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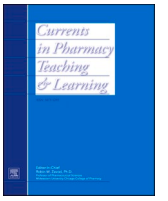

Review Article

Enhancing lifelong learning skills in pharmacy education: A scoping review of the literature

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ABSTRACT

Background: As pharmacy practice evolves with advancing therapeutics and extended scope, pharmacists must engage in lifelong learning to maintain professional competence. The International Pharmaceutical Federation (FIP) identifies three key lifelong learning behaviors: self-directed learning, reflective practice and continuous professional development. Developing these lifelong learning skills during higher education prepares students for professional practice. This review explores lifelong learning education interventions used in pharmacy schools worldwide.

Methods: A scoping review using the Sage Research Methods framework was conducted across Medline, Embase and CINAHL. Grey literature was searched applying the same search strategy using grey literature databases, Google advanced search and relevant professional pharmacy websites. The articles were screened using Covidence and included if they described a lifelong learning educational intervention targeting pharmacy students delivered in pharmacy schools.

Results: A total of 19 records (18 peer-reviewed studies and 1 grey literature source) met the inclusion criteria. Most studies were US-based, mainly involving Doctor of Pharmacy students (n = 13). Diverse formats were delivered including reflective writing interventions, capstone group projects, and simulation-based learning activities. Most interventions addressed all three lifelong learning skills, with self-directed learning the most targeted and continuous professional development the least. Most interventions were short-term and course-based, with limited innovative and long-term approaches applied. Faculty support and involvement were seen as key contributors to fostering lifelong learning culture.

Implications: This scoping review describes a variety of lifelong learning education approaches used by pharmacy schools. Future work could focus on fostering long-term approaches to the development of lifelong learning skills.

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Introduction

As pharmacy practice continually evolves and therapeutic advances are regularly introduced, pharmacists are required to develop their scope of practice and consistently update their knowledge and clinical competence to optimize patient health outcomes.[1,2] Consequently, the development of lifelong learning skills is seen as essential for pharmacists and widely accepted as a key component of pharmacy education.[2] The importance of lifelong learning is recognized across other health professions to support professional competency and enhance patient care.[3] A meta-analysis across multiple health professions (including medicine, nursing, and allied health) found that individuals' orientation toward lifelong learning increases with greater educational and professional experience, highlighting the role of lifelong learning in health-profession education.[3]

Global frameworks such as the International Pharmaceutical Federation's (FIP) Global Competency Framework and the World Health Organization's guidelines on health profession education highlight the importance of lifelong learning and competency-based development, reinforcing the need for pharmacy programs across the world to equip students with ongoing self-directed learning.[4,5] The Accreditation Council for Pharmacy Education (ACPE) - the accrediting body for pharmacists in the United States of America acknowledges that pharmacy education must change to accommodate this expectation, encouraging all pharmacy schools and colleges to foster a learning environment that equips students with the habits and skills necessary for ongoing professional development.[1,6,7] Therefore, intentional teaching strategies focused on the development of critical thinking, reflective capacity and problem-solving proficiency are strongly emphasized as part of the pharmacy curriculum standards.[1] Similarly, the Australian Pharmacy Council (APC) Accreditation Standards necessitate the integration of lifelong learning, self-directed learning, and reflective practice as essential graduate attributes across pharmacy programs.[8] The Australian Pharmacy Council (APC) Accreditation Standards for Pharmacy Programs (2022) require pharmacy curricula to ensure that graduates can engage in lifelong professional development and be responsible for professional actions (Standard 1.2 and Domain 5 – Outcome and Assessment).[8] These standards set lifelong learning as a core graduate attribute, guiding pharmacy schools to integrate self-directed learning, reflective practice, and continuing professional development (CPD) throughout the curriculum.[8] This review also evaluates how current educational interventions meet these accreditation standards.

Lifelong learning interventions will benefit students' academic progression and prepare graduates to quickly adapt to future career challenges. In this context, lifelong learning is defined as the ongoing, voluntary, and self-motivated pursuit of knowledge for continuing personal or professional development throughout a pharmacist's career.[9,10]

