The Evolution of Pharmacy Education: Navigating Modern Trends and Transformative Practices

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Libyan Int Medical Univ J 2025;10:79–85.

Abstract

The field of pharmacy is undergoing a major transformation, driven by evolving health care needs, technological advancements, and the expansion of pharmacists' roles. This review offers a comprehensive analysis of modern trends in global pharmacy education, including the shift toward competency-based education, the integration of digital technologies, the emphasis on interprofessional education, and the enhancement of experiential learning to ensure practice readiness among graduates. In this review, we also examine the increasing attention to global perspectives on pharmacy education and the emerging directions that will shape future educational approaches. We evaluate the effectiveness and challenges of the above-mentioned trends, providing a critical analysis of their impact on preparing future-ready graduates. We also examine global perspectives and future directions, and provide futuristic insights about how pharmacy education can shape the future of the health care industry. By embracing evidence-based educational pedagogies and foreseeing future challenges, we offer a prescription for helping pharmacy graduates acquire skills and adaptability necessary for better patient outcomes and the ever-changing global health care landscape.

Keywords
- pharmacy education
- curriculum development
- educational trends
- competency-based education
- interprofessional education
- technology integration
- digital health
- workforce development

Introduction

The pharmacist's role is evolving beyond merely dispensing medications toward providing direct patient care services, having public health duties, and expanding toward specialized clinical roles.[1] This transformation necessitates a similar evolution for pharmacy programs to support professionals in navigating the complexities of modern health care.[2] Therefore, conventional pharmacy educational models are no longer efficient in this mission. Shifting toward proactive experiential learning supported with technological integration is essential for practice-ready graduates, as advocated by the International Pharmaceutical Federation (FIP), in its Global Vision for Education and Workforce.[3–6] The movement toward patient-focused care, evidence-based practice, and collaborative health care models has required corresponding adjustments in the education of pharmacists.[7] Moreover, the swift advancement of technology, especially in fields such as artificial intelligence (AI), digital health, and informatics, presents both opportunities and challenges for those teaching pharmacy.[7,8] The COVID-19 pandemic further hastened many of these changes, compelling the quick adoption of remote

received
July 9, 2025
accepted after revision
September 9, 2025
article published online
December 9, 2025

DOI https://doi.org/10.1055/s-0045-1812288.
ISSN 2519-139X.

Thieme Medical and Scientific Publishers Pvt. Ltd., A-12, 2nd Floor, Sector 2, Noida-201301 UP, India

ملخص المقال باللغة العربية

تطور التعليم الصيدلي: مواكبة الاتجاهات الحديثة والممارسات التحويلية

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تشهد مهنة الصيدلة تحولاً جذرياً، مدفوعاً باحتياجات الرعاية الصحية المتطورة، والتقدم التكنولوجي، وتوسع أدوار الصيادلة. تقدم هذه المراجعة تحليلاً شاملاً للاتجاهات الحديثة في تعليم الصيدلة العالمي، بما في ذلك التحول نحو التعليم القائم على الكفاءة، ودمج التقنيات الرقمية، والتركيز على التعليم متعدد التخصصات، وتعزيز التعلم التجريبي، لضمان جاهزية الخريجين للممارسة الصيدلانية. في هذه المراجعة، ندرس أيضاً الاهتمام المتزايد بالمنظورات العالمية لتعليم الصيدلة والاتجاهات الناشئة التي ستشكل مناهج التعليم المستقبلية. نقيّم فعالية وتحديات الاتجاهات المذكورة أعلاه، مقدمين تحليلاً نقدياً لتأثيرها على تخريج خريجين جاهزين للمستقبل. كما ندرس المنظورات العالمية والاتجاهات المستقبلية، ونقدم رؤى مستقبلية حول كيفية مساهمة تعليم الصيدلة في تشكيل مستقبل قطاع الرعاية الصحية. من خلال تبني مناهج تعليمية قائمة على الأدلة واستشراف تحديات المستقبل، نقدم حلولاً فعّالة لمساعدة خريجي الصيدلة على اكتساب المهارات والقدرة على التكيف اللازمة لتحسين نتائج علاج المرضى ومواكبة التغيرات المستمرة في مشهد الرعاية الصحية العالمي.

