

Comparison of the clinical pharmacy curriculum of the China Pharmaceutical University with those of three universities in three foreign countries

Yan Chen^{1,2,#}, Han-Han Li^{1,#}, Xuan Zhu³, Charles D. Sands⁴, Tetsumi Irie⁵, Ju-Yeun Lee⁶ and Chang-Qing Yang^{1,*}

¹Department of Clinical Pharmacy, School of Basic Medicine and Clinical Pharmacy, China Pharmaceutical University, Jiangsu Province, P.R. China

²Affiliated Hospital of Zunyi Medical University, Guizhou Province, P.R. China

³School of Pharmaceutical Sciences, Xiamen University, Fujian Province, P.R. China

⁴Former Dean at the College of Health Sciences, Samford University, Alabama, USA

⁵Department of Pharmaceutical Packaging Technology, Faculty of Life Sciences, Kumamoto University, Kumamoto, Japan

⁶Department of Pharmacy, College of Pharmacy and Research Institute of Pharmaceutical Sciences, Seoul National University, Seoul, Republic of Korea

[#]These authors contributed to this paper equally.

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*Corresponding author

School of Basic Medicine and Clinical Pharmacy, China Pharmaceutical University, 639 Longmian Avenue, Jiangning District, Nanjing City, Jiangsu Province, P.R. China
E-mail: 1020102186@cpu.edu.cn

ABSTRACT

The paper summarized clinical pharmacy programs at China Pharmaceutical University, Samford University, Kumamoto University, and Seoul National University based on three key domains: training objectives, curriculum, and pharmacy practice experience. The curriculum offered at China Pharmaceutical University more meets the requirements of Accreditation Council for Pharmacy Education standards for the Doctor of Pharmacy program than Kumamoto University and Seoul National University, but more attention should be paid to active learning, curriculum integration, and engagement with stakeholders and education policymakers to drive further improvement.

Key words: clinical pharmacy, undergraduate education, curriculum, pharmacy practice experience, comparison

1. Introduction

A well-established clinical pharmacy education is the crucial prerequisite for nurturing high-quality pharmacists for society. Based on the Accreditation Council for Pharmacy Education (ACPE) standards (Accreditation Council for Pharmacy Education; ACPE, 2015), the Doctor of Pharmacy (Pharm.D.) program developed in the United States as the sole professional practice degree for pharmacy in 1997 has become a scientific, rigorous and standardized pharmaceutical curriculum pattern (Commission to Implement Change in Pharmaceutical Education, 1993a, 1993b). It provides an invaluable reference for countries to learn from established best practice.

The 6-year clinical pharmacy program in Japan was formally implemented in 2006, and only graduates of the program are qualified to take the National Pharmacist Exam (Inoue, 2007). Similarly, since 2013 the Japan Accreditation

Board for Pharmaceutical Education has been responsible for evaluating and accrediting universities that offer the 6-year clinical pharmacy program to ensure the quality and healthy development of clinical pharmacy education (Japan Accreditation Board for Pharmaceutical Education, n.d.).

The clinical pharmacy program in South Korea was initiated by the Ministry of Education and Human Resources Development in August 2005 and was fully implemented as a 6 (2+4)-year clinical pharmacy program in 2011 (Yoo et al., 2014). However, the emergence of issues such as the weakening of basic disciplines and the proliferation of private education for pharmacy education eligibility test has attracted educators' attention. The Pharmaceutical Education Association transformed the "2 + 4" year system to an integrated 6-year program in 2022 to ensure global competitiveness (Korean Association of Pharmacy Education, n.d.).

Clinical pharmacy education in China is different from that in the United States, Japan, and South Korea. First of all, since the 1990s, the pharmaceutical industry in China has developed rapidly, and the types of drugs have greatly increased. There is a big gap between doctors' clinical optional drugs and their own knowledge of rational drug use, and the problems of adverse drug reactions and medication errors have increased, which has threatened the safety of patients' medication. Pharmacists are required to participate in clinical drug use decision-making from traditional drug allocation to promote rational drug use. Secondly, since 1960, clinical pharmacy in the United States has been gradually systematized. After joining the WTO, the medical system in China has gradually been in line with international standards, and it has become an inevitable choice to learn from international experience and promote the development of clinical pharmacy. In addition, in 2002, the Ministry of Health of China promulgated the Interim Provisions on Medical Institutions, which proposed the establishment of a clinical pharmacist system for the first time, and defined the responsibilities of pharmacists in clinical medication. In addition, with the improvement of public health awareness, patients have higher and higher requirements for the quality of pharmaceutical services, and there is a lack of professional clinical pharmacists. Therefore, the establishment of a five-year clinical pharmacy specialty in 2006 is the result of policy promotion, medical system reform, international experience and other factors. China needs pharmacists who are committed to public health and promote safe and rational drug use. To meet the development needs of medical and health services, the Ministry of Education of the People's Republic of China officially approved the establishment of the first 5-year clinical pharmacy program at CPU in 2006, and since 2012, colleges and universities of pharmacy in China were required to extend their B.S. clinical pharmacy program with 5 years. To evaluate our early curriculum, we compared the curriculum of our university with that of Samford University (SU) based on the ACPE 2007 standards in 2014. The results showed that our curriculum needed improvement in areas such as course types and teaching approaches (Madiha et al., 2014). This promoted the curriculum reform from discipline-oriented curriculum to the Outcome-Based Education oriented curriculum in 2016. Moreover, CPU led the development of the National Standard of Clinical Pharmacy Teaching Quality in 2018. Compared with the American ACPE 2015 standards, there are some deficiencies in the core curriculum, student achievement evaluation and clear responsibilities of the administrative leadership team (Abdelrahman et al., 2019).

There is no Pharm. D. as a professional degree in China, Japan and South Korea. After graduating from a six-year pharmacy course in Japan and South Korea or a five-year clinical pharmacy course in China, the student will be awarded a Bachelor of Pharmacy degree. The six-year

pharmacy education or the five-year clinical pharmacy education in the three countries aims to train pharmacists with advanced skills in line with the increasing sophistication of medical technology and the development of the separation of medical and pharmaceutical practice. The situation differs from country to country, but the aim of training pharmacists is the same in clinical pharmacy education. In international comparison, obvious differences in the structure of clinical pharmacy education can be observed, typically attributed to varying conditions or restrictions brought by different developmental processes in different countries (Supapaan et al., 2019). Currently, fifty-seven colleges and universities in China offer clinical pharmacy education. However, varying levels of education for clinical pharmacy are noticed in different colleges and universities (Li et al., 2023). Additionally, there has been no evaluation of the effectiveness of the reform of clinical pharmacy program at CPU in 2016. This inspires us to analyze issues from different perspectives and understand various clinical pharmacy programs through comparisons aimed at drawing on others' strong points to overcome our own weaknesses.

