < 0.001$; Percentage of variance explained 79.50%			
2.2. Compounding medicines	2.2.5. Be familiar with quality assurance and quality control principles.	0.882	0.938
	2.2.4. Determine drug stability and expected shelf life of different pharmaceutical dosage forms.	0.855	
	2.2.7. Demonstrate technical skills to prepare pharmaceutical products appropriate for a given formulation.	0.843	
	2.2.6. Choose the appropriate route of administration and dosage form for a drug based on pharmaceutical knowledge.	0.823	
	2.2.8. Counsel patients on the use of compounded dosage forms.	0.822	
	2.2.1. Determine a proper formulation for a given dosage form.	0.794	
	2.2.2. Perform pharmaceutical calculations accurately.	0.790	
	2.2.9. Prepare pharmaceutical products based on local standard operating procedures (SOPs), guidelines, or good manufacturing practice (GMP) as appropriate.	0.785	
	2.2.3. Know the principles for the drug development and formulation of different pharmaceutical dosage forms.	0.773	
	Kaiser-Meyer-Olkin (KMO) = 0.915; Bartlett's test of sphericity $p < 0.001$; Percentage of variance explained 67.12%		
2.3. Dispensing	2.3.6. Label the medicines (with the required and appropriate information).	0.910	0.954
	2.3.4. Appropriately validate prescriptions, ensuring that prescriptions are correctly interpreted and legal.	0.900	
	2.3.8. Implement and maintain a dispensing error reporting system and a 'near misses' reporting system.	0.886	
	2.3.7. Dispense medications and devices.	0.880	
	2.3.5. Document and act upon dispensing errors.	0.850	
	2.3.9. Learn from and act upon previous 'near misses' and 'dispensing errors'.	0.847	

Table II: Factor analysis with Promax rotated component matrix and internal consistency of the programme learning outcomes (Continued)

Domain/ competency	Programme learning outcomes	Loading	Cronbach's alpha
	2.3.1. Dispense medications accurately to patients in a safe manner according to professional judgment and up to date clinical knowledge.	0.826	
	2.3.3. Conduct a drug utilization review, patient counseling and maintaining patient record based on Omnibus Budget Reconciliation Act (OBRA 90).	0.813	
	2.3.2. Appropriately validate defective or substandard medicines to the appropriate authorities.	0.791	
	Kaiser-Meyer-Olkin (KMO) = 0.933; Bartlett's test of sphericity $p < 0.001$; Percentage of variance explained 73.40%		
Domain 3: Essentials for practice and care			
3.1. Patient-centred care	3.1.5. Evaluate the data and propose the most effective therapeutic options for the patients.	0.894	0.956
	3.1.9. Consult patients for the symptoms, signs and management of medication side effects.	0.883	
	3.1.7. Formulate a follow up contact with patients to evaluate the effectiveness of the care plan.	0.872	
	3.1.3. Generate an appropriate individualized plan based on the most updated evidence.	0.869	
	3.1.2. Identify and prioritize pharmacotherapy and pharmaceutical needs.	0.862	
	3.1.6. Recommend appropriate monitoring parameters for both safety and efficacy.	0.859	
	3.1.4. Interpret pharmacokinetic parameters to calculate appropriate doses.	0.846	
	3.1.8. Educate patients, caregivers and other healthcare team members to provide optimal care regarding prescription medications, nonprescription medications, and the proper use of medical devices.	0.844	
	3.1.1. Collect and interpret all necessary subjective and objective data including patient history, physical assessment, laboratory test results and allergies from patient medication profiles and other resources.	0.821	
	Kaiser-Meyer-Olkin (KMO) = 0.931; Bartlett's test of sphericity $p < 0.001$; Percentage of variance explained 74.20%		
3.2. Medication use systems management	3.2.6. Identify and evaluate the evidence base to improve the use of medicines and services, including risk management.	0.897	0.955
	3.2.5. Recognize quality as a core principle of medicines management and healthcare provision.	0.884	
	3.2.3. Recognize all of the available resources including human, financial, and physical resources to optimize the medication use system.	0.871	
	3.2.4. Understand the importance to contribute to the development, implementation, maintenance and training of staff on standard operating procedures, as appropriate to their level of responsibilities.	0.860	
	3.2.10. Understand the role of policies and procedures in the organizational structure and in the provision of healthcare.	0.858	
	3.2.9. Demonstrate awareness of different pharmacoeconomic aspects and financial management relating to pharmacy practice.	0.847	
	3.2.1. Identify, describe, and implement the duties of pharmacists in each component of medication use system (procurement, storage, prescribing, transcription, dispensing, administration, monitoring documentation, and outcome) in different practice settings.	0.820	
	3.2.7. Employ standards, guidelines, best practices, and established processes related to safe and effective medication use.	0.816	
	3.2.8. Implement a system for documentation and record keeping.	0.792	
	3.2.2. Utilize the technology available to optimize the efficacy and safety of the medication use system.	0.784	
	Kaiser-Meyer-Olkin (KMO) = 0.932; Bartlett's test of sphericity $p < 0.001$; Percentage of variance explained 71.17%		
3.3. Promoter & care provide	3.3.3. Design and implement strategies and programmes to prevent and manage chronic diseases.	0.917	0.899
	3.3.4. Assess the healthcare status and needs of variant populations.	0.895	
	3.3.2. Promote educational strategies such as awareness campaigns.	0.872	
	3.3.1. Describe and recommend preventive health services such as immunization and screening tests.	0.825	
	Kaiser-Meyer-Olkin (KMO) = 0.816; Bartlett's test of sphericity $p < 0.001$; Percentage of variance explained 77.07%		
Domain 4: Approach to practice and care			
4.1. Problem solver	4.1.5. Reflect on the applied solution in order to improve future performances.	0.890	0.920
	4.1.1. Identify the primary problem while defining goals and alternative ones.	0.878	

Table II: Factor analysis with Promax rotated component matrix and internal consistency of the programme learning outcomes (Continued)