الكلمات المفتاحية: تعليم الصيدلة، تطوير المناهج، الاتجاهات التعليمية، التعليم القائم على الكفاءة، التعليم متعدد التخصصات، تكامل التكنولوجيا، الصحة الرقمية، تطوير القوى العاملة.

learning technologies and underscoring the critical role of pharmacists during public health crises.[9–11]

Recent bibliometric studies on pharmacy education literature indicate a steady rise in research within this domain, transitioning from theoretical models to practical applications in clinical environments.[12] The global research landscape highlights substantial contributions from institutions across various continents, with notable productivity from the United States, the United Kingdom, Australia, and Canada.[12] This international viewpoint is essential as pharmacy education increasingly tackles global health issues while considering regional health care contexts.[13]

The progression and transformation of clinical pharmacy practice in different countries are influenced by facilitators and obstacles that vary significantly and are closely tied to the context. These factors include financial, regulatory, technical, attitudinal, and political elements.[12,13] Grasping these contextual elements is crucial for crafting effective educational strategies that equip pharmacists to handle the practical realities in their specific settings.

This narrative review aims to identify, discuss, synthesize, and critically evaluate the contemporary trends that are influencing the global direction of pharmacy education. By analyzing these new developments, the article seeks to offer insights into their effects on curriculum design, teaching strategies, and the readiness of future pharmacists.[12] The goal is to comprehend how pharmacy education is adapting to and can proactively tackle the evolving challenges and opportunities in the modern health care sector.[13–15]

Methods

In this review, an extensive search of the literature was performed to find pertinent articles on current trends in pharmacy education. The search strategy aimed to include peer-reviewed scientific articles that discuss recent trends, major advancements, innovations, and challenges in pharmacy education worldwide over the past 5 years, with a focus on the most recent publications released after the pandemic.

Multiple electronic databases were used, including PubMed/MEDLINE, Scopus, Web of Science, and CINAHL. The search terms included combinations of keywords such as “pharmacy education,” “pharmaceutical education,” “pharmacy curriculum,” “competency-based education,” “digital transformation,” “interprofessional education,” “experiential learning,” “professional identity,” and “pharmacy workforce development.”

Articles were included if they met the following criteria: (1) published in peer-reviewed scientific journals; (2) focused on pharmacy education at the undergraduate, graduate, or continuing professional development (CPD) levels; (3) addressed one or more modern trends in pharmacy education; (4) published in English; and (5) provided substantive insights, empirical data, or theoretical frameworks relevant to the evolution of pharmacy education.

The initial search yielded more than 200 potentially relevant articles. After removing duplicates and screening the titles and abstracts, ~100 articles were selected for full-text review. Following a thorough assessment, 39 articles were ultimately included in this review based on their relevance, methodological quality, and contribution to the understanding of modern trends in pharmacy education.

The selected articles were analyzed thematically to identify the major trends and developments in pharmacy education. The analysis focuses on identifying patterns, commonalities, and unique perspectives in the literature. Special attention was given to evidence-based educational innovations, implementation challenges, assessment strategies, and the outcomes of various educational approaches (Figures in this article are AI-generated from the article content using Napkin AI tool [https://www.napkin.ai/]).

Results and Discussion

This review is structured around seven key themes identified in the literature: competency-based education (CBE), digital transformation, interprofessional education (IPE), experiential learning, the development of professional identity, global perspectives and workforce development, and future directions. Each theme is thoroughly examined, including a discussion on current practices, challenges, and the implications for stakeholders in pharmacy education (►**Fig. 1**).

It is important to note that this narrative review, although comprehensive, is not exhaustive. The rapidly evolving nature of pharmacy education means that new developments have continued to emerge. Additionally, the review primarily reflects trends in countries with well-established pharmacy education systems, although efforts have been made to include global perspectives that are available in the literature.