According to the ACPE 2015 standards, the present study is a curriculum-based comparison of clinical pharmacy programs between CPU, SU, Seoul National University (SNU, South Korea), and Kumamoto University (KU, Japan) to identify future recommendations for clinical pharmacy curriculum improvement in CPU [CPU and SNU are leading universities in pharmacy education in their respective countries. KU is a national university in Japan and hosted the 8th Annual Meeting of the Japanese Society for Pharmaceutical Education in 2023, significantly contributing to pharmaceutical education in Japan. In addition, KU has been selected as one of four universities to receive funding from the Ministry of Education, Culture, Sports, Science and Technology's 2023 University Education Revitalisation Strategy Promotion Fund 'Support for Initiatives in Advanced Pharmaceutical Education Responding to Regional Medical Needs.' SU is a private comprehensive university in the United States, and proposed the establishment of the Asian Conference on Clinical Pharmacy (ACCP) in 1997, highlighting SU's influence in the development of clinical pharmacy. In addition, all four universities have national accreditation in their respective countries, ensuring their programs meet certain quality standards.]. We attempted to obtain information regarding training objectives, curriculum contents, teaching approaches, assessment of learning and pharmacy practice experience (PPE) to compare and evaluate these programs. In addition, there are five-year clinical pharmacy programs in Pakistan award graduates Pharm.D. degrees (Khan, 2011). By comparison, we tried to assess the possibility of CPU to build a 5-year Pharm D. program.

2. Comparison of Four Clinical Pharmacy Programs

2.1. Data and Method for Comparison

Program information was collected from each university's website, then three basic domains including training objectives, curriculum and pharmacy practice experience were evaluated and descriptively analyzed via in-depth discussions with investigators from four universities. Finally, recommendations for improving the clinical pharmacy program in CPU are outlined.

2.2. Overall Framework of Clinical Pharmacy Programs

There is little difference in the overall framework of clinical pharmacy programs among the four universities as shown in Figure 1. In the early stage of the curriculum, courses were designed to help students build a solid foundation of basic knowledge and develop professional awareness. Then there will be an involvement in Basic Biomedical Sciences, Pharmaceutical Sciences and Clinical Sciences with Introductory Pharmacy Practice Experience (IPPE) interspersed, and the full-time Advanced Pharmacy Practice Experience (APPE) with different structures among universities allows students to strengthen their knowledge in pre-APPE courses. However, each program has its own characteristics in practical implementation. For example, the clinical pharmacy program at CPU, like most undergraduate programs in China, is a five-year bachelor-degree program.

Students at KU are assigned to research laboratories from year three with the goal of training pharmacists with a scientific mindset. Unlike at CPU, graduates of KU and SNU are qualified to take the pharmacist license exam, and can directly apply to pursue their Ph.D.

The mission of clinical pharmacy education in CPU is to prepare pharmaceutical care-oriented professionals who possess fundamental knowledge, basic theories and basic skills of clinical pharmacy, and have innovative thinking capability and the ability to promote rational drug use. Similarly, the Pharm.D. program at SU is designed to create graduates that are "Team and Practice Ready". The school is dedicated to "nurturing and preparing persons within a Christian environment to be exemplary pharmacists and to improve health worldwide through innovative pharmacy practice, scholarship, and service" (Samford University, n.d.). The clinical pharmacy program at KU aims to "cultivate highly-qualified pharmacists who are leaders in drug therapy in advanced medical care, and clinical researchers involved in the prevention and treatment of diseases, and it is mainly from the standpoint of medical and hygiene-related social pharmacy while encouraging humanity, flexibility in a social situation, and ethics in medicine when teaching students applied science" (School of Pharmacy, n.d.). The training objective of the integrated 6-year clinical pharmacy program at SNU is to develop innovative pharmaceutical researchers who can lead the entire cycle of new drug development

University	1st	2nd	3rd	4th	5th	6th	Degree	National licensing exam		
CPU	Culture(Primary subject, Liberal Arts, Foreign language...)		IPPE	IPPE	APPE	N/A	Bachelor	N/A		
	Intro to specialty	IPPE	Major subject	Major subject						
		Major subject								
SU	Culture(Primary subject, Liberal Arts...)		IPPE	IPPE	IPPE	APPE	Pharm.D.	Required		
					Capstone courses					
	Pre-pharmacy curriculum		Major subject	Major subject	Major subject	Major subject				
KU	Culture(Basic seminar, Primary subject, Liberal Arts, Foreign language...)		Graduation research work and Laboratory assignments						Bachelor	Required
			Lab experiments	IPPE		APPE				
				PhCAT						
	Intro to specialty	Lab experiments	Major subject	Major subject		Advanced pharmaceutical education				
	IPPE									
Major subject	Major subject					Major subject				
SNU	Culture(Basic seminar, Primary subject, Foreign language...)		Lab experiments	IPPE	APPE	APPE	APPE	Pharm.D.	Required	
				Lab experiments						
			Intro to specialty	Major subject	Major subject	Major subject				Major subject

Figure 1. The Overall Framework of Clinical Pharmacy Programs in Four Universities.

CPU: China Pharmaceutical University; SU: Samford University; KU: Kumamoto University; SNU: Seoul National University; IPPE: Introductory Pharmacy Practice Experiences; APPE: Advanced Pharmacy Practice Experiences; PhCAT: Pharmaceutical Common Achievement Tests. Major subject: Courses that are strongly related to PCOA content areas; Lab experiments: Relevant teaching activities that students can enter the laboratory and participate in the front line of research work with the help of mentorship system.

and pharmacy talents who can contribute to the future advancement of pharmaceutical care and pharmaceutical industry based on pharmaceutical professional knowledge (College of Pharmacy, n.d.).

The training objective of the CPU is similar to SU. Both of them are committed to delivering excellent service-oriented pharmaceutical skills for the clinical setting. Both KU and SNU place significant emphasis on developing students' research skills in clinical pharmacy education.