Domain/ competency	Programme learning outcomes	Loading	Cronbach's alpha
4.2. Educator	4.1.3. Investigate positive and negative results by reviewing discrepancies and unplanned consequences.	0.877	0.921
	4.1.2. Explore multiple solutions by developing potential strategies to solve identified problems.	0.868	
	4.1.4. Employ the most feasible solutions.	0.838	
	Kaiser-Meyer-Olkin (KMO) = 0.816; Bartlett's test of sphericity $p < 0.001$; Percentage of variance explained 77.07%		
4.3. Advocate	4.2.2. Coordinate educational efforts with other healthcare providers.	0.909	0.897
	4.2.4. Select strategies of information delivery that are adapted to the intended audience and assess comprehension at the end of the educational session.	0.909	
	4.2.1. Educate and give support to other healthcare professionals in a manner suitable to their training, skills and work experience.	0.900	
	4.2.3. Ensure that the delivered information contains the most updated evidence and is customized to fit the attending audience.	0.879	
Kaiser-Meyer-Olkin (KMO) = 0.859; Bartlett's test of sphericity $p < 0.001$; Percentage of variance explained 80.87%			
4.4. Collaborator	4.3.2. Work with patients and the public to increase opportunities to adopt healthy behaviors.	0.952	0.921
	4.3.1. Provide information, advice and education for patients and the public on health awareness, disease prevention and control, and healthy lifestyle and wellness.	0.952	
	Kaiser-Meyer-Olkin (KMO) = 0.500; Bartlett's test of sphericity $p < 0.001$; Percentage of variance explained 90.67%		
4.5. Scholar	4.4.4. Join with other healthcare team members in respectful and effective shared decision-making.	0.905	0.926
	4.4.1. Participate with inter-professional healthcare team members including patients, pharmacy colleagues and individuals from other professions.	0.893	
	4.4.3. Optimize patient outcomes through clearly defined roles and responsibilities for team members.	0.888	
	4.4.2. Operate in an atmosphere of shared values and mutual respect necessary to meet patient care needs.	0.856	
	4.4.5. Establish productive and effective collaborations and networks with other schools (pharmacy, other health professions and disciplines), universities, pharmacy practice community, pharmaceutical industry, government, and national and international organizations.	0.822	
Kaiser-Meyer-Olkin (KMO) = 0.820; Bartlett's test of sphericity $p < 0.001$; Percentage of variance explained 76.29%			
4.6. Cultural sensitivity	4.5.3. Deliver effective feedback in teaching and learning situations.	0.862	0.861
	4.5.4. Apply principles of scientific enquiry to investigate a medicine or practice related issue.	0.861	
	4.5.2. Demonstrate the ability to critically reflect on their own practice and skills, to identify learning and development needs.	0.860	
	4.5.1. Apply medication therapy expertise to optimize pharmacy care, pharmacy services and healthcare delivery.	0.840	
	4.5.6. Use multiple drug information sources.	0.824	
	4.5.7. Appraise research studies with regards to study design, methodology, statistical analysis, significance, and validity of data reported.	0.791	
	4.5.5. Possess the skills to initiate research and practice development activities.	0.786	
Kaiser-Meyer-Olkin (KMO) = 0.884; Bartlett's test of sphericity $p < 0.001$; Percentage of variance explained 69.31%			
4.7. Communicator	4.6.2. Safely and appropriately incorporate patients' cultural beliefs and practices into health and wellness care plans.	0.938	0.957
	4.6.1. Demonstrate an attitude that is respectful of different cultures and does not discriminate between patients' access to quality care.	0.938	
	Kaiser-Meyer-Olkin (KMO) = 0.500; Bartlett's test of sphericity $p < 0.001$; Percentage of variance explained 87.99%		
	4.7.6. Communicate with appropriate levels of assertiveness, confidence, empathy and respect.	0.904	
4.7. Communicator	4.7.5. Use verbal communications tailored to varied patient specific criteria.	0.882	0.880
	4.7.1. Communicate effectively with patients, caregivers, families and laypersons of diverse backgrounds.	0.880	
	4.7.2. Demonstrate the ability to build positive relationships with other healthcare professionals and stakeholders.	0.880	

Table II: Factor analysis with Promax rotated component matrix and internal consistency of the programme learning outcomes (Continued)

Domain/ competency	Programme learning outcomes	Loading	Cronbach's alpha
	4.7.8. Provide and obtain feedback to assess learning and promote goal setting and attainment.	0.874	
	4.7.3. Provide clear and concise consultations to other healthcare professionals.	0.872	
	4.7.7. Use available technology and other media to help with communication as appropriate.	0.867	
	4.7.4. Develop professional written communications that are appropriate to the audience and checks understanding.	0.857	
	Kaiser-Meyer-Olkin (KMO) = 0.934; Bartlett's test of sphericity $p < 0.001$; Percentage of variance explained 76.91%		
Domain 5: Professionalism			
5.1. Practices professionally	5.1.3. Exemplify the professional values of pharmacy, including compassion, integrity, social responsibility and respect for all persons.	0.873	0.831
	5.1.1. Demonstrate the responsible behaviors expected of pharmacists, including accountability, patient confidentiality, punctuality and the prioritizing of the needs of patients.	0.868	
	5.1.2. Serve as a credible role model/leader for students, trainees and colleagues by exhibiting values and behaviors of a professional.	0.853	
	Kaiser-Meyer-Olkin (KMO) = 0.722; Bartlett's test of sphericity $p < 0.001$; Percentage of variance explained 74.75%		
5.2. Practices legally	5.2.7. Understand the steps needed to bring a medicinal product to the market including the safety, quality, efficacy and pharmacoeconomic assessments of the product.	0.895	0.939
	5.2.4. Comply with legislation for drugs with the potential for abuse.	0.887	
	5.2.5. Demonstrate knowledge in marketing and sales.	0.884	
	5.2.2. Apply knowledge in relation to the principles of business economics and intellectual property rights including the basics of patent interpretation.	0.843	
	5.2.1. Apply and understand regulatory affairs and the key aspects of pharmaceutical registration and legislations.	0.840	
	5.2.3. Be aware of and identify the new medicines coming to the market.	0.832	
	5.2.6. Engage with health and medicines policies.	0.813	
	Kaiser-Meyer-Olkin (KMO) = 0.902; Bartlett's test of sphericity $p < 0.001$; Percentage of variance explained 73.39%		
5.3. Practices ethically	5.3.3. Protect and respect the confidentiality of patient's information.	0.898	0.941
	5.3.2. Respect the dignity and autonomy of patients.	0.897	
	5.3.5. Accept constructive criticism and modify behavior if necessary.	0.881	
	5.3.6. Obtain patient consent (it can implicit on occasion).	0.880	
	5.3.4. Protect intellectual properties.	0.873	
	5.3.1. Demonstrate awareness of recognized codes of ethics.	0.840	
	Kaiser-Meyer-Olkin (KMO) = 0.916; Bartlett's test of sphericity $p < 0.001$; Percentage of variance explained 77.14%		
Domain 6: Personal and professional development			
6.1. Self-awareness	6.1.1. Understands and accepts the importance of life-long learning for pharmacists.	0.941	0.915
	6.1.3. Determine areas of deficiencies and interests.	0.927	
	6.1.2. Demonstrate skills of self-awareness, self-assessment, and self-development.	0.907	
	Kaiser-Meyer-Olkin (KMO) = 0.748; Bartlett's test of sphericity $p < 0.001$; Percentage of variance explained 85.55%		
6.2. Leadership and management	6.2.1. Identify characteristics that reflect leadership skills in demonstrating the responsibility for creating and achieving shared goals, regardless of position.	0.878	0.890
	6.2.2. Demonstrate self-management skills.	0.871	
	6.2.3. Demonstrate efficient time management skills and have the ability to prioritize important tasks.	0.867	
	6.2.4. Know how to empower team members by actively listening, gathering input or feedback, and fostering collaboration.	0.855	
	Kaiser-Meyer-Olkin (KMO) = 0.804; Bartlett's test of sphericity $p < 0.001$; Percentage of variance explained 75.28%		
6.3. Innovation	6.3.1. Engage in innovative activities by using creative thinking to envision better ways of accomplishing professional goals.	0.914	0.896
	6.3.2. Define new questions to be answered or problems to be solved.	0.913	
	6.3.3. Use different search strategies to retrieve information from literature.	0.904	
	Kaiser-Meyer-Olkin (KMO) = 0.751; Bartlett's test of sphericity $p < 0.001$; Percentage of variance explained 82.84%		