Competency-Based Education in Pharmacy

The paradigm shift from a primarily knowledge-focused approach to a CBE model represents a significant advancement for pharmacy education. This change acknowledges that effective pharmacy practice demands not only theoretical understanding but also the capability to apply that knowledge in various clinical environments. A recent study describes competency-based pharmacy education as an outcomes-focused approach that incorporates modes of instructional delivery and assessment designed to evaluate mastery of learning by students through their demonstration of the knowledge, skills, values, and attitudes required for effective performance in a given profession.[16]

Gillani et al conducted an extensive analysis of CBE implementation across pharmacy schools in various countries, revealing that although adoption rates differ, there is a visible trend toward competency frameworks that prioritize clinical reasoning, patient-centered care, and professional judgment.[16] These frameworks typically delineate specific, measurable competencies that students are required to demonstrate prior to advancing through the curriculum or graduating.

Numerous models and frameworks have been created to facilitate the adoption of CBE in the field of pharmacy. Abeyaratne and Galbraith conducted a survey of pharmacy faculty to gather their views on CBE implementation, identifying several prevalent strategies such as phased competency development, entrustable professional activities (EPAs), and milestone-based advancement.[17] The research emphasized that for successful implementation, it is crucial to have faculty support, administrative backing, and alignment with accreditation standards. Al-Haqan et al expanded on this by illustrating how pharmacy schools have tailored global competency frameworks to address local requirements while still adhering to international standards.[4]

In CBE, a major challenge is designing valid and reliable assessment techniques such as objective structured clinical examinations, workplace assessments, and portfolio reviews that are increasingly utilized to assess competency achievement.[18] Abeyaratne and Galbraith delved into the use of EPAs as an assessment framework, highlighting that EPAs offer a practical method for assessing readiness for practice by concentrating on specific professional tasks that can be entrusted to students once they demonstrate competence.[17] Furthermore, Gavaza et al pointed out that maintaining a balance between standardization and the flexibility needed to address diverse learning requirements continues to be a challenge for pharmacy educators.[3] Additionally, the shift from a time-based to a competency-based progression system poses logistical and administrative difficulties for pharmacy schools. On the other hand, CBE provides the opportunity for more tailored learning experiences, clearer expectations for students, and a better alignment between educational outcomes and practical needs. It improves accountability in pharmacy education by ensuring that graduates have the necessary skills for modern practice.[5] Additionally, competency-based methods may help meet workforce demands by producing graduates who are more equipped for the changing roles of pharmacists within health care systems (►**Fig. 2**).

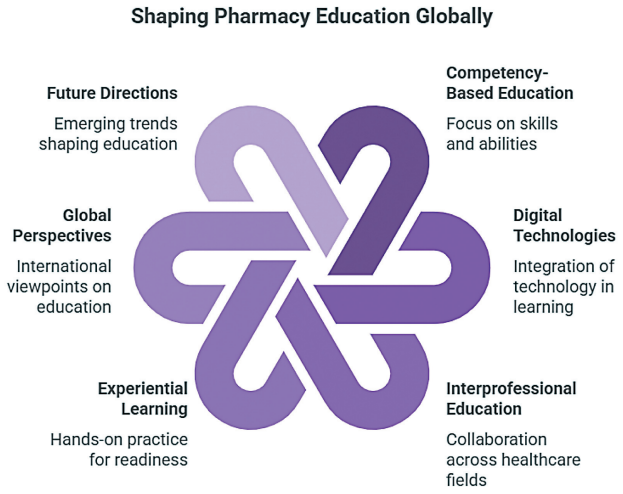

Fig. 1 Themes in pharmacy education.

Digital Transformation in Pharmacy Education

The integration of digital technologies in pharmacy education is no longer optional but essential to prepare graduates for practice in increasingly digitalized health care environments.[19] This digital transformation encompasses various elements, ranging from the adoption of technology-enhanced teaching methods to the incorporation of digital health concepts into pharmacy curricula.

In recent years, the incorporation of technology into education has accelerated, and several key technologies have become increasingly important. These include learning management systems, audience response systems, virtual patient simulations, and mobile applications for learning and assessment.[20] These tools have facilitated more interactive, adaptable, and personalized learning experiences for pharmacy students.