While lifelong learning is essential at all career stages, evidence suggests its foundational behaviors are most effectively developed during higher education, whether at the undergraduate or postgraduate level.[2] Building lifelong learning skills from early stages ensures students benefit from early exposure and constant practice, gaining confidence and becoming more disciplined before entering professional practice.[10] As students progress through their degrees, their learning often advances from surface-level to more meaning-driven approaches.[11] These deeper learning patterns are strongly associated with the development of lifelong learning habits. Educational interventions utilizing active and student-centered learning methods, such as flipped classrooms and experiential learning, have also positively influenced pharmacy students' self-regulation, motivation, and engagement.[12] In practice, pharmacists acknowledge the importance of self-directed learning yet report challenges balancing professional development with the realities of daily workload.[13] This further emphasizes the important role of pharmacy schools equipping students with lifelong learning capabilities from early stages, enabling students to carry those skills into their future professional careers.[9,14]

In pharmacy education, lifelong learning encompasses a range of self-directed learning behaviors and metacognitive skills, including self-assessment, goal setting, reflective practice and ongoing evaluation of learning needs.[15] Self-directed learning is when learners take initiative and responsibility in planning, setting goals and identifying their learning needs.[16] Reflective practice refers to the process in which students critically analyze their past experiences whether successful or challenging, to gain insights that help inform and improve future performances.[15] Continuing Professional Development (CPD) is the cyclical and outcome-focused learning approach for professionals to maintain and enhance knowledge and skills throughout their careers.[6,17] The CPD cycle involves four steps: reflecting on current competencies and identifying learning needs, planning learning goals and developing strategies to achieve those goals, then acting through relevant educational activities, and evaluating the impact of those learning activities on practice and professional development.[17] These behaviors are developed through various educational strategies such as reflective writing, portfolio-based assessments,[15,18] active learning methods (e.g. problem-based learning, flipped classroom)[1,12] and structured CPD activities.[9] Pharmacy educators' and institutions' cultural competency also plays a crucial role in developing lifelong learning behaviors in students. Pharmacy educators facilitate lifelong learning habits by giving comprehensive orientation, providing frequent constructive feedback and following up frequently to keep students engaged and provide a smooth learning experience throughout their studies.[14] The faculty should actively support educational interventions that emphasize valuing lifelong learning and professional development with regular mentorship of the program, ensuring student engagement for effectively preparing students for lifelong learning.[9]

Despite the increasing number of educational interventions aiming to foster lifelong learning skills in the pharmacy curriculum, the literature remains fragmented, with studies varying in intervention design, program delivery and outcome measures.[6,9,14] Existing studies often evaluate self-reported or course-specific performance rather than using objective and long-term indicators.[15,18] Notably, there are significant gaps in the literature regarding the long-term retention of lifelong learning skills after graduation, the comparative effectiveness of different approaches and the integration and sustainability across diverse institutional and cultural contexts.

This review explores and maps educational interventions that develop students' lifelong learning abilities in pharmacy schools worldwide. As a result, this review aims to provide pharmacy educators and program coordinators with a clearer understanding of