Furthermore, all competencies displayed significant correlations with their corresponding domains, with all associated p -values being less than 0.001. Additionally, all domains correlated significantly together and with

the total PLOs ($p < 0.001$). The detailed Pearson correlation analysis for the domains and competencies of the PLOs is shown in Table III.

Table III: Structure validity of the programme learning outcomes domains and competencies via Pearson correlation analysis

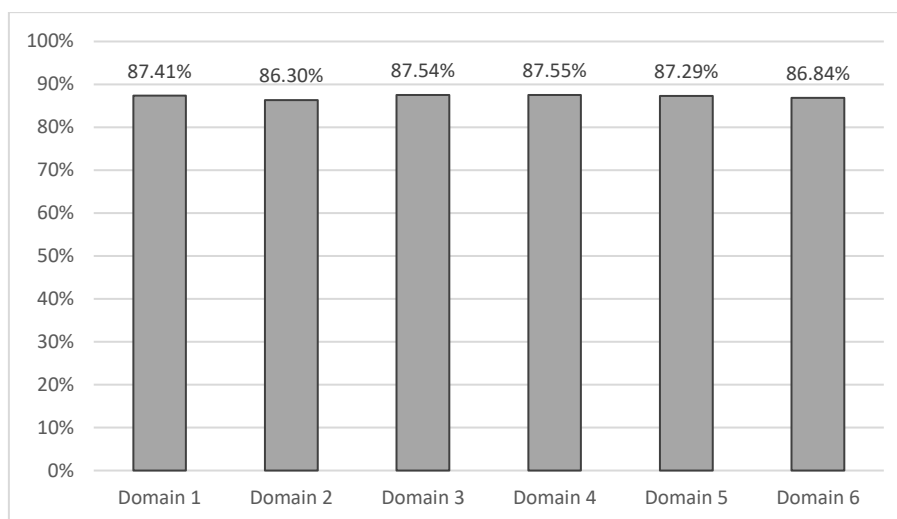
	Domain 1	Domain 2	Domain 3	Domain 4	Domain 5	Domain 6
Total programme learning outcomes	0.800	0.905	0.960	0.971	0.927	0.897
Domain 1		0.772	0.788	0.713	0.628	0.641
Domain 2	0.772		0.851	0.827	0.761	0.737
2.1. Assessment of medicines		0.837				
2.2. Compounding medicines		0.945				
2.3. Dispensing		0.940				
Domain 3	0.788	0.851		0.920	0.846	0.814
3.1. Patient-centred care			0.966			
3.2. Medication use systems management			0.967			
3.3. Promoter & care provide			0.866			
Domain 4	0.713	0.827	0.920		0.911	0.863
4.1. Problem-solver				0.871		
4.2. Educator				0.929		
4.3. Advocate				0.896		
4.4. Collaborator				0.932		
4.5. Scholar				0.943		
4.6. Cultural sensitivity				0.882		
4.7. Communicator				0.937		
Domain 5	0.628	0.761	0.846	0.911		0.923
5.1. Practices professionally					0.883	
5.2. Practices legally					0.945	
5.3. Practices ethically					0.940	
Domain 6	0.641	0.737	0.814	0.863	0.923	
6.1. Self-awareness						0.919
6.2. Leadership and management						0.955
6.3. Innovation						0.905

*All p -values < 0.001. Domain 1 = Foundational knowledge; Domain 2 = Pharmaceutical care; Domain 3 = Essentials for practice and care; Domain 4 = Approach to practice and care; Domain 5 = Professionalism; Domain 6 = Personal and professional development

Assessment of the achievement of programme learning outcomes

Figure 1 depicts the assessment of the 6 PLO domains among BPharm graduates. The participants indicated their proficiency across all domains, with an average percentage score ranging from 87.29% for professionalism to 87.55% for the approach to practice and care. Two domains displayed marginally lower scores of 86.30% for pharmaceutical care, and 86.84% for personal and professional development.

The evaluation of individual competencies within the domains revealed that the competencies with the lowest average scores were compounding medicines (85.45%, pertaining to pharmaceutical care), patient-centred care (87.50%, involving the essentials to practice and care), having scholarly activities (86.99%, related to the approach to practice and care), practising legally (87.09%, encompassing professionalism), and innovation (85.96% concerning personal and professional development). The comprehensive assessment of the scores of the PLO domains and competencies is reported in Table IV.



Domain 1 = Foundational knowledge; Domain 2 = Pharmaceutical care; Domain 3 = Essentials for practice and care; Domain 4 = Approach to practice and care; Domain 5 = Professionalism; Domain 6 = Personal and professional development.