2.3. Curriculum Contents

The course lists and credits for each area in the four universities are presented in Table 1 and Figure 2. Based on the Pharm.D. program at SU, the clinical pharmacy programs of the other three universities include two parts: pre-pharmacy and professional education. The pre-pharmacy credit requirements at SU and CPU are significantly higher than those at KU and SNU. According to the American National Association of Boards of Pharmacy, the didactic courses in the four programs are classified as “Basic Biomedical Sciences, Social/Behavioral/Administrative Sciences, Pharmaceutical Sciences and Clinical Sciences” (ACPE, 2015; National Association of Boards of Pharmacy, 2016).

The SU clinical pharmacy program established according to ACPE standards has the highest credits in Clinical Sciences, but credits for Basic Biomedical Sciences are lower than those in the other three universities. Credits in Basic Biomedical Sciences in CPU are twice as high as those in SU, but credits in other areas in both universities are similar. KU has the fewest credits in Social/Behavioral/Administrative Sciences. These differences may also be related to the credit systems of various universities. SNU attaches great importance to Pharmaceutical Sciences, which has 96 credits. Additionally, credits in Social/Behavioral/Administrative

Sciences and Basic Biomedical Sciences are also the highest. Finally, the total credits required for graduation from clinical pharmacy programs in four universities are 216 for SU, 206 for CPU, 193 for KU and 211 for SNU.

Considering the proportion of the content areas as shown in Figure 3, the Pharm.D. program at SU meets the requirements of the National Association of Boards of Pharmacy. The curriculum at CPU is insufficient in the Social/Behavioral/Administrative Sciences. In contrast, KU has a large proportion of Basic Biomedical Sciences. Pharmaceutical Sciences are fully emphasized in the clinical pharmacy curriculum at SNU.

2.4. Teaching Approaches

As shown in Figure 4, the concept of active learning (AL) permeates the whole instructional process of the Pharm.D. program at SU, such as problem-based learning and team-based learning, with the percentage of time devoted to AL dependent upon the adaptability of the course material to these learning methods. In each professional year, students are divided into groups of four to nine students, and group work is periodically assigned to them. The horizontally and vertically integrated approaches including *Integrated Pharmacy Lab* courses and layered learning are intended to make learning interesting and relevant for students. At CPU, traditional lecture-based instruction prevails in didactic courses, but methods like case-based study and role-play teaching are also increasingly applied. AL is also adopted in the educational process at KU. The implementation of online-based lectures, simulations, experiential practice, and project-based learning will promote students' understanding and consolidation of knowledge and contribute to a comprehensive capacity-building experience. Teaching approaches at SNU are similar to those at KU with the combination of didactic lectures and AL.

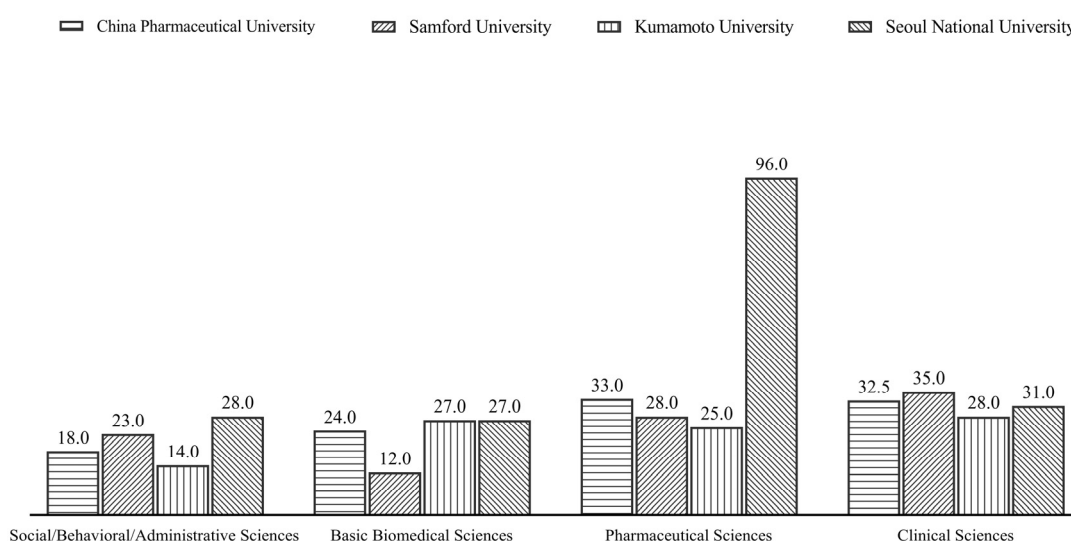


Figure 2. The Credit Distribution of Four Content Areas in the Clinical Pharmacy Programs.

Table 1. Comparison of Courses Taught in Clinical Pharmacy Programs from Four Universities.