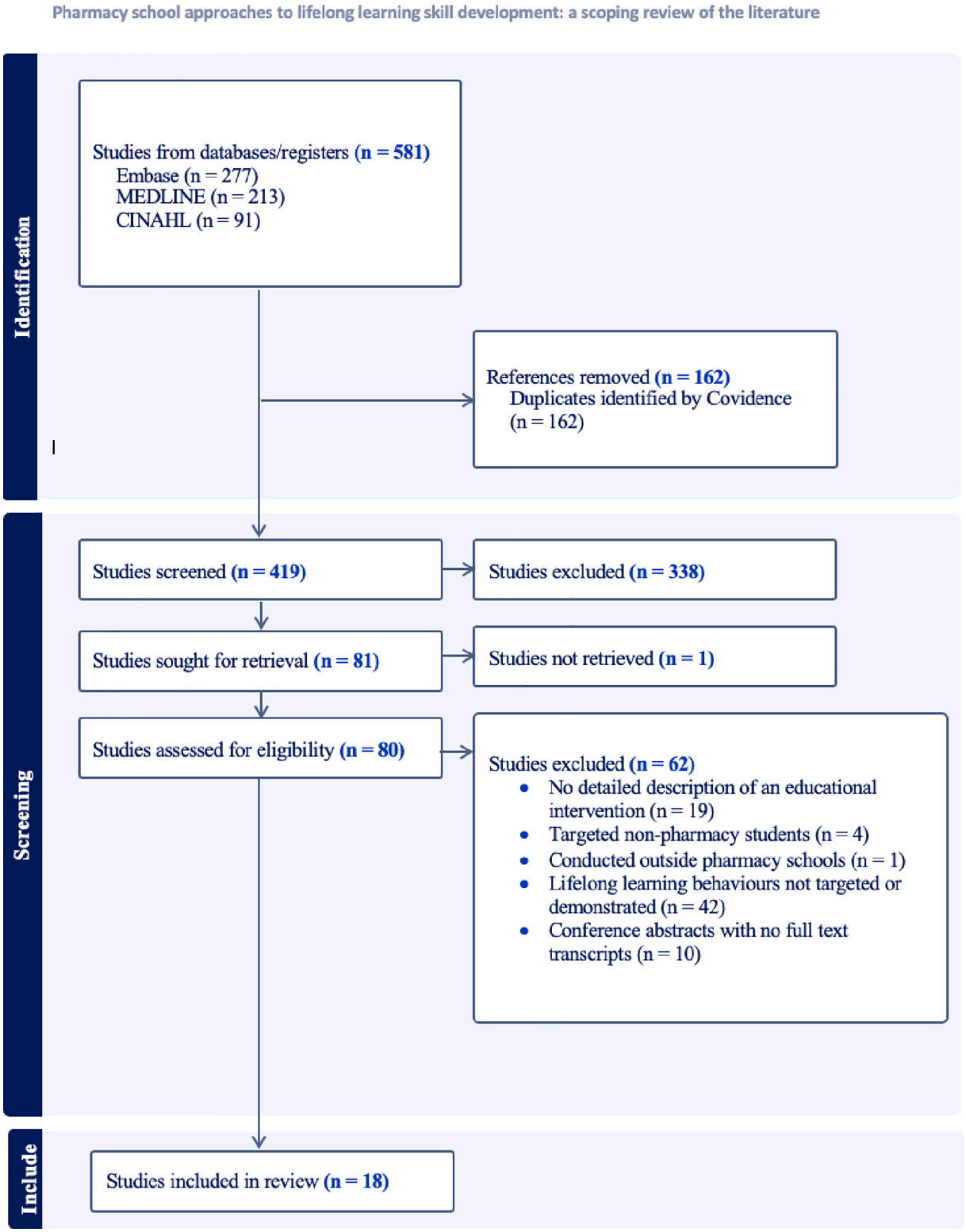

Fig. 1. PRISMA flowchart of search strategy and study selection adopted from Covidence [22].

current practices, areas for potential future development, and opportunities to strengthen curriculum design and accreditation frameworks to support lifelong learning skills.

Methods

A scoping review methodology was chosen as it allowed for mapping, categorizing and synthesizing the included literature to explore educational interventions fostering lifelong learning skill development in pharmacy education, regardless of study design or quality.[19] The methodology was conducted following the scoping review framework from Sage Research Methods[19] and in accordance with the Joanna Briggs Institute methodology and reported following the PRISMA-ScR (Preferred Reporting Items for Systematic