Figure 1: Assessment of the 6 competency-based domains of the programme learning outcomes

Table IV: Assessment of the programme learning outcomes domains and competencies

Domain/competency	Mean	±SD	% of Mean	Median	Minimum	Maximum
Domain 1: Foundational knowledge	34.96	4.38	87.41	35.00	18.00	40.00
1.1. Learner	34.96	4.38	87.41	35.00	18.00	40.00
Domain 2: Pharmaceutical care	86.30	10.15	86.30	85.00	53.00	100.00
2.1. Assessment of medicines	8.63	1.06	86.31	8.00	6.00	10.00
2.2. Compounding medicines	38.45	4.85	85.45	37.00	27.00	45.00
2.3. Dispensing	39.22	4.99	87.16	39.00	20.00	45.00
Domain 3: Essentials for practice and care	100.67	11.58	87.54	100.00	69.00	115.00
3.1. Patient-centred care	39.38	4.80	87.50	39.00	27.00	45.00
3.2. Medication use systems management	43.77	5.20	87.53	44.00	30.00	50.00
3.3. Promoter & care provide	17.52	2.22	87.62	17.00	12.00	20.00
Domain 4: Approach to practice and care	144.45	15.98	87.55	145.00	99.00	165.00
4.1. Problem solver	21.83	2.72	87.32	22.00	11.00	25.00
4.2. Educator	17.60	2.13	88.01	17.00	12.00	20.00
4.3. Advocate	8.81	1.11	88.09	9.00	6.00	10.00
4.4. Collaborator	21.81	2.64	87.23	22.00	15.00	25.00
4.5. Scholar	30.45	3.51	86.99	30.00	21.00	35.00
4.6. Cultural sensitivity	8.82	1.11	88.23	9.00	6.00	10.00
4.7. Communicator	35.13	4.13	87.84	35.00	24.00	40.00
Domain 5: Professionalism	69.83	7.94	87.29	70.00	48.00	80.00
5.1. Practices professionally	13.10	1.60	87.33	13.00	9.00	15.00
5.2. Practices legally	30.48	3.71	87.09	30.00	21.00	35.00
5.3. Practices ethically	26.25	3.21	87.49	26.00	18.00	30.00
Domain 6: Personal and professional development	43.42	5.26	86.84	43.00	30.00	50.00
6.1. Self-awareness	13.10	1.69	87.33	13.00	9.00	15.00
6.2. Leadership and management	17.43	2.23	87.13	17.00	12.00	20.00
6.3. Innovation	12.89	1.74	85.96	12.00	8.00	15.00

Bivariate analysis

Table V presents the bivariate association between the mean of each competency domain grade as the dependent variable and the academic and graduates' sociodemographic characteristics as independent variables. The scores of the six domains were comparable across all campuses for both the pre-professional and professional pharmacy years (all p -values > 0.05). Similarly, the scores of all domains were comparable regardless of age, gender, and final GPA upon graduation (all p -values > 0.05). Moreover, the financial status and the capacity to cover the expenses of the SOP with or without resorting to loans did not lead to significant differences in domain scores.

Furthermore, the scores of the domains remain consistent regardless of whether the BPharm graduates possessed prior higher education before commencing their pharmacy studies or had intentions for postgraduate studies ($p > 0.05$). Notably, BPharm graduates who held a Master's degree before enrolling in the pharmacy programme exhibited a significantly higher mean score of professionalism in comparison with those who did not have any degree before pharmacy studies ($p = 0.045$) and those who had obtained a bachelor degree in science or arts before pursuing pharmacy studies ($p = 0.042$).

Table 5: Bivariate associations of the programme learning outcomes competency-domains with the academic and sociodemographic characteristics of graduates

	Domain 1 Mean \pm SD	Domain 2 Mean \pm SD	Domain 3 Mean \pm SD	Domain 4 Mean \pm SD	Domain 5 Mean \pm SD	Domain 6 Mean \pm SD
Gender						
Male	34.25 \pm 5.62	86.32 \pm 10.45	101.29 \pm 12.79	144.00 \pm 18.04	70.32 \pm 8.75	43.32 \pm 5.68
Female	35.14 \pm 4.02	86.30 \pm 10.13	100.51 \pm 11.32	144.57 \pm 15.51	69.71 \pm 7.76	43.44 \pm 5.17
<i>p-value</i>	0.435	0.992	0.753	0.867	0.716	0.914
Main campus during professional years of pharmacy						
Beirut	34.99 \pm 4.41	86.39 \pm 9.72	100.86 \pm 11.69	144.39 \pm 16.22	70.13 \pm 7.80	43.68 \pm 5.12
Bekaa	34.90 \pm 4.35	86.08 \pm 11.35	100.15 \pm 11.41	144.62 \pm 15.54	69.05 \pm 8.34	42.74 \pm 5.60
<i>p-value</i>	0.911	0.870	0.746	0.941	0.473	0.348
Campus during pre-professional pharmacy study						
Akkar	34.80 \pm 4.51	85.40 \pm 9.86	99.33 \pm 12.86	142.13 \pm 16.98	68.80 \pm 8.32	43.47 \pm 5.49
Beirut	34.07 \pm 4.38	85.13 \pm 8.11	99.44 \pm 10.54	143.51 \pm 14.80	70.09 \pm 7.31	43.40 \pm 4.81
Bekaa	35.03 \pm 4.37	86.43 \pm 11.42	100.53 \pm 11.51	145.13 \pm 15.67	69.33 \pm 8.41	42.93 \pm 5.65
Mount Lebanon	35.11 \pm 5.51	86.78 \pm 12.55	99.89 \pm 15.58	142.00 \pm 20.36	68.22 \pm 9.07	41.89 \pm 5.42
Nabatieh	37.50 \pm 3.79	90.75 \pm 9.78	105.75 \pm 10.28	151.25 \pm 15.67	73.75 \pm 7.76	46.25 \pm 4.79
Saida	33.71 \pm 2.29	85.71 \pm 6.95	100.29 \pm 7.72	143.71 \pm 12.51	68.14 \pm 3.13	42.43 \pm 4.28
Tripoli	35.75 \pm 4.67	86.50 \pm 13.15	100.92 \pm 14.53	143.17 \pm 20.45	70.17 \pm 9.84	44.33 \pm 6.43
Tyre	38.11 \pm 3.26	90.89 \pm 11.22	108.11 \pm 9.79	151.78 \pm 15.91	73.22 \pm 8.24	45.44 \pm 4.98
<i>p-value</i>	0.262	0.856	0.638	0.846	0.812	0.762
Borrowing money or loans to pay for SOP expenses						
No	35.48 \pm 4.10	87.39 \pm 9.40	101.52 \pm 11.18	145.33 \pm 15.59	70.15 \pm 7.75	43.69 \pm 4.99
Yes	33.94 \pm 4.77	84.13 \pm 11.31	98.96 \pm 12.29	142.70 \pm 16.77	69.19 \pm 8.35	42.87 \pm 5.76
<i>p-value</i>	0.062	0.092	0.232	0.372	0.513	0.408
University degrees earned before admission to the SOP						
BS or BA degree	34.67 \pm 3.28	85.89 \pm 7.52	100.00 \pm 9.86	142.00 \pm 12.13	67.44 \pm 5.32	42.33 \pm 3.50
Did not earn any university degree prior to admission to SOP	34.89 \pm 4.52	86.10 \pm 10.45	100.34 \pm 11.79	144.01 \pm 16.26	69.63 \pm 8.05	43.30 \pm 5.40
Master's degree	37.00 \pm 2.10	91.33 \pm 5.96	108.50 \pm 6.95	157.50 \pm 9.33	77.67 \pm 3.83	47.50 \pm 1.64
<i>p-value</i>	0.506	0.466	0.239	0.116	0.033*	0.131
Future plans for additional academic degrees						
Not sure	34.51 \pm 3.91	85.24 \pm 9.67	99.96 \pm 10.51	142.22 \pm 13.20	68.29 \pm 6.63	42.47 \pm 4.53