	China Pharmaceutical University	Samford University	Kumamoto University	Seoul National University
Other Graduation Requirements	Pre-Pharmacy (73)	Pre-Pharmacy (70) Advanced Elective (2)	Pre-Pharmacy (57) Graduation Research (12) Pre-graduation Summary Course (1)	Pre-Pharmacy (44) Global Colloquium of Multidisciplinary Pharmacy (1) Integrated Approaches for New Drug Development (3) Research Rotations in Pharmacy (I-II) (3)
Social/ Behavioral/ Administrative Sciences	Introduction to Clinical Medicine (2), Introduction to Pharmacy (1), Doctor-Patient Communication Skills (2), Medical Ethics (2), Pharmaceutical Administration (2), Introduction of Pharmaceutical Care (2), Medical Information Technology (2), Pharmacoeconomics (3), Pharmaceutical Commodity (2)	Foundations of the Pharmacy Profession (4), Professional Development & Wellness (4), Ethics in Healthcare & Christianity (2), Pharmacy Financial Mgmt. & Pharmacoeconomics (2), Pharmacy Law (2), Human Resource Mgmt. for Pharmacy (1), Capstone Module Courses (6), Applied Pharmacy Research and Service (1), Intro. to Applied Pharm Research & Service (1)	Introduction to Pharmacy (3), Medical Ethics (3), Introduction to General Skill (1), Pharmaceutical Statistics (2), Pharmaceutical Law (1), Regional Pharmacy (2), Medical Economics (2)	Seminars for First-year Pharmacy Students (1), Introduction to Pharmacy (1), Ethics in Pharmaceutical Affairs (1), Humanity and Literature in Pharmacy (2), Artistic Inspiration in Pharmacy (1), Communication in Pharmacy Research and Practice (2), Critical and In-depth Analysis in Pharmacy (2), Leadership in Pharmacy (2), History of Drug Discovery and Development (3), Introductory to Clinical Pharmacy (2), Pharmacopeia and Pharmaceutical Manufacturing Quality Control (3), Regulations in Pharmaceutical Affairs (2), Pharmacoeconomics (2), Health Promotion and Pharmacist (2), Pharmacy Management (2)
Basic Biomedical Sciences	Human Anatomy (3), Physiology T/P* (4.5), Pathophysiology T/P (3), Medical Biochemistry T/P (5.5), Medical Microbiology & Immunology T/P (5.5), Molecular Biology T/P (2.5)	Integrated Biomedical Sciences (I-IV) (12)	Introduction to Anatomy and Physiology (2), Biochemistry (6), Molecular Biology (2), Pathophysiological Anatomy (2), Immunology (2), Microbial Chemistry (4), Developmental Biology (2), Bio-functional Chemistry (2), Biological Laboratory (I-V) (5)	Biochemistry (5), Human Anatomy (2), Cell Biology and Genetics (2), Human Physiology (2), Immunology (2), Human Pathology (5), Pharmaceutical Microbiology (4), Data Sciences in Pharmacy (3), Applied Statistics in Pharmacy (2)
Pharmaceutical Sciences	Pharmacology T/P (4.5), Medicinal Chemistry T/P (4), Chinese Traditional Medicine Identification (0.5), Pharmaceutics T/P (3), Pharmaceutical Analysis T/P (3), Biopharmaceutics T/P (3), Pharmacogenomics and Genetics T/P (1.5), Molecular Pharmacology (2), Fundamentals of Chinese Medicine (4), Pharmacognosy T/P (2.5), Food Nutrition (2), Pharmacotoxicology T/P (3)	Drug Delivery Systems (I, II) (5), Pharmaceutical Calculations (2), Intro. to Applied Science & Pharmacotherapy (3), Pharmacy Informatics (1), Pharmacokinetics & Pharmacogenomics (3), Sterile Products (1), Integrated Pharmacy Lab(I-VI) (11), Didactic Elective (2)	Introduction to Pharmacology (2), Pharmacology (6), Pharmacognosy (2), Pharmaceutics (4), Radiochemistry (2), Natural Medicine Chemistry (2), Pharmaceutical Engineering (4), Toxicity /Environmental Pharmacy (2), Chemical Laboratory (III) (1)	Physical Pharmacy (5), Pharmaceutical Organic Chemistry (5), Medicinal Plant (3), Fundamentals of Pharmacognosy (3), Pharmaceutical Analysis (5), Practical Laboratory in Pharmaceutical Research (8), Pharmaceutical Synthetic Chemistry (3), Pharmacology (5), Fundamentals of Pharmaceutics & Pharmacokinetics (3), Preventive Pharmacy (5), Applied Pharmacognosy (2), Pharmaceutical Molecular Biology (3), Synthetic Approach for Drug Pharmacophore (2), Medicinal Chemistry (5), Natural Medicines (2), Nutraceuticals and Cosmeceuticals (3), Toxicology (3), Biopharmaceutical Analysis (3), Drug Delivery (3), Introduction to Bioactive Natural Products (3), Biopharmaceutics (4), Practical Drug Synthesis (3), Natural Products Chemistry (3), Personalized Pharmaceutics (3), Molecular Cancer Biology (3), Introduction to Pharmacogenomics (3), Veterinary Pharmacy (2), Principles of Drug Development (2), Modern Herbal Medicine (2)
Clinical Sciences	Clinical Pharmacotherapy T/P (I, II, III, IV) (11.5), Diagnostics (3), Adverse Drug Reaction and Pharmacovigilance (2), Clinical Pharmacology T/P (4), Clinical Pharmacokinetics T/P (3), Pharmaceutical Practice Methods (4), Hospital Pharmacy (2), Pharmaceutical Information Retrieval (1), Medical Psychology (2)	Pharmacist Patient Assessment (1), Applied Science & Pharmacotherapy (I, II, III, IV, V, VI, VII) (28), Applied Biostats & Drug Literature Eval (1), Nonprescription Medicines (4), Professional Activities & Competencies Evaluation (1)	Information management (2), Clinical Psychology (2), Health Pharmacy (4), Clinical Examination (2), Pharmacotherapy (I, II, III, IV) (8), Pharmaceutical Information Management (2), Introduction to Traditional Chinese Medicine (2), Tumor Therapeutics (1), Clinical Pharmacokinetics (1), Nursing (1), Drug prescription (1), Introduction to Pharmacopoeia (2)	Pharmacotherapy and Lab: Cardiovascular and Respiratory Disorders (3), Clinical Pharmacokinetics and Pharmacodynamics (3), Applied Pharmacokinetics & Biopharmaceutics (2), Health and Pharmaceutical Systems Science (3), Clinical Pharmacology (3), Pharmacotherapy and Lab: Endocrine and Oncology Disorders (3), Pharmacotherapy and Lab: Gastrointestinal and Bones & Joints Disorders (3), Pharmacotherapy and Lab: Immunologic and Dermatologic Disorders (3), Pharmacotherapy and Lab: Infectious Diseases and Kidney Disorders (3), Pharmacotherapy and Lab: Psychiatric Neurological and Genitourinary Disorders (3), Pharmaceutical Care for Special Population (2)

Pre-pharmacy: courses include primary subjects, liberal arts and others about general education; T/P*: Theoretical/Practical.