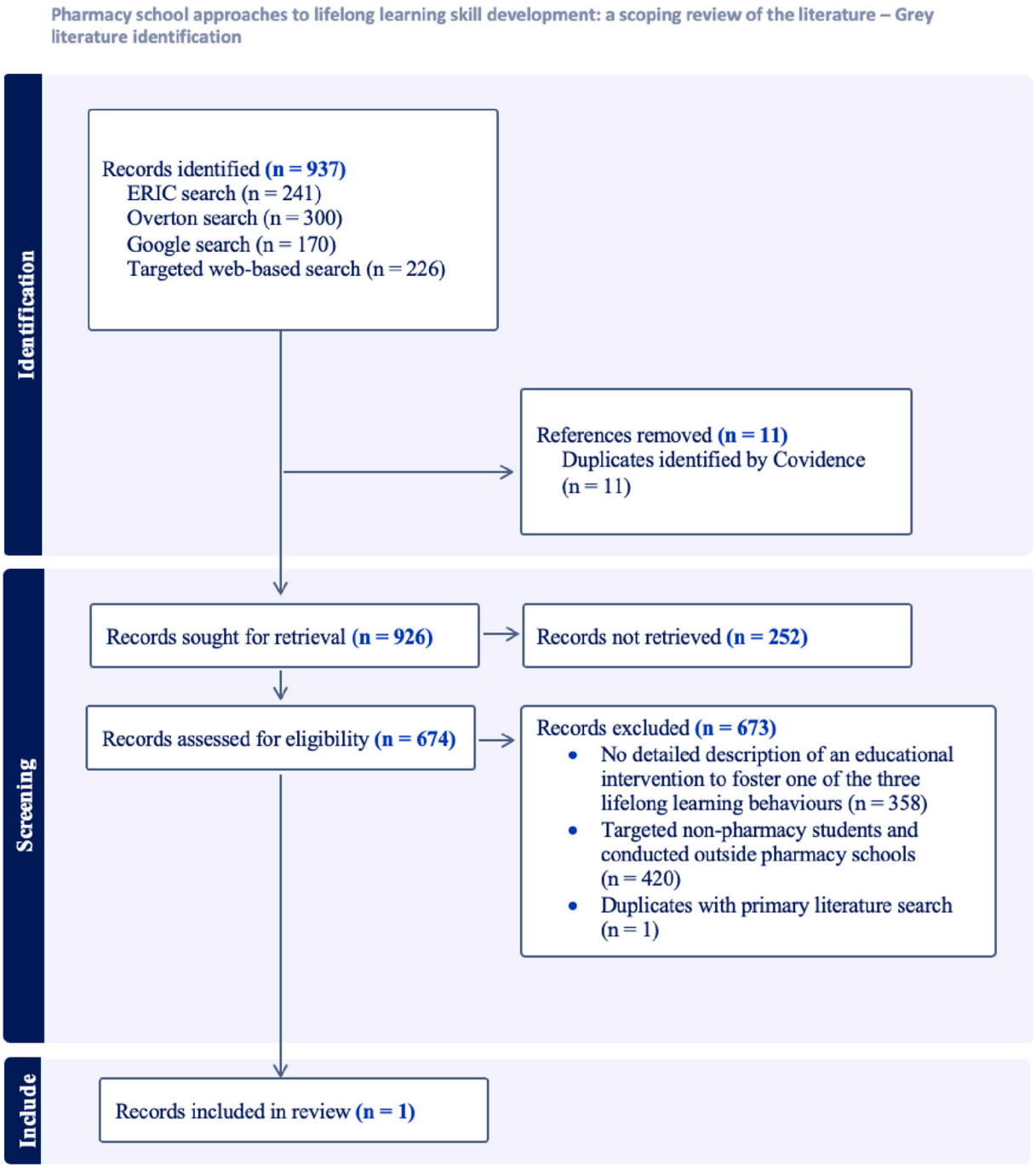

Fig. 2. PRISMA flowchart of grey literature search and records selection adopted from Covidence [22].

Reviews and Meta-Analyses extension for Scoping Reviews) checklist[20].

Search strategies

A search of published articles with no limitations on location and publication date was conducted across Medline, Embase, and CINAHL databases. In addition, a search of grey literature was conducted to identify additional unpublished interventions for lifelong learning development in pharmacy schools. Following consultation with the University of Technology Sydney librarian, search terms were developed, combining key vocabulary concepts using Boolean operators (Appendix A). The search strategy was finalized in April 2025, and studies added after April 22, 2025, were not considered for the review. The final search results from three databases were exported into Covidence systematic review tool for screening, and duplications were automatically removed.

The grey literature search process was adopted from Godin et al.,[21] including grey literature database searches (ERIC, Overton), Google search engine results and reviewing content from targeted websites. The search strategy used was the same as the scoping review (Appendix A), and the reporting process also followed the PRISMA-ScR checklist[20]. The first 300 results of each database (ERIC, Overton, and Google) were exported into Covidence[22] for screening. Additionally, content from websites relevant to pharmacy professions worldwide, including professional pharmacy organizations, government departments, and universities ($n = 13$), was included as part of the screening process (Appendix B).

Articles were included if they provided a clear and detailed description of an educational intervention conducted within a pharmacy education setting, targeting pharmacy students enrolled in higher degree programs (e.g. Bachelor of Pharmacy, Master of Pharmacy or Doctor of Pharmacy) and focused on developing lifelong learning behaviors. Lifelong learning behaviors were defined according to the FIP Global Competency Framework v2 (GbCFv2), and include three core skills: self-directed learning, reflective practice and CPD.[4,9,10] Articles were excluded if they targeted non-pharmacy students (e.g. pre-pharmacy, medical, nursing or other health students), were conducted outside pharmacy school settings (such as community-based training programs or within pharmacy professional organizations), lacked a clear description of the educational interventions or were not aimed at developing lifelong learning skills as defined by the FIP GbCFv2 framework. Conference abstracts were also excluded where no full-text transcripts were available for retrieval.

Two reviewers (VN and HB) independently screened and reviewed the titles and abstracts using the Covidence systematic review tool[22] to identify studies for inclusion, with a third reviewer consulted (NAF) to resolve any discrepancies. Full-text articles were reviewed for inclusion by VN, with any uncertainties referred to the supervisors (HB and NAF) for a final decision. References of included articles were also reviewed to identify additional articles for inclusion.