Table 5: Bivariate associations of the programme learning outcomes competency-domains with the academic and sociodemographic characteristics of graduates (Continued)

	Domain 1	Domain 2	Domain 3	Domain 4	Domain 5	Domain 6
	Mean ±SD	Mean ±SD	Mean ±SD	Mean ±SD	Mean ±SD	Mean ±SD
No, there are no plans for further education in the coming year	34.88 ±4.70	85.94 ±10.73	100.06 ±12.17	140.19 ±17.14	68.75 ±8.88	43.06 ±6.01
Yes, Master's programme	34.80 ±4.74	86.49 ±9.60	101.02 ±11.50	146.04 ±16.07	70.43 ±7.92	43.86 ±5.28
Yes, MBA programme	37.33 ±4.62	94.00 ±10.39	111.00 ±5.29	161.33 ±3.21	78.67 ±1.53	48.67 ±2.31
Yes, Pharm.D. programme	35.63 ±4.37	86.59 ±11.65	99.89 ±13.47	145.19 ±18.94	70.59 ±9.18	43.59 ±5.89
Yes, Ph.D. programme	40.00 ±0.00	100.00 ±0.00	115.00 ±0.00	165.00 ±0.00	80.00 ±0.00	50.00 ±0.00
<i>p-value</i>	0.648	0.542	0.513	0.181	0.162	0.263
	Correlation coefficient	Correlation coefficient	Correlation coefficient	Correlation coefficient	Correlation coefficient	Correlation coefficient
Age	0.138	0.069	0.103	0.133	0.159	0.136
<i>p-value</i>	0.104	0.417	0.225	0.116	0.060	0.107
Final GPA	-0.055	-0.090	-0.037	-0.048	-0.022	0.017
<i>p-value</i>	0.515	0.293	0.663	0.574	0.794	0.839

Domain 1 = Foundational knowledge; Domain 2 = Pharmaceutical care; Domain 3 = Essentials for practice and care; Domain 4 = Approach to practice and care; Domain 5 = Professionalism; Domain 6 = Personal and professional development; SD = standard deviation; GPA = grade point average; SOP = school of pharmacy; BS = bachelor of science; BA = bachelor of arts; MBA = master of business administration; Pharm.D. programme = additional one academic year for doctor of pharmacy; Ph.D. = doctor of philosophy.

*Post hoc analysis showed a significant difference between holding a previous Master's degree before studying pharmacy and not holding any previous degree before studying pharmacy ($p = 0.045$); post hoc analysis also showed a significant difference between holding a previous master's degree before studying pharmacy and holding a BS or BA degree before studying pharmacy ($p = 0.042$).

Discussion

This study represents a pioneering effort, both nationally and internationally, in which a pharmacy school validates its programme learning outcomes (PLOs). The validation demonstrated robust internal coherence and substantial correlations among all competencies and domains of the PLOs. The BPharm programme graduates reported exceptionally high levels of proficiency across all competency domains. Notably, the results indicated no significant differences in domain scores across the different campuses and among various sociodemographic characteristics of the graduates.

The LIU BPharm PLOs are categorised into six competency domains, i.e., Foundational Knowledge, Pharmaceutical Care, Essentials for Practice and Care, Approach to Practice and Care, Professionalism, and Personal and Professional Development. These domains draw inspiration from several internationally recognised and validated competency frameworks for pharmacy education, such as the FIP Global Competency Framework (Stupans *et al.*, 2016), CAPE educational outcomes (Medina *et al.*, 2013), and American Association of Colleges of Pharmacy (AACP) curricular outcomes and entrustable professional activities (COEPA) (Medina *et al.*, 2023), among others.

In addition, they align with the ACPE international accreditation standards (Accreditation Council for Pharmacy Education).

Each pharmacy school in Lebanon adopts unique educational programme competencies influenced by various models, such as the American, Canadian, and French systems (Akel *et al.*, 2020). Therefore, validating the PLOs of each school is pivotal as it lays the groundwork for designing and evaluating curricula, ensuring that students acquire the vital knowledge and skills essential for succeeding as pharmacists (Kelley *et al.*, 2008a; Kelley *et al.*, 2008b), especially in Lebanon, given the diverse curriculum approaches across different pharmacy schools and the absence of national accreditation standards. The current study was able to validate the structure of the LIU BPharm PLOs, with each learning outcome correctly linked to its respective competency domain. The current dataset was found to be adequate and suitable for all models and factor analysis. Furthermore, the PLOs exhibited strong internal consistency, reflected by good to excellent Cronbach's alpha values within each competency (Taber, 2018). Notably, all competencies displayed highly significant correlations with their respective domains, and all domains demonstrated highly significant correlations among themselves and with the overall PLOs. The validation of PLOs enables LIU-SOP to uphold educational excellence, produce proficient

graduates, and contribute to the advancement of pharmaceutical practice and patient care, further enhancing the school's reputation and accreditation status (Etukakpan *et al.*, 2023).

To the best of the authors' knowledge, no pharmacy school in Lebanon has previously undertaken the validation of its PLOs. On the other hand, the Order of Pharmacists of Lebanon (OPL) has recently validated a core competencies framework based on international models and adapted to the local context (Hajj *et al.*, 2021; Sacre *et al.*, 2022). This framework has demonstrated sufficient structural validity and reliability, although additional validation steps such as test-retest reliability measures and criterion validity are still needed. While the OPL has proposed this framework, it has not yet been officially adopted by the MEHE or national schools of pharmacy. Additionally, several specialised competency frameworks specific to industry pharmacists (Sacre *et al.*, 2023), community pharmacists (Sakr *et al.*, 2023), and hospital pharmacists (Chamoun *et al.*, 2023) have been validated in Lebanon. These specialised competency frameworks can serve as valuable guiding principles for Lebanese pharmacy schools seeking to update their curricula. It is worth noting that the LIU BPharm PLOs considerably align with these specialised competencies and the framework proposed by the OPL.