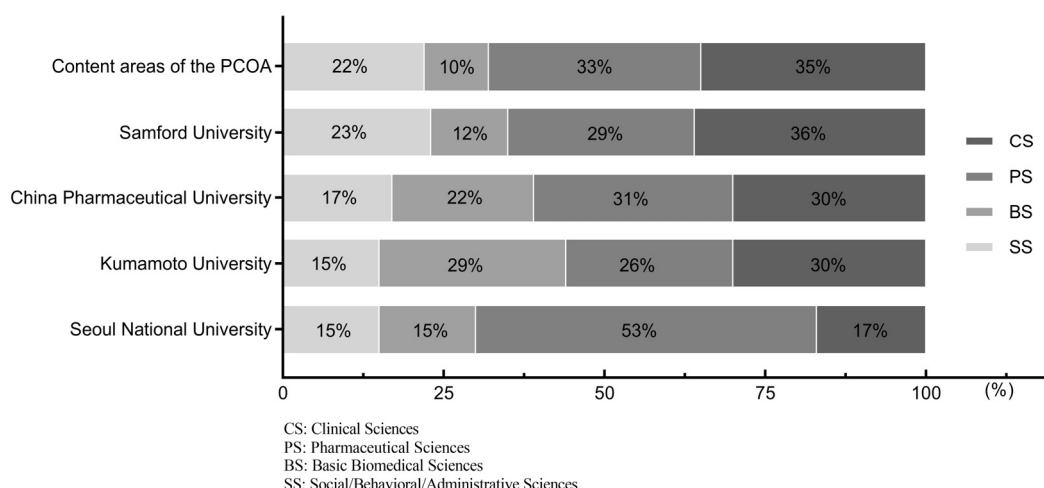


Figure 3. The Proportion of Four PCOA Content Areas in Clinical Pharmacy Programs.

PCOA: The Pharmacy Curriculum Outcomes Assessment (PCOA) is an assessment tool developed by the National Association of Boards of Pharmacy as an external measure of student performance in the Doctor of Pharmacy curriculum. The assessment spans four content areas, including Basic Biomedical Sciences (10% of the assessment), Social/Behavioral/Administrative Sciences (22% of the assessment), Pharmaceutical Sciences (33% of the assessment), and Clinical Sciences (35% of the assessment).

		China Pharmaceutical University	Samford University	Kumamoto University	Seoul National University
Teaching approaches	Didactic lectures	○	○	○	○
	Group discussion	○	○	○	○
	Practical training	○	○	○	○
	Case-based study	○	○	○	○
	Problem-based learning		○	○	○
	Role-playing teaching	○	○	○	○
	Simulation	○	○	○	○
	Interprofessional education		○	○	
	Collaborative teaching		○	○	○
	Layered learning		○		
Assessment of learning	Traditional exams	○	○	○	○
	Student Portfolio		○	○	
	Formative assessment	○	○	○	
	Performance assessment	○	○	○	○
	Essays/Reports	○	○	○	○
	Presentation	○	○	○	○

Figure 4. Comparison of Teaching Approaches and Assessments among the Four Programs.

2.5. Assessment of Learning

In conjunction with traditional methods, students at SU must create their portfolios following the instructions and information provided by the School of Pharmacy from year 1. After adding various course items into their portfolio, the portfolio may be read by faculty, preceptors, and/or alumni who provide feedback and advice to the students. Learning assessment of CPU students includes conventional formative and summative assessment methods such as tests, midterm

exams, course participation, homework (experiments) and a final exam, while practical examinations occur only in laboratory courses and simulated pharmacy. During the clinical rotation, the paper portfolios that students are required to complete are considered reference documents for completing the rotation. The final grade for each course at KU depends on the quiz, report, discussion, course participation and final exam. A unique e-portfolio system similar to that of SU has been constructed. Class instructors deliver comments and feedback on student-submitted

reports and materials and all faculty members can track the growth of individual students from their first year. At SNU, grades are determined by exams, classroom activities, and assignments during the semester (Figure 4).

2.6. Pharmacy Practice Experience

As outlined in the ACPE standards, PPE comprises two phases: IPPE, in which students intentionally develop a clear understanding of what constitutes exemplary pharmacy practice, and APPE which introduces students to a variety of practice settings and helps them gain in-depth experience in delivering direct continuous patient care. The PPE implementation processes at four universities are illustrated in Figure 5.

2.6.1. Simulation for IPPE

The Experiential Learning and Simulation Center in the College of Health Sciences (SU) utilizes the most sophisticated technology available to provide both undergraduate and graduate students with a safe yet realistic environment to develop their clinical skills, especially for interprofessional practice. To promote an understanding of the job content and functioning of clinical pharmacists in health care settings and to master certain pharmaceutical service skills on campus, fourth-year clinical pharmacy students at CPU are required to complete 51 hours (3 credits) of practical training in a simulated pharmacy, which

includes eight modules: traditional pharmacy practice, physical assessment, cardiopulmonary resuscitation, medication information service, patient education services, pharmaceutical care for COPD patients, pharmacy intravenous admixture services, and therapeutic drug monitoring service (Li et al., 2019). Similarly, KU students are required to complete a two-month experience in the simulated pharmacy during their fourth year. KU's simulated pharmacy replicates the real-life settings of hospital and community pharmacies. The training content primarily covers patient interview, drug dispensing, physical examination, prescription audit, aseptic technique and medication instruction. There is a comparable simulated pharmacy and pharmaceutical factory that serves as preparatory practice sites for practical training in SNU, which aims not only to prepare pharmacists in clinical rational drug use but also to develop pharmaceutical experts.

2.6.2. Assessment of APPE readiness

At SU, the Objective Structured Clinical Examination (OSCE) is integrated into the teaching process of the Pharm.D. program. And in the summer of the fourth year, students will complete the comprehensive Professional Activities and Competencies Evaluation course to ensure they demonstrate skills and other learning acquired during APPE. The Pharmaceutical Common Achievement Test (PhCAT) which consists of Computer-Based Testing (CBT)