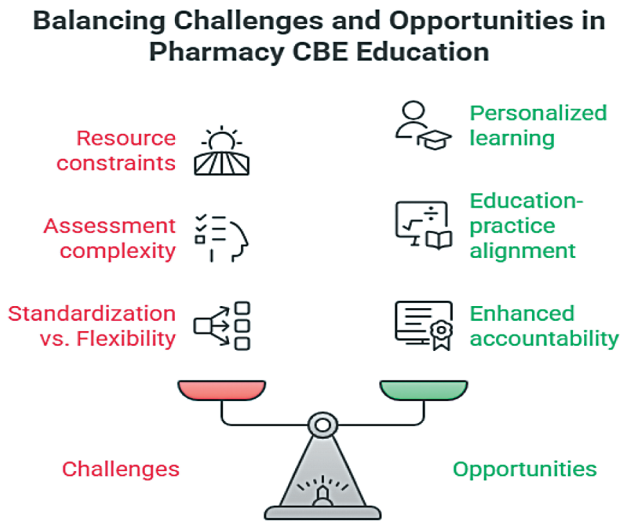

Fig. 2 Challenges and opportunities of competency-based education (CBE) in pharmacy.

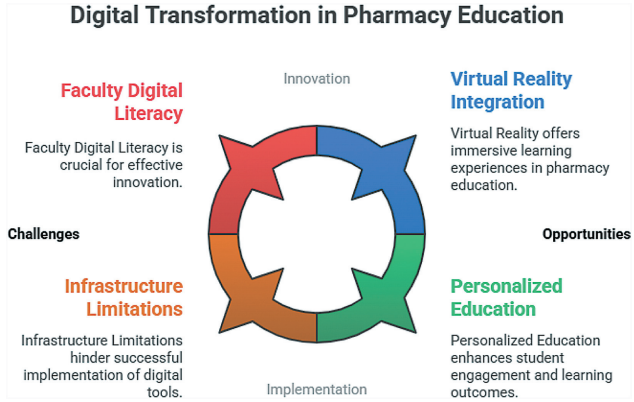

Fig. 3 Challenges and opportunities of digital transformation in pharmacy education.

Simulation and virtual learning environments have emerged as valuable tools in pharmacy education, especially during the pandemic. A study by Bartlett et al assessed the effects of simulation-based training on pharmacy students and observed notable enhancements in their clinical decision-making, communication abilities, and self-assurance.[21] These virtual settings enable students to engage in realistic scenarios without compromising patient safety, serving as a link between theoretical learning and practical application. They also improve critical thinking and problem-solving skills, which are crucial for modern pharmacy practice.[22]

AI is emerging as a highly transformative force in the realm of pharmacy education. Mortlock and Lucas investigated the roles and effects of generative AI within this field, highlighting both the potential for tailored learning experiences and the challenges related to maintaining academic integrity.[11] They stressed the necessity for pharmacy educators to keep pace with this swiftly changing technology by crafting suitable policies, revamping assessments, and instructing students on the ethical and effective use of AI tools. As AI technology progresses, its incorporation into pharmacy education is expected to grow, possibly revolutionizing the ways in which students learn, practice, and are evaluated.

Incorporating digital health literacy and informatics into pharmacy education has become crucial.[10] Kinny et al detailed the creation and assessment of a digital health elective course, emphasizing the necessity of equipping pharmacy students to handle electronic health records, telehealth systems, and digital health tools.[8] Similarly, recent studies reported on the inclusion of digital health-oriented medical devices in pharmacy training, stressing the importance of practical experience with technologies students will use in their careers.[9,10]

Although digital transformation in pharmacy education offers significant advantages, it encounters numerous hurdles. Challenges such as infrastructure constraints, faculty's digital proficiency, issues of equity and access, and the swift evolution of technology hinder its successful implementation. For pharmacy educators, it will be vital to strike a balance between technological advancements and core educational principles as they navigate this digital shift (►**Fig. 3**).

Interprofessional Education

IPE has become a fundamental aspect of contemporary pharmacy education, highlighting the growing emphasis on teamwork in health care services. IPE involves occasions when members or students of two or more professions learn with, from, and about each other to improve collaboration and the quality of care.[23] This educational strategy acknowledges that delivering effective patient care necessitates pharmacists collaborating effortlessly with doctors, nurses, and other health care professionals within integrated teams.