Variables and data extraction

A data extraction template was developed and exported into Covidence for a consistent process. Data charting items included study title, author(s), year of publication, country, study settings, target populations (with reported numbers if available), details of the educational intervention (name, learning activities, mode of delivery, duration, assessment methods, learning objections), and core lifelong learning behaviors demonstrated in the study. Extracted study characteristics were analyzed and summarized into a table format using Microsoft Excel, followed by a narrative synthesis of common intervention types, demonstrated lifelong learning competencies and key findings across studies.

Results

A total of nineteen records comprised eighteen peer-reviewed studies, and one grey literature record met the criteria to be included in this review. The inclusion and exclusion process can be found in Figs. 1 and 2. Main characteristics of 19 included records are summarized in Table 1.

Most included studies (74 %, $n = 14$) of the educational interventions were implemented in US-based pharmacy schools. All studies (n = 14) originating from the US explicitly targeted students enrolled in the Doctor of Pharmacy program at both pre-clinical (year 1–3) and experiential practice (year 4) stages, with three studies specifically targeting final-year cohorts when students were at the closest transition stage to professional practices.[14,23,37] The remaining four studies were conducted in other regions, including the UK and Australia, which mainly targeted students enrolled in Bachelor of Pharmacy ($n = 2$)[29,32] and Master of Pharmacy degrees (n = 2),[9,24] focused on early years training for students with placement-focused reflective practice or introductory group-based portfolio programs.[9,24,29,32] One additional grey literature record from an Australian university was also included, targeting both Bachelor and Master of Pharmacy students.[28]

The nineteen included records reflected a diverse range of educational intervention types designed to develop lifelong learning habits in students. Sample sizes ranged from large-scale experiential placements involving over 800 participants[29] to a small pilot program involving 75 participants.[31] Intervention formats and study designs also reported considerable variation: some used portfolios and reflective rubrics[14,36]; others relied on self-assessment tools or group projects.[26,32] Among these, the most common approach was the integration of CPD as a framework for curriculum design, which appeared in 9 out of 19 studies.[9,13,14,26,31,33,35,36] Most interventions were short-term and course-specific, typically carried out within a placement period or one academic semester, following a structured template or framework.[27,33,35] Only a minority conducted longitudinal intervention and utilized innovative strategies such as simulation-based learning[9] or leadership electives.[13] For example, the Holistic Student Engagement Model (HSEM) described a longitudinal framework.[28]

Table 1
Summary analysis of characteristics of included records ($n = 19$).

Study / Record (Year, Site)	Targeted populations	Intervention types	Key findings	Lifelong learning behaviors: Self-directed learning (SDL) Reflective Practice (RP) Continuing Professional Development (CPD)
Briceland et al. 2021 (US)[23]	Final year PharmD students: 411 students (with intervention), 228 students (pre-intervention)	Students created individual reflective Experiential Success Plans (ESPs) during their 6-week experiential rotation and were then evaluated by preceptors, incorporating feedback from preceptors to further reflect and improve performance across placement activities.	Among students' reflections, performance issues in patient rotations were the most identified issue. These issues often fell within the Pharmacists' Patient Care Process (PPCP) and self-directed learning competencies. The ESP intervention effectively strengthened self-awareness and self-directed learning, with 78 % of the reflections demonstrating critical thinking throughout their placement experiences.	SDL, RP
Cooley et al. 2023 (US)[14]	Final year PharmD students: 172 students in total across 3 universities – 32 (Midwestern), 62 (Arizona), 78 (Tennessee)	PharmD students participated in a novel CPD rotation, engaged in activities related to real-world clinical contexts. The activities were linked to the full CPD cycle across placements with faculty mentoring throughout.	Students reported being highly satisfied with the intervention, which supported them in strengthening their professional development, time management skills, and accountability. Authors also acknowledged the CPD-focused model integrated during experiential placements helped promote LLL habits and prepare students for professional growth in their future careers.	SDL, RP, CPD
Deslandes et al. 2018 (UK)[24]	First year MPharm students: 345 students	Students completed a structured reflective template to guide deeper critical thinking for enhancing self-awareness and reflective practice during experiential placements across four years of the program, evaluated by academic staff.	A structured reflective tool was developed across three phases and evolved with feedback from students, educators, and placement providers. The number of students demonstrated as "critical reflectors" increased from 6 % ($n = 11$) in phase 2 to 62.9 % in phase 3 ($n = 156$), indicating the importance of structured templates along with collaborative input in enhancing reflective practice.	RP
Hokanson et al. 2022 (US)[25]	PharmD students (feedback in years 1–3 but the main focus was on year 3): 133 students	Students and educators co-created structured reflective templates conducted in classroom and experiential settings. The templates focused on personal and professional development, and professional identity formation, with clear objectives, guided questions, and shared rubric.	Both students and educators recognized the value of this intervention in promoting meaningful reflective practice. The intervention was initially implemented in a third-year course and demonstrated high feasibility, implying plans to expand these co-created activities to others across the curriculum. The authors emphasized faculty development and institutional support to promote an LLL culture in pharmacy education.	SDL, RP, CPD
Kalata & Abate 2013 (US)[26]	Pharm D students (year 1 &2): 84 students (P1), 74 students (P2)	A mentor-guided electronic portfolio program in which students completed three self-assessment reflections linked to professional competencies, and writing which utilized a structured template.	First year students demonstrated increased self-assessment scores with fewer required resubmissions. Meanwhile, second year students had stable scores. Both students and mentors considered this intervention effective, yet its relevance to developing CPD skills remains varied. The intervention was still considered	SDL, RP, CPD