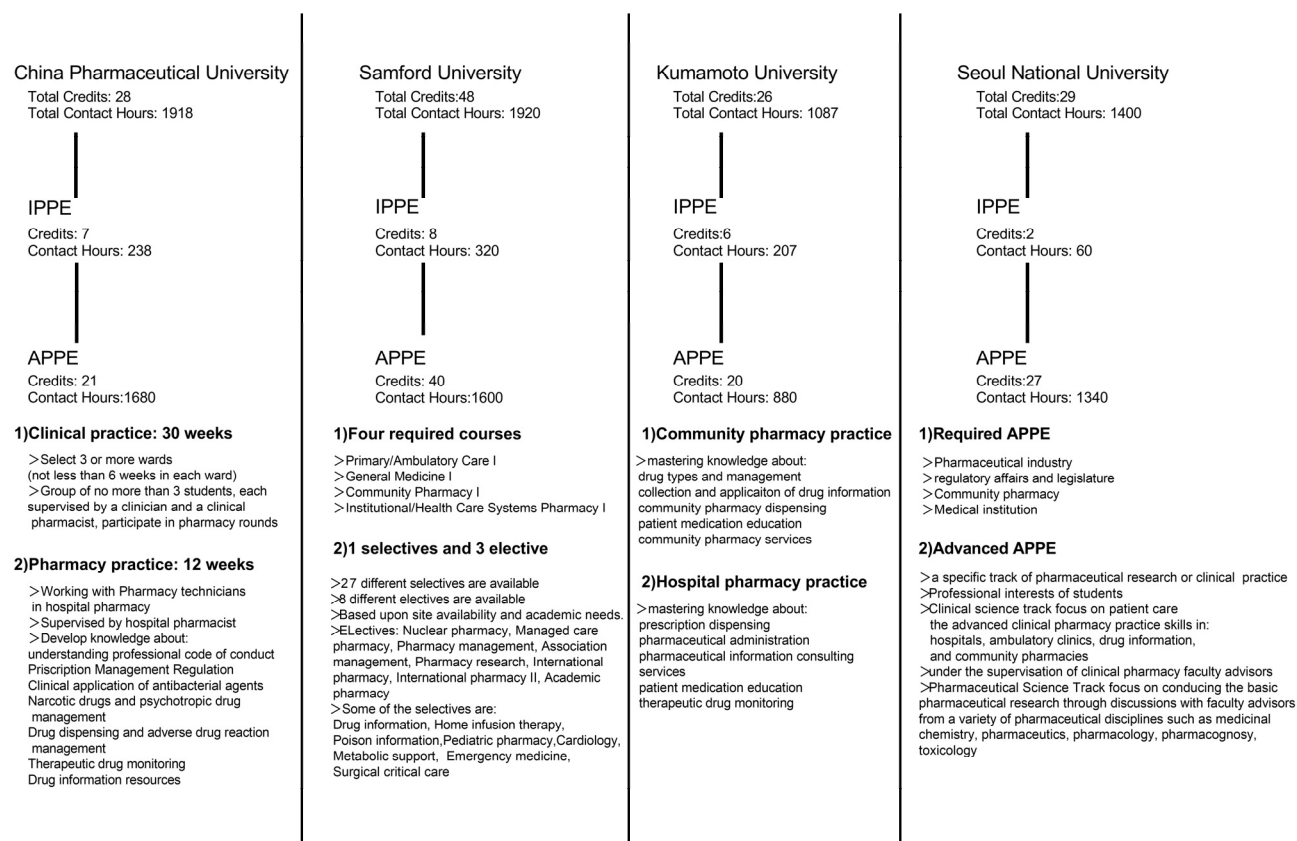


Figure 5. Comparison of Pharmacy Practice Experience among the Four Programs.

and OSCE can help confirm whether students in KU have the necessary capabilities and attitudes to develop clinical practice before embarking on long-term training. The content of CBT involves comprehensive pharmaceutical knowledge to assess the knowledge base and problem-solving skills of students. OSCEs are utilized to evaluate students' practical skills and attitudes following their participation in simulated pharmacy. Students can start clinical training after achieving a passing grade. However, CPU has not yet implemented OSCE for clinical pharmacy training. The OSCE was just introduced to SNU until 2022. Currently, there are no relevant methods to evaluate whether students meet or exceed the criteria of basic knowledge, skills and attitudes required of clinical pharmacy students.

2.6.3. Pharmacy practice experience

IPPE is early exposure experience before finishing didactic lecture and related courses. It occurs each didactic year at SU and offers students the opportunity to apply their knowledge in real patient care. The professional pharmacy curriculum requires 40 credits of APPE which start in the spring of the third year and continue throughout the fourth year. Eight APPE courses including four required courses, three electives and one selective must be completed by all students. There are 8 electives and 27 selectives available for students to choose based on their interests, site availability and academic needs. The pharmacist-preceptor is responsible for supervising and monitoring the implementation of APPE to ensure the quality of practice.

At CPU, standardized IPPE such as hospital trainee and retail pharmacy internships is carried out annually to introduce students to the clinical responsibilities of pharmacists. In the final year, APPE, which is implemented in cooperation with different hospitals, is divided into pharmacy practice and clinical practice. Three or more clinical departments are selected for clinical practice with no more than three students in each department under the supervision of clinical pharmacists and clinicians. Respiratory medicine, cardiovascular medicine and endocrinology medicine are preferred. The allocation of hospitals is based on students' preferences and the availability of hospitals.

At KU, *Early Experiential Learning* in the first year may be designed to enhance the acceptance and effectiveness of APPE. During the fifth year, qualified students undergo approximately five months of clinical training including one month on campus and a long-term participatory clinical training experience at a hospital or insurance pharmacy. High-quality training is conducted by well-trained pharmacists as instructors (certified clinical training pharmacists). During some of the clinical training periods on campus, students engage in “coordinated participatory experience with medical student clinical training (Porikuri)” to improve their ability in providing team care.

The PPE of the integrated 6-year clinical pharmacy

program at SNU includes IPPE (60 hours) and APPE (1340 hours) which comprises required APPE and advanced APPE. The IPPE is a common practice for all pharmaceutical students to master the basic knowledge and skills required to provide pharmaceutical care and develop a clear understanding of their responsibilities as a pharmaceutical care provider. However, as an indispensable part of promoting students' professional cognition, it seems insufficient that only one course named *Pharmaceutical Care and Practice* is offered on the topic of IPPE in SNU. The APPE is a professional internship for strengthening professionalism after IPPE. During the required APPE from the fourth to sixth year, students have the opportunity to learn and apply knowledge, skills and professionalism as pharmacists in various settings such as pharmaceutical industry, community pharmacy, hospital pharmacy, regulatory affairs and legislature. Advanced APPE allows students to pursue an area of emphasis within a track from the Pharmaceutical Science Track or Clinical Science Track consistent with their professional interests in the sixth year. Each track consists of a set of required learning activities and emphasizes the research foundation. This can help students develop advanced clinical skills and research abilities to function effectively in specialized pharmacy practice environments.

3. Recommendations for the Clinical Pharmacy Program in CPU

Considering the above differences among clinical pharmacy programs in four universities, Existing deficiencies and appropriate recommendations based on ACPE standards for further improvement on clinical pharmacy education in CPU are outlined as follows.