The rationale for integrating IPE into pharmacy education is both compelling and varied. A recent investigation into the outcomes of IPE for pharmacy students showed notable enhancements in interprofessional competence, communication abilities, and comprehension of professional roles.[24] These advantages are directly applicable in practice environments, where effective interprofessional collaboration is associated with better patient outcomes, fewer medication errors, and improved health care efficiency. Another recent study highlighted that accreditation organizations are increasingly requiring IPE as a crucial part of pharmacy education, underscoring its acknowledged significance in preparing graduates who are ready for practice.[25] IPE initiatives have been proven to be successful in enhancing teamwork abilities and mutual respect among different professions.[26] Well-structured IPE activities can break down traditional professional barriers and promote true collaboration. Therefore, they should be introduced early in the curriculum, utilizing real clinical scenarios, ensuring equal participation from all professions, and offering chances for meaningful reflection.[24]

Evaluating interprofessional competencies poses distinct challenges that pharmacy educators are actively tackling. Creating and validating a tool specifically aimed at assessing the influence of IPE on the development of pharmacy competencies such as team dynamics, role understanding, interprofessional communication, and collaborative leadership.[25]

Although IPE offers numerous advantages, its effective implementation encounters various obstacles such as

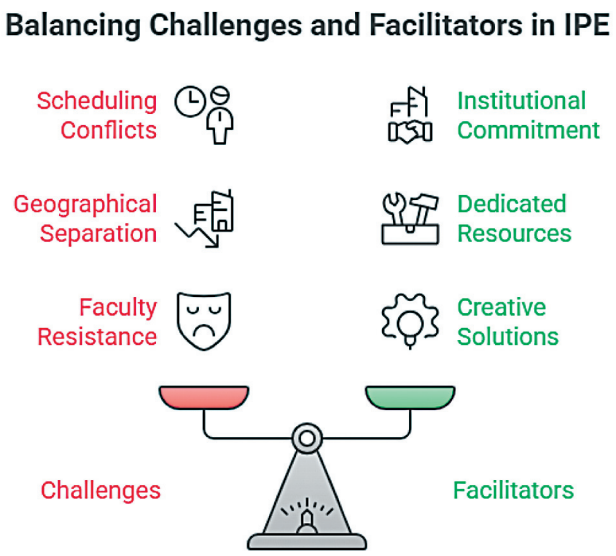

Fig. 4 Challenges and facilitators of interprofessional education (IPE) implementation in pharmacy education.

scheduling conflicts, the geographical separation of professional schools, faculty opposition, and limited resources.[14] For IPE to be successfully implemented, it requires institutional dedication, allocated resources, and innovative approaches to overcome logistical issues. Similarly, interprofessional continuing education faces distinct challenges in practice environments, where existing professional hierarchies and time limitations can hinder collaborative learning (►**Fig. 4**).[27]

The future of IPE in pharmacy programs is expected to feature more comprehensive integration across the curriculum (like a continuous thread woven throughout the fabric of pharmacy education), enhanced real-world practice experiences, and a greater reliance on technology to support interprofessional learning.[24]

Experiential Education and Practice Readiness

Experiential education has gained increasing importance in pharmacy programs globally, acting as a transition from theoretical learning to real-world practice. During these placements, students are expected to acquire tangible skills, develop their professional identity, and demonstrate readiness for independent practice.[28] This educational strategy includes various activities such as introductory and advanced pharmacy practice experiences, service learning, and simulation-based learning, all focusing on preparing pharmacy students for future practice.

The development of experiential learning models in pharmacy education mirrors the growing breadth and intricacy of the field. A survey-based study of experiential education practices at the U.S. pharmacy colleges and schools revealed a wide range of program structures, durations, and environments, and highlighted a shift toward incorporating experiential elements earlier in the curriculum rather than concentrating them solely in the final year.[29] This forward-thinking strategy enables students to gradually enhance their clinical skills while applying theoretical knowledge in practical settings. Another study stressed the significance of embedding professional identity formation within experiential pharmacy education, proposing that practice experiences should be crafted to not only hone clinical skills but also to acculturate students into their professional roles.[30]

Another vital component of experiential education is the development and support of preceptors. Although they play a pivotal role, many preceptors have minimal formal training in educational techniques and evaluation strategies. The authors suggested that comprehensive programs for preceptor development should focus on enhancing teaching abilities, feedback skills, and assessment methods to improve the quality of experiential education.[29]