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Table 1 (*continued*)

Study / Record (Year, Site)	Targeted populations	Intervention types	Key findings	Lifelong learning behaviors: Self-directed learning (SDL) Reflective Practice (RP) Continuing Professional Development (CPD)
			feasible to foster self-directed learning and reflective practice habits.	
Khamis et al. 2020 (Cyprus)[9]	Fifth year MPharm students: 27 students	Students documented their pharmaceutical care experience during hospital placements, using a guided rubric to reflect skill application, self-directed learning, and professional competencies developed.	Students showed improvements in knowledge, skills, and attitudes related to the CPD cycle and LLL skills, as measured by a validated self-assessment tool. Students also reported high satisfaction and appreciation for the intervention. Despite being conducted in resource-limited settings, this intervention still demonstrated the feasibility and impact of a structured CPD-based program on developing students' LLL skills.	SDL, RP, CPD
King et al. 2017 (US)[27]	PharmD students (year 1–3): 93 students (Class of 2015), but only 48 responded to the survey	Students were required to complete multiple reflection assignments related to various learning experiences across the curriculum. An increased understanding of academic and professional development was reported.	Students acknowledged the integration of reflection assignments into their curriculum. They found the intervention beneficial in recognizing professional growth, improving self-awareness and processing learning experiences for their experiential placement, and supporting lifelong learning habits.	RP
Monash University, Faculty of Pharmacy and Pharmaceutical Sciences n.d. (Australia)[28]	All BPharm and MPharm students	Students engaged with a Holistic Student Engagement Model (HSEM) throughout the degree. This model was integrated into active learning, interprofessional education, and experiential placements. Students were able to evaluate their own skills and knowledge with authentic assessments and constructive feedback.	This pedagogical framework supports the development of applied knowledge, critical thinking, communication, teamwork, and professional identity formation. Along with feedback received from their learning, students were able to continue self-improvement and prepare for lifelong learning and professional growth after graduation.	SDL, RP, CPD
McKague & Coombes 2005 (Australia)[29]	Fourth year BPharm students: 871 students	Students conducted a Quality Use of Medicines (QUM) project through experiential placements, in collaboration with the preceptors. They were able to self-select their placement site and the topic they would work on. The intervention integrated reflective assignments with real patient care to support self-directed learning.	Students completed four-week placements in diverse settings, including hospitals, rural clinics, aged care facilities, and international pharmaceutical sites. They reported high satisfaction with the experience, which benefited them by enhancing their professional knowledge, exploring career options, and developing LLL skills. Feedback from preceptors was positive; they recognized students' enthusiasm and contributions and acknowledged how this intervention enhanced their professional practice.	SDL, RP
Mekonnen et al. 2023 (US)[30]	PharmD students (year 1–4): not specified	A longitudinal co-curricular program where students engage in activities related to the CPD cycle to develop professional identity formation (PIF) such as peer discussion, goal-setting, and reflective documentation across multiple semesters.	Following the intervention, students reported a high completion rate (> 83 %) of the activities and improved community outreach participation across four years from 64 % to 82 %. Underperformance dropped from 22 % in the first year to 8 % in the third year. Faculty support and the educator's role were highlighted as key contributors to the success of this	SDL, RP, CPD

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Table 1 (*continued*)