3.1. Training Objectives

Professional training objectives should address internal and external requirements. KU and SNU aim to prepare service-oriented pharmacists. Similar to Pharm.D. program at SU, the clinical pharmacy program at CPU lays emphasis on nurturing and preparing graduates who are “pharmaceutical service-oriented” as stated in ACPE standards. Just as the Eight-Star Pharmacist presented by the World Health Organization and International Pharmaceutical Federation, which states that a pharmacist is a caregiver, communicator, decision-maker, teacher, life-long learner, leader, manager and researcher (Wiedenmayer et al., 2006; World Health Organization; WHO, 1997;). However, under the background of China's medical system, pharmacists need to engage in kinds of experimental research that is conducive to the development of pharmaceutical industry and innovative drug research and development while caring out clinical work. This suggests that the CPU's training objective is partially divorced from the needs of stakeholders or society. Furthermore, the achievement and rationality of training

objectives should be regularly assessed through questionnaires or interviews involving graduates, education experts, enterprises and other stakeholders.

3.2. Curriculum Contents

3.2.1. Developing students' research abilities

To develop pharmacists with a researcher's mindset, mentorship is implemented in both KU and SNU. Students in both universities have opportunities to acquire "hands-on" experience in various aspects of research through various kinds of lab experiments. Moreover, the importance attached by the two universities to students' research ability can also be demonstrated by the credits and proportion of courses. However, there is a lack of research ability training for students at CPU, which may be unfavorable for pharmacists to meet the scientific research requirements of medical institutions in clinical work. We should learn the training pattern in KU and SNU to enhance students' research abilities.

3.2.2. Broadening the range of courses

Social/Behavioral/Administrative Sciences such as professional communication, professional attitude and occupational planning are extremely important for the career development of students. At SNU, courses including *Seminars for First-year Pharmacy Students* and *Communication in Pharmacy Research and Practice* are designed to provide the opportunity for students to learn essential communication skills through face-to-face interaction. Students have the opportunity to learn professional responsibility and leadership as pharmacists and experts in the field. Meanwhile, in *Research Rotations in Pharmacy*, students have the opportunity to explore careers in academic or basic science research based on their interests. At SU, clinical pharmacy students will participate annually in interprofessional education sessions/activities with students and healthcare providers from other institutions. They may model effective communication through case study, simulation and other methods integrated with a variety of courses. *Professional Development and Wellness* delivered from professional year 1 and *Management, Innovation, Leadership and Entrepreneurship* in year 4 at SU enable students to comprehensively recognize the difference between workplace demands and professional learning while shaping a correct view of employment. However, there are no related or similar courses at KU. Curricula on communication skills at CPU rely on lectures in a special course named *Doctor-Patient Communicating Skills* in the fourth year and lack a practicum that provides students with experience in interprofessional communication. Students can acquire basic employment skills such as resume writing in *Employment Guidance and Entrepreneurship Education*. As pharmaceutical care has become more patient-centered, there is a consensus on the great importance of effective communication among pharmacists, patients, and other healthcare providers for

optimal treatment outcomes (ACPE, 2015; Ilardo and Speciale, 2020; Medina et al., 2013). Practice courses similar to courses mentioned above is the key for communication, in which preceptors are the role model for students. In addition, if students are provided with opportunities for communication and discussion in various types of courses, it will be of great benefit to improve their communication skills. Moreover, growing demands for career planning in an increasingly competitive employment environment highlight the need for continuing professional development seminars. In addition to exploring their interests as soon as possible, students can steadily improve their knowledge and skills to meet the requirements for future career development and enhance their professional competencies. Educators should make efforts in these areas when arranging courses.

3.2.3. Promoting integration of curriculum content

The surge in courses and projects, the cultivation of students' comprehensive ability, the diversity of students and the deficiency of traditional isolated disciplinary models in connectedness among different learning experiences strongly demand elaborate curriculum scheming described as curriculum integration (ACPE, 2015; Islam et al., 2016; Pearson and Hubball, 2012). The *Integrated Pharmacy Lab* course in each semester will link information between courses in a given semester and different academic years as a method to coordinate and integrate course contents at SU. *Global Colloquium of Multidisciplinary Pharmacy* and *Integrated Approaches for New Drug Development* and the method of collaborative teaching in SNU can also benefit the integration of course content. KU and CPU lack courses related to content integration. Moreover, content repetition still exists in the teaching process of courses at CPU. This may result from insufficient communication between teaching staff and an incomplete understanding of curriculum integration and teaching objectives of each course. In response, the curriculum structure should be consistent with the training objectives. The breadth and depth of curricular content areas and deep-layer correspondence between course objectives and training objectives need to be fully explained and demonstrated through mapping such as the curriculum tree in KU or other comparable methods (Beckett et al., 2017; Pearson and Hubball, 2012). Additionally, appropriate methods, such as specialized integrated courses or teaching methods, can strengthen the integration of course content.

3.3. Teaching Approaches

The passive, lecture-based instruction characterized by delivery-acceptance contributes little to the cultivation of students' critical thinking, communication, and problem-solving ability required for clinical practice. With the reform of clinical pharmacy education, AL has become increasingly important in engaging students in teaching and facilitating the achievement of learning outcomes (Freeman et al., 2014;

Medina, 2017). AL has been effectively implemented in the clinical pharmacy programs at SU and KU. Teaching methods such as case-based discussion, group activity and debate incorporate the concept of AL at SNU. In recent years, CPU has incorporated group discussion and role-playing into *Clinical Pharmacotherapy* and *Practice Methods of Pharmaceutical Care*. Traditional teaching is conducive to systematically mastering subject knowledge. AL emphasizes inspiring students' interest and their ability to recall, build upon and apply knowledge. Reasonably balancing the proportion of traditional teaching and AL and implementing AL on a larger scale may improve students' readiness for clinical practice and the outcomes of clinical pharmacy education.

3.4. Assessment of Learning

Conventional examinations attach importance to the recognition of what students have learned. It is challenging to assess students' key competencies such as knowledge application, thinking development, problem-solving and values through this "knowledge reappear" evaluation method. The OSCE, which emphasizes the application of knowledge, is advantageous for evaluating competency in these difficult-to-assess areas. It is commonly used in clinical pharmacy curricula abroad (Martin et al., 2020). Moreover, effective two-way feedback is paramount in further developing learners by encouraging self-evaluation and reflection of students and descriptive evaluation of teachers, as exemplified by the e-portfolio developed at SU and KU. Summarily, employing a combination of quantitative methods and qualitative tools may provide a more overall picture of the knowledge and competency of students. Developing OSCEs that are valid and reliable as well as student portfolios in CPU are both challenging and resource intensive but extremely necessary. Furthermore, the formative assessment, occurring during the teaching-learning process, should be fully utilized for modifying the instructional experience timely (DiVall et al., 2014).