The assessment of PLOs among recent graduates yielded remarkably positive outcomes, with graduates self-reporting a high level of proficiency across all six domains, each scoring well above 85%. This result indicates the effectiveness of the LIU BPharm curriculum and underscores its robust structure. The impressive proficiency scores also reflect well on the programme's teaching methods, pedagogical tools, and faculty expertise, all of which have contributed to graduates' mastery of the programme's outcomes and competencies (Brazeau *et al.*, 2009; Gleason *et al.*, 2011; Akel *et al.*, 2020; Dabbous *et al.*, 2022). The consistently high proficiency scores also suggest that the evaluation methods used to monitor students' progress and competence are rigorous and accurate (Sottiyotin *et al.*, 2023). The current findings are consistent with those of a study conducted at Santo Tomas University in the Philippines, which indicated that their current curriculum played a substantial role in the successful attainment of programme components by their BPharm graduates (Doria, 2017). On the other hand, a recent study in Lebanon evaluated pharmacists' perception of competencies acquired across Lebanese pharmacy schools, based on the competency framework suggested by the OPL. The overall results showed varying levels of competence perception among pharmacists, ranging from 67% to 79% (Zeenny *et al.*, 2021). This lower perception of

competencies compared to the current findings may be attributed to the fact that the previous Lebanese study included pharmacists who graduated between 2009 and 2020 from all five schools in Lebanon. Individual experiences in practice, challenges faced during their years of practice, and the specific programme they graduated from could have influenced their confidence in these competencies.

The current study reveals that competency scores across the six domains are consistent across all LIU campuses for both pre-professional and professional pharmacy years. Despite offering pre-professional years in eight different campuses and professional years in two, course content, teaching methods, and assessment approaches are standardised across all campuses, thereby emphasising the commitment of the LIU-SOP to ensuring educational equality and equity among its campuses. Interestingly, the competency scores did not vary significantly based on age, gender, or final GPA upon graduation. This result contrasts with the findings of other studies from the United States and Great Britain that had identified variations in competency assessment scores influenced by factors like gender, age, race, and ethnicity (Mills *et al.*, 2005; Crawford *et al.*, 2016). However, the current findings align with a previous Lebanese study that reported no significant gender-based differences in fundamental knowledge, medicines supply, pharmaceutical public health, and organisational management (Zeenny *et al.*, 2021).

The current findings also showed that financial status and postgraduate study plans did not lead to significant differences in competency domain scores, highlighting the dedication of both students and faculty to education quality and curricular effectiveness. Notably, graduates with a Master's degree before enrolling in the BPharm programme scored significantly higher in professionalism, likely due to their enhanced abilities, maturity, and professionalism stemming from their prior advanced education (Harrell, 2015; Mylrea *et al.*, 2015). These results reflect the commitment of LIU-SOP to educational equity, which is one of the school's core values.

Practical implications

The validation and evaluation of the PLOs holds significant practical implications that benefit both students and pharmacy schools. It ensures that graduates are thoroughly prepared for their chosen careers while maintaining the programme's standards and high quality. The validation of PLOs is instrumental in guaranteeing that current and prospective graduates possess the requisite knowledge and skills, which are particularly valuable for upholding the programme's

quality and meeting accreditation criteria, assuring potential employers that pharmacy graduates have acquired the essential capabilities needed for their roles. Moreover, the present study can serve as the catalyst for an ongoing cycle of continuous improvement. By regularly assessing and adapting learning outcomes, the programme can remain aligned with evolving pharmacy standards and the ever-changing needs of society. Emerging developments and modifications in pharmacy curricula have necessitated altering the educational process to embrace the digital revolution, telehealth, entrepreneurial, and deep learning techniques.

Strengths and limitations

This study possesses several notable strengths. It pioneers the validation of PLOs within one SOP, ensuring their construct and structural validity and reliability. The robust and significant correlations in the current findings provide a strong basis for the study's reproducibility. Additionally, the sample size was adequate for all statistical analyses in both the validation and assessment phases. On the other hand, it is essential to acknowledge some limitations. There is a potential risk of information bias due to the lengthy questionnaire and potential participant fatigue, compounded by the reliance on self-reported data, which might lead to misinterpretations of certain questions. Furthermore, assessing graduates' proficiency in achieving PLOs through self-reporting may not be the most precise method. Nevertheless, given the absence of standardised tools that delve into individual competencies upon assessing practice readiness, this approach remains the most feasible means of assessment. For instance, the current national colloquium examination to assess practice readiness looks at the overall achievement of the desired competencies without exploring the achievement of each competency or competency domain at the individual level. Hence, it is advisable to conduct prospective studies to compare different generations and track the achievement of PLOs over time.

Conclusion

This study holds substantial significance both nationally and internationally. The findings reveal a valid structure of the current PLOs with robust internal consistency. The high proficiency levels of graduates across all competency domains confirm the effectiveness and structural integrity of the curriculum. Remarkably, no significant differences in competency-domain scores

were observed across various campuses and sociodemographic characteristics of graduates. The consistency in competency scores across campuses reflects a commitment to educational equality and equity. This study also establishes a framework for continuous improvement by regularly validating, assessing and adapting learning outcomes to ensure that professional programmes can remain aligned with the dynamic landscape of the pharmacy profession.

Authors' contribution

FS conceptualised the study, analysed, validated, and curated the data, interpreted the results, and drafted the manuscript. JS and IF drafted parts of the manuscript. MA, MD, and MR reviewed and edited the manuscript. All authors read and approved the final version of the manuscript.

Conflict of interest

The authors have nothing to disclose.

Source of funding

This research did not receive any specific grant from funding agencies in the public, commercial, or not-for-profit sectors.

Acknowledgements

The authors extend their gratitude to the graduates who actively participated in this research. Furthermore, special thanks are extended to Dr. Etwal Bouraad for her valuable contribution to the competency-domains of the PLOs within the SOP.

References

- Accreditation Council for Pharmacy Education (2015). Accreditation standards and key elements for the professional program in pharmacy leading to the doctor of pharmacy degree ("Standards 2016"). Retrieved June 15, 2023, from <https://www.acpe-accredit.org/pdf/Standards2016FINAL.pdf>
- Akel, M. E., Rahal, M., Dabbous, M., Mourad, N., Dimassi, A., & Sakr, F. (2020). Experiential education in pharmacy

curriculum: The Lebanese International University Model. *Pharmacy (Basel)*, **9**(1), 5. <https://doi.org/10.3390/pharmacy9010005>

Atkinson, J., De Paepe, K., Pozo, A. S., Rekkas, D., Volmer, D., Hirvonen, J., Bozic, B., Skowron, A., Mircioiu, C., Marcincal, A., Koster, A., Wilson, K., & van Schravendijk, C. (2016). The second round of the PHAR-QA survey of competences for pharmacy practice. *Pharmacy (Basel)*, **4**(3), 27. <https://doi.org/10.3390/pharmacy4030027>