Study / Record (Year, Site)	Targeted populations	Intervention types	Key findings	Lifelong learning behaviors: Self-directed learning (SDL) Reflective Practice (RP) Continuing Professional Development (CPD)
			program to support students in fostering self-assessment, professionalism, and leadership competencies.	
Nuffer et al. 2013 (US)[18]	PharmD students (year 1–3): 160 students per cohort, total ~ 480 students	Students enrolled in a structured three-year reflective writing program as part of their experiential placement course. Reflections were guided and assessed by the faculty, aiming to foster progressive reflective practice.	The program recorded an average grade above 99 % over eight years of implementation in the school. Preceptors acknowledged students' competencies and the applicability of this intervention to future practical experiences. The mentor-mentee relationships were appreciated by both students and preceptors, recording a high satisfaction rate (89 %) with the overall experience.	SDL, RP, CPD
O'Brocta et al. 2012 (US)[31]	PharmD (year 1) students: 75 students	First-year students participated in a semester-long CPD course covering the entire cycle: Reflect, Plan, Act, Evaluate; to allow them to develop continuous professional growth habits. The intervention aimed to promote early integration of CPD behaviors and planning for professional development.	All students completed the four steps of the CPD cycle with the support of educators. A voluntary survey recorded students' responses regarding this intervention: 11 students appreciated the value of this CPD model, and 21 students indicated that continuing this intervention would benefit fostering self-directed learning and continuing professional development. The faculty also supported the continuation of this intervention.	SDL, RP, CPD
Patterson et al. 2013 (US)[13]	PharmD students (enrolled in a leadership elective course): 7 students	An elective teaching course about leadership incorporated CPD cycle principles for goal-setting and personal reflection on personal development through leadership. The intervention aimed to develop critical reflection and planning through professional identity formation.	57.1 % ($n = 4$) of students reported successfully achieving their leadership development goals, and 71.4 % ($n = 5$) acknowledged the efficiency of this intervention. While 85.8 % ($n = 6$) of students felt confident in identifying their needs, others remained neutral about their capacity to plan and evaluate their professional development. The intervention suggested that the CPD-focused tool was helpful in fostering reflective practice and goal setting, with additional guidance to enhance its effectiveness in leadership development further.	SDL, RP, CPD
Petit et al. 2008 (Belgium)[32]	BPharm first year students: 438 students	A course-based group project requiring students to explore pharmaceutical product development from molecule to patient, fostering self-directed and reflective learning throughout the course.	This intervention was a foundational component of a three-year "Line project" recognized by students for its relevance and applicability to developing professional development. Students consistently reported increased motivation, engagement, and higher performance ratings following this intervention.	SDL, RP
Tofade et al. 2012 (US)[33]	PharmD students (year 1&2): 443 students across 2 years	A course-wide intervention teaching CPD module in class to early year PharmD students through SMART goals and structured learning objectives. Activities were designed to let students familiarize themselves	Following the intervention, students reported improvement in designing their SMART goals. Online training, in-class sessions, and integration of the CPD cycle into the program were	SDL, RP, CPD

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Table 1 (*continued*)

Study / Record (Year, Site)	Targeted populations	Intervention types	Key findings	Lifelong learning behaviors: Self-directed learning (SDL) Reflective Practice (RP) Continuing Professional Development (CPD)
		with the CPD concept early in their degree, mainly focused on reflection and planning stages.	practical and feasible in fostering LLL goals in students.	
Trujillo et al. 2014 (US)[34]	PharmD students (year 3): 299 students	A pharmacotherapy capstone course included student-directed (SD) and instructor-directed (ID) case discussions. In SD sessions, students prepared to lead small-group analysis of patient cases followed by reflective debriefs to reinforce clinical reasoning and learning behaviors. Educators led ID sessions to teach clinical decision-making when encountering complex cases.	For written assessments, students' performance was reported better on ID sessions (79.8 % vs. 73.9 %). On the other hand, performance for verbal assessments was reported higher for SD sessions (79.5 % vs. 74.5 %). Despite this result, students reported increased confidence in critical thinking and problem-solving, and this level of confidence persisted after six months, indicating that LLL behaviors were fostered by this intervention.	SDL
Unni et al. 2019 (US)[35]	PharmD students (year 1&2): 95 students (P1), 102 students (P2)	Students completed reflective planning, goal-setting assignments, and tracked their own progress over time through SMART goals and a structured reflection template. The program aimed to develop CPD behaviors in students early and continuously throughout graduation.	Over the year, students demonstrated improvements in communication, time management, and leadership skills, related to the core components of LLL. Both students and the faculty acknowledged the effectiveness of this intervention in the curriculum, with suggestions on improving mentoring training and assessments to further benefit students in developing LLL skills.	SDL, RP, CPD
Vos et al. 2018 (US)[36]	PharmD students (year 1–3): 756 students (from 2010 to 2016)	Co-curricular activities such as professional leadership, professional services and community engagement activities were implemented where students selected and reflected on extracurricular learning experiences supported by SMART goals. Students then submitted their reflections for faculty feedback.	56 % of students met their outlined SMART goals, while 70 % found them challenging to achieve, demonstrating the course's role in fostering self-awareness and goal setting. This intervention provided a sustainable framework for developing LLL behaviors through experiential learning, reflection, and structured mentor feedback.	SDL, RP, CPD
Welch et al. 2019 (US)[37]	Final year PharmD students: 75 students	Underperforming students individually developed a structured academic success plan (ASP) during their placement, including personal reflections, self-assessments, and performance goal tracking based on reflective rubric.	89.6 % ($n = 93$) of ASPs were implemented due to repeated issues in specific learning outcomes, most found in drug therapy planning. After the intervention, students demonstrated improvement in 9 out of 12 learning outcomes, highlighting the effectiveness of ASPs in improving placement performance.	SDL, RP, CPD