3.5. Pharmacy Practice Experience

a) Compared with medical institutions, community pharmacies are characterized by large quantity, wide coverage and superior convenience, making them the ideal place for pharmacists to provide pharmaceutical care. However, the current APPE offered at CPU is only a hospital-oriented experience. Lack of in-depth understanding of work in community pharmacy leads to cognitive deviation. Moreover, under the influence of Chinese traditional employment concept, few students chose to work in a community pharmacy after graduating from the clinical pharmacy at CPU. The structure of APPE should be reframed to broaden the practice domain like community pharmacy or provide elective APPE to help students explore career possibilities.

b) Participating in APPE rotations at healthcare facilities with distinct APPE plans. The quality of clinical rotations is greatly diminished by the lack of healthy and productive communication among the college, hospitals and students. The importance of maintaining direct supervision has not been emphasized, and faculty rarely visit these sites. Therefore, the content of clinical rotations and APPE plans for healthcare facilities are required to be standardized and implemented under supervision (Sales et al., 2019).

c) Core domains that students should acquire before APPE are outlined in ACPE standards. Appropriate breadth and depth of pre-APPE curriculum can promote the students' success in APPE and help them mature professionally. Additionally, several studies suggest that certain factors are correlated with APPE readiness, including overall pharmacy education knowledge, performance in didactic courses, application of content, and critical thinking (Porter et al., 2023). It is crucial for schools and colleges of pharmacy to assess student readiness prior to the first APPE and provide early intervention as needed (ACPE, 2015). The capstone experiences and OSCE are both effective strategies to help students integrate cumulative learning in preparation for APPE (Minshew et al., 2020). At SU, capstones consist of two parts: one elective providing immersive experiences for practice before APPE and capstone (Final) module courses designed to prepare and transition students to the profession after APPE. *Practice Preparation* in KU, *Practice of Clinical Pharmacotherapy* in CPU and *Pharmacotherapy and Lab* in SU serve the same purpose as capstone experiences. Moreover, prior to the APPE curriculum, not just in KU, but for all of Japan, all pharmacy students are required to complete the PhCAT. Only students who have passed the examination and confirmed their ability and attitude can enter the APPE. As APPE is a priority within clinical pharmacy education, similar readiness assessment ahead of APPE should be encouraged in clinical pharmacy education at CPU to ensure the quality of clinical practice.

3.6. Stakeholders Engaging in Education

Stakeholder is defined as "any group or individual who can affect or is affected by the achievement of the organization's objectives" (Freeman, 2010). Stakeholders in higher education are separated into two groups as internal and external stakeholders. Internal stakeholders include academic staff, administrative staff and students. External stakeholders include employers, parents, society at large and other groups or individuals who are interested in higher education but not internal stakeholders (Kuzu et al., 2013). Between these stakeholders, academic individuals as the core of scientific production and students as the direct recipients of higher education and future external stakeholders seem to be important internal stakeholders (Kuzu et al., 2013). While the purpose of education is to transport all kinds of talents for the society, external stakeholders are more aware of the

professional skills that students who will be assimilated into the society after graduation should have to meet the needs of society (Marshall, 2018). Therefore, it is very important to build cooperative partnership among stakeholders to improve the quality of higher education. Currently, government still occupy a dominant position in pharmacy education in CPU. Strengthening the speaking rights of stakeholders such as academic staff, students and employers in pharmacy education is an important measure of the follow-up education reform in CPU. It is worth considering to establish a sustainable communication mechanism among stakeholders, integrate and share resources, encourage participation and constantly evaluate improvements, so as to promote multi-party cooperation and finally strengthen the current educational framework. In this study, we have not yet compared the stakeholder engaging in clinical pharmacy education program among four universities. In order to promote reformation of the education program in CPU, further corresponding qualitative comparison needs to be implemented.

In conclusion, compared with the Pharm.D. program, what deserves to be discussed is whether it is appropriate to award the Bachelor's degrees to graduates of clinical pharmacy programs in China. The educational goal of clinical pharmacy is to prepare professionals providing pharmaceutical services, which emphasizes the development of positional competence. Establishing a program that meets the needs of the profession will help optimize clinical pharmacy education and cultivate applied talents. Although through continuous exploration and optimization of training programs, clinical pharmacy education at CPU has met the requirements of ACPE standards in this study, the following limitations of present study should also be considered: (1) the credits and hours of a course can vary among countries and schools; (2) the contents in the course of the same name can vary in the contents among schools and counties; (3) quality of practice courses which is determined by accreditation of training site and preceptors were not assessed in this study. As five-year clinical pharmacy programs, Pakistan award graduates Pharm.D. degrees. After further optimization, should the five-year clinical pharmacy Bachelor of Science (B.S.) degree in CPU be transitioned to the Pharm.D. degree?

4. Summary

Mapping and comparing the current clinical pharmacy program in CPU with those abroad enable educators to have a better overview of exploring areas for promoting the sustainability of clinical pharmacy education. Although each country has different needs for pharmaceutical education due to different backgrounds of healthcare systems, the basic structure of clinical pharmacy programs in the four universities is quite similar. However, several aspects need further improvement. For example, more attention should be paid to active learning, curriculum integration,

interprofessional education, and the introduction of new assessment approaches regarding the B.S. clinical pharmacy offered in CPU. In addition, future efforts should focus on enhancing known educational deficiencies and optimizing the educational framework. This should involve not only addressing the needs but also engaging stakeholders and education policymakers in the process.

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Ethics Approval and Consent to Participate

This study does not involve life science and medical research activities of human or animal.

Conflict of Interest

The authors declare no conflict of interest.

Abbreviations

B.S.: Bachelor of Science; Pharm.D.: Doctor of Pharmacy; CPU: China Pharmaceutical University; SU: Samford University; KU: Kumamoto University; SNU: Seoul National University; ACPE: Accreditation Council of Pharmacy Education; PCOA: Pharmacy Curriculum Outcomes Assessment.

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