Boyle, M., & Myford, C. (2013). Pharmacists' expectations for entry-level practitioner competency. *American Journal of Pharmaceutical Education*, **77**(1), 5. <https://www.ncbi.nlm.nih.gov/pmc/articles/PMC3578337/>

Brazeau, G. A., Meyer, S. M., Belsey, M., Bednarczyk, E. M., Bilic, S., Bullock, J., DeLander, G. E., Fiese, E. F., Giroux, S. L., McNatty, D., Nemire, R., Prescott, W. A., Jr., & Traynor, A. P. (2009). Preparing pharmacy graduates for traditional and emerging career opportunities. *American Journal of Pharmaceutical Education*, **73**(8), 157. <https://www.ncbi.nlm.nih.gov/pmc/articles/PMC2828318/>

Britton, M., Letassy, N., Medina, M. S., & Er, N. (2008). A curriculum review and mapping process supported by an electronic database system. *American Journal of Pharmaceutical Education*, **72**(5), 99. <https://www.ncbi.nlm.nih.gov/pmc/articles/PMC2630156/>

Bruno, A., Bates, I., Brock, T., & Anderson, C. (2010). Towards a global competency framework. *American Journal of Pharmaceutical Education*, **74**(3), 56. <https://doi.org/10.5688/aj740356>

Chamoun, N., Ramia, E., Sacre, H., Haddad, M., Haddad, C., Hajj, A., Namnoum, J., Zeenny, R. M., Iskandar, K., Akel, M., & Salameh, P. (2023). Validation of the specialized competency framework for pharmacists in hospital settings (SCF-PHS): A cross-sectional study. *Journal of Pharmaceutical Policy and Practice*, **16**(1), 86. <https://doi.org/10.1186/s40545-023-00592-7>

Crawford, S. Y., Awé, C., Tawk, R. H., & Simon Pickard, A. (2016). A cross sectional and longitudinal study of pharmacy student perceptions of readiness to serve diverse populations. *American Journal of Pharmaceutical Education*, **80**(4), 62. <https://doi.org/10.5688/ajpe80462>

Dabbous, M., Kawtharani, A., Fahs, I., Hallal, Z., Shouman, D., Akel, M., Rahal, M., & Sakr, F. (2022). The role of game-based learning in experiential education: Tool validation, motivation assessment, and outcomes evaluation among a sample of pharmacy students. *Education Sciences*, **12**(7), 434. <https://doi.org/10.3390/educsci12070434>

Doria, M. (2017). Outcomes-based approach to pharmacy curriculum review and redevelopment. *Pharmaceutical Sciences Asia*, **44**(3), 115–133. <https://doi.org/10.29090/psa.2017.03.115>

Etukakpan, A., Uzman, N., Ozer, O., Tofade, T., Leite, S. N., Joda, A., Choonara, Y., Mwila, C., Azzopardi, L. M., Mantel-Teeuwisse, A. K., Rahal, M., Darwish, R., Lee, B. J., Shaky, R., Gallagher, P. J., Moreau, P., Lourenço, L., McKinnon, R. A., & Altieri, R. J. (2023). Transforming pharmaceutical education: A needs-based global analysis for policy development. *Exploratory Research in Clinical and Social*

Pharmacy, **9**, 100234. <https://doi.org/10.1016/j.rcsop.2023.100234>

Frank, J. R., Snell, L. S., Cate, O. T., Holmboe, E. S., Carraccio, C., Swing, S. R., Harris, P., Glasgow, N. J., Campbell, C., Dath, D., Harden, R. M., Iobst, W., Long, D. M., Mungroo, R., Richardson, D. L., Sherbino, J., Silver, I., Taber, S., Talbot, M., & Harris, K. A. (2010). Competency-based medical education: theory to practice. *Medical Teacher*, **32**(8), 638–645. <https://doi.org/10.3109/0142159x.2010.501190>

Friedlander, L. T., Meldrum, A. M., & Lyons, K. (2019). Curriculum development in final year dentistry to enhance competency and professionalism for contemporary general dental practice. *European Journal of Dental Education*, **23**(4), 498–506. <https://doi.org/10.1111/eje.12458>

Gleason, B. L., Peeters, M. J., Resman-Targoff, B. H., Karr, S., McBane, S., Kelley, K., Thomas, T., & Denetclaw, T. H. (2011). An active-learning strategies primer for achieving ability-based educational outcomes. *American Journal of Pharmaceutical Education*, **75**(9), 186. <https://doi.org/10.5688/ajpe759186>

Hajj, A., Hallit, S., Sacre, H., Akel, M., Zeenny, R. M., & Salameh, P. (2021). Lebanese pharmacy core competencies framework: Tool validation for self-declared assessment. *International Journal of Pharmacy Practice*, **29**(6), 598–604. <https://doi.org/10.1093/ijpp/riab055>

Harrell, K. (2015). Has the time come for a bachelor's degree prerequisite to pharmacy school? *American Journal of Pharmaceutical Education*, **79**(8), 111. <https://doi.org/10.5688/ajpe798111>

Hepler, C. D. (2004). Clinical pharmacy, pharmaceutical care, and the quality of drug therapy. *Pharmacotherapy*, **24**(11), 1491–1498. <https://doi.org/10.1592/phco.24.16.1491.50950>

International Pharmaceutical Federation (FIP). (2022). Competency-based education in pharmacy and pharmaceutical sciences, A FIP handbook to support implementation of competency-based education and training, Version 1. FIP. <https://www.fip.org/file/5338>

Jungnickel, P. W., Kelley, K. W., Hammer, D. P., Haines, S. T., & Marlowe, K. F. (2009). Addressing competencies for the future in the professional curriculum. *American Journal of Pharmaceutical Education*, **73**(8), 156. <https://www.ncbi.nlm.nih.gov/pmc/articles/PMC2828317/>

Kaldan, G., Nordentoft, S., Herling, S. F., Larsen, A., Thomsen, T., & Egerod, I. (2019). Evidence characterising skills, competencies and policies in advanced practice critical care nursing in Europe: A scoping review protocol. *BMJ Open*, **9**(9), e031504. <https://doi.org/10.1136/bmjopen-2019-031504>

Kelley, K. A., Coyle, J. D., McAuley, J. W., Wallace, L. J., Buerki, R. A., & Frank, S. G. (2008a). Writing PharmD program-level, ability-based outcomes: Key elements for success. *American Journal of Pharmaceutical Education*, **72**(5), 98. <https://www.ncbi.nlm.nih.gov/pmc/articles/PMC2630155/>

Kelley, K. A., McAuley, J. W., Wallace, L. J., & Frank, S. G. (2008b). Curricular mapping: Process and product. *American*