Experiential education aims to prepare pharmacy graduates thoroughly. This approach includes not just clinical expertise and skills but also encompasses professional judgment, adaptability, and the capability to operate effectively in various health care settings. By offering genuine learning opportunities under the mentorship of seasoned practitioners, experiential education is crucial in shaping pharmacy students into skilled and self-assured professionals ready to address the intricate health care demands of the communities they serve.[31,32] To truly prepare pharmacy graduates for the modern pharmacy demands, a more rigorous and evidence-based approach to experiential education is required, and performance assessment is another area that requires critical attention. This should include strengthening collaborative ties between academic institutions and practice sites, investing in preceptor development programs, and implementing robust performance-based assessment to translate it into a truly transformative learning experience for students.

Global Perspectives and Workforce Development

The globalization of health care and pharmacy practice calls for more expansion in pharmacy educational programs to consider international trends, cultural contexts, and produce a diverse workforce. A qualitative study conducted recently examining global trends in clinical pharmacy practice revealed notable differences in educational strategies, practice models, and professional roles across different parts of the world.[33] Their findings emphasized that although pharmacy education is undergoing transformation, the rate and direction of these changes are influenced by cultural influences, regulatory environments, and local health care systems.

Pharmacy colleges around the world are currently aligning educational programs with workforce needs. A recent study explored new trends in pharmacy workforce research.[34] The study highlighted several significant challenges in workforce development, such as shifts in practice settings, the transformation of pharmacist roles, and the uneven distribution of pharmacists across regions.[34] The study underlined the necessity for adaptable pharmacy programs to cope with the workforce changes, and to equip graduates to work in a variety of practice environments and new professional roles. Another study investigated patterns in interprofessional continuous medical education for pharmacists, revealing that continuous professional development is

crucial for satisfying workforce competence in the ever-changing health care landscape.[27]

CPD is crucial part of lifelong learning for pharmacists. Wadelin et al explored the present and future possibilities and obstacles in continuing pharmacy education, identifying several new trends such as personalized learning paths, competency-based CPD, and the growing use of technology for professional growth.[35] The study emphasized the importance of pharmacy education to help students develop skills required for self-directed, lifelong learning by cultivating the habits necessary for continuous professional advancement. This preparation involved encouraging reflective practice in different courses, critical thinking abilities, and adaptation with various nontraditional learning methods.

Modern pharmacy education is continuously undergoing global transformation. Therefore, international organizations such as the FIP are currently playing crucial roles in setting educational benchmarks, promoting collaboration, and exchanging best practices worldwide. Al-Haqan et al highlighted the importance of FIP's initiatives in creating global competency frameworks, educational tools, and workforce development plans that can be tailored to various contexts.[4] These global efforts, along with local initiatives, drive the progress of pharmacy education globally and help prepare the pharmacy workforce to tackle complex health care issues in various settings.[12]

Conclusion and Future Directions

Pharmacy education stands at a critical moment. The emerging directions—CBE, digital transformation, IPE and collaboration, and enhanced experiential learning—are not minor adjustments but rather fundamental shifts in how we shape the future pharmacy workforce. The key task ahead is no longer just to recognize these trends, but to critically assess their outcomes, tackle the challenges of implementation, and design a sustainable roadmap for the future.

Looking forward, several themes are set to define the evolution of pharmacy education. Personalization of learning is gaining traction, driven by adaptive technologies, flexible learning pathways, and opportunities for student choice and self-directed growth. Moreover, data science integration and AI are transforming both curriculum content and teaching methodology.[36] Future graduates must be skillful in data-driven clinical decision-making, while educators will need to apply AI to enhance students' engagement and learning effectiveness.[37,38]

In summary, while the future of pharmacy education is promising, challenges are expected to be there anyway. By embracing these transformative trends with a critical and forward-thinking perspective, we can prepare graduates who are not only ready for current practice but also equipped to lead future innovations in health care. The overarching goal is to develop pharmacists who are capable of driving health system transformation and advancing the well-being of patients and communities worldwide. Achieving this vision will demand courage, creativity, and a steadfast commitment to innovation grounded in both evidence and professional values.

Conflict of Interest
None declared.

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