- Journal of Pharmaceutical Education*, **72**(5), 100. <https://www.ncbi.nlm.nih.gov/pmc/articles/PMC2630125/>
- Kirwin, J., Miller, D. M., & DiVall, M. (2019). Lessons learned from evaluating a process for systematic curriculum review. *American Journal of Pharmaceutical Education*, **83**(1), 6783. <https://doi.org/10.5688/ajpe6783>
- Medina, M., Stolte, S., Conry, J., Culhane, N., Farland, M. Z., Kennedy, D. R., Lockman, K., Malcom, D. R., Mirzaian, E., Vyas, D., Steinkopf, M., & Ragucci, K. (2023). Revising the Center for the Advancement of Pharmacy Education (CAPE) educational outcomes and entrustable professional activities (EPAs): The report of the 2021-2022 academic affairs standing committee. *American Journal of Pharmaceutical Education*, **87**(1), ajpe9453. <https://doi.org/10.5688/ajpe9453>
- Medina, M. S., Plaza, C. M., Stowe, C. D., Robinson, E. T., DeLander, G., Beck, D. E., Melchert, R. B., Supernaw, R. B., Roche, V. F., Gleason, B. L., Strong, M. N., Bain, A., Meyer, G. E., Dong, B. J., Rochon, J., & Johnston, P. (2013). Center for the Advancement of Pharmacy Education 2013 educational outcomes. *American Journal of Pharmaceutical Education*, **77**(8), 162. <https://doi.org/10.5688/ajpe778162>
- Miller, B. M., Moore, D. E., Jr., Stead, W. W., & Balsler, J. R. (2010). Beyond Flexner: A new model for continuous learning in the health professions. *Academic Medicine*, **85**(2), 266–272. <https://doi.org/10.1097/ACM.0b013e3181c859fb>
- Mills, E., Laaksonen, R., Bates, I., Davies, G., & Duggan, C. (2005). Self-assessment of competence in a community pharmacy setting. *Pharmacy Education*, **5**(3), 1–11. <https://pharmacyeducation.fip.org/pharmacyeducation/article/view/178>
- Mylrea, M. F., Gupta, T. S., & Glass, B. D. (2015). Professionalization in pharmacy education as a matter of identity. *American Journal of Pharmaceutical Education*, **79**(9), 142. <https://doi.org/10.5688/ajpe799142>
- Nash, R. E., Chalmers, L., Brown, N., Jackson, S., & Peterson, G. (2015). An international review of the use of competency standards in undergraduate pharmacy education. *Pharmacy Education*, **15**(1), 131–141. <https://pharmacyeducation.fip.org/pharmacyeducation/article/view/324>
- Sacre, H., Hallit, S., Hajj, A., Zeenny, R. M., Akel, M., Raad, E., & Salameh, P. (2022). Developing core competencies for pharmacy graduates: The Lebanese experience. *Journal of Pharmacy Practice*, **35**(2), 332–339. <https://doi.org/10.1177/0897190020966195>
- Sacre, H., Saab, M., Haddad, C., Haddad, M., Zeenny, R. M., Akel, M., Hajj, A., Iskandar, K., & Salameh, P. (2023). The specialized competency framework for industry pharmacists (SCF-IP): Validation and pilot assessment. *Journal of Pharmaceutical Policy and Practice*, **16**(1), 96. <https://doi.org/10.1186/s40545-023-00602-8>
- Safwan, J., Cherfan, M., Dabbous, M., Hammoudi, D., Akiki, Z., Saade, F., Akel, M., Younes, S., Rahal, M., & Bouraad, E. (2022). Faculty perceptions on online education in a school of pharmacy during the COVID-19 pandemic. *Pharmacy Education*, **22**(1), 450–457. <https://doi.org/10.46542/pe.2022.221.450457>
- Sakr, F., Akel, M., Sacre, H., Haddad, C., Tawil, S., Safwan, J., Hajj, A., Zeenny, R. M., Iskandar, K., & Salameh, P. (2023). The specialized competency framework for community pharmacists (SCF-CP) in Lebanon: Validation and evaluation of the revised version. *Journal of Pharmaceutical Policy and Practice*, **16**(1), 77. <https://doi.org/10.1186/s40545-023-00585-6>
- Sakr, F., Fahs, I., Dimassi, A., Younes, S., Mourad, N., Safwan, J., Akel, M., Rahal, M., & Dabbous, M. (2022). Experiential pharmacy education in trying times: Lessons learned from the COVID-19 pandemic. *Pharmacy Education*, **22**(1), 823–834. <https://doi.org/10.46542/pe.2022.221.823834>
- Sottiyotin, T., Uitrakul, S., Sakdiset, P., Sukkarn, B., Sangfai, T., Chuaboon, L., & Palee, P. (2023). Effective formative assessment for pharmacy students in Thailand: Lesson learned from a school of pharmacy in Thailand. *BMC Medical Education*, **23**(1), 300. <https://doi.org/10.1186/s12909-023-04232-1>
- Stupans, I. (2017). A curriculum challenge—the need for outcome (competence) descriptors. *Pharmacy (Basel)*, **5**(1), 7. <https://doi.org/10.3390/pharmacy5010007>
- Stupans, I., Atkinson, J., Meštrović, A., Nash, R., & Rouse, M. J. (2016). A shared focus: comparing the Australian, Canadian, United Kingdom and United States pharmacy learning outcome frameworks and the global competency framework. *Pharmacy (Basel)*, **4**(3), 26. <https://doi.org/10.3390/pharmacy4030026>
- Taber, K. S. (2018). The use of Cronbach's alpha when developing and reporting research instruments in science education. *Research in Science Education*, **48**(6), 1273–1296. <https://doi.org/10.1007/s11165-016-9602-2>
- van Mil, J. W., Schulz, M., & Tromp, T. F. (2004). Pharmaceutical care, European developments in concepts, implementation, teaching, and research: A review. *Pharmacy World & Science*, **26**(6), 303–311. <https://doi.org/10.1007/s11096-004-2849-0>
- Zeenny, R. M., Akel, M., Hajj, A., Sacre, H., Hallit, S., & Salameh, P. (2021). Descriptive assessment of graduates' perceptions of pharmacy-related competencies based on the Lebanese pharmacy core competencies framework. *Pharmacy Practice (Granada)*, **19**(2), 2320. <https://doi.org/10.18549/PharmPract.2021.2.2320>
- Zeitoun, A., Sacre, H., Hallit, S., Zeenny, R. M., Sili, G., & Salameh, P. (2020). Clinical preceptor competencies for a better pharmacy education: A suggested framework for Lebanon. *Journal of Pharmaceutical Policy and Practice*, **13**, 21. <https://doi.org/10.1186/s40545-020-00217-3>