Abbreviations: LLL: Lifelong Learning; BPharm: Bachelor of Pharmacy; MPharm: Master of Pharmacy; PharmD: Doctor of Pharmacy; SDL: Self-Directed learning; RP: Reflective practice; CPD: Continuing Professional Development; ESP: Experiential Success Plan; PPCP: Pharmacists' Patient Care Process; P1/P2/P3/P4: first, second, third, fourth year Doctor of Pharmacy students, respectively; PIF: Professional Identity Formation; SD: Student-Directed; ID: Instructor-Directed; ASP: Academic Success Plans.

Two thirds (68 %, $n = 3$) of the educational interventions addressed all three lifelong learning core components. Self-directed learning was the most addressed lifelong learning component, presented in 17 out of 19 records, supported by SMART goals, learning plans, and student-led development activities.[9,27,33,35] Reflective practice was the second most addressed behavior, widely supported through structured reflective templates, portfolio-based reflections, and rubric-based analysis.[24,32,36] Despite being the most common approach to fostering lifelong learning habits, CPD was the least addressed, often targeted in combination with self-directed learning and reflective practice.

Discussion

This review recognizes lifelong learning as a learning goal in pharmacy education and highlights considerable variation in how educational intervention was delivered and how lifelong behaviors were assessed across programs worldwide.

Given the global emphasis on lifelong learning as a graduate attribute, pharmacy schools are increasingly required to demonstrate their competency in supporting studies with exposure to lifelong learning concepts and fostering these behaviors throughout graduation.[4,8,33] The dominance of US-based literature may limit the generalizability and applicability to studies in non-US contexts, yet it can be considered a valuable reference model to other regions where it starts to recognize Doctor of Pharmacy as a qualified program (e.g. UK, Australia).[38,39] The limited number of studies outside the US suggested the growing interest in embedding lifelong learning culture into pharmacy education worldwide.[9,24,29,32] In addition, this result also informed a need to expand research to broader geographic settings and deeper exploration of intervention implementation in different contexts is prioritized to inform more flexible and globally relevant learning strategies in pharmacy education.[4,12]

Many interventions focused on final-year PharmD students at the closing stage of going into professional practice,[14,23,37] often integrated with capstone projects or advance placements to develop self-awareness, resilience, and accountability.[14,23,37] While these strategies are valuable for reinforcing skills before professional practices, introducing lifelong learning later in the degree might not be sufficient to embed as a sustained habit when students have limited time to engage and practice lifelong learning behaviors.[24,37,40] Exposing students to these elements in the early stages of their degree would be more beneficial.[2,10,40] As outlined in the FIP Global Competency Framework (v2) and APC accreditation standards, developing lifelong learning capacity should be an intentional and long-term process.[4,8] To meet these standards and to further benefit students, pharmacy schools should start integrating lifelong learning development from the early years of study (ideally from the first year) and progressively reinforce those skills and habits throughout the program.[6,8] The earlier adjustment would allow students to gradually build core competencies, preparing them more thoroughly before transitioning into practice as competent healthcare professionals in an evolving practice.[9,11,40]

Findings from this review indicate partial alignment between lifelong learning interventions in pharmacy programs and the APC Accreditation Standards. Such interventions included reflective portfolios, self-directed learning plans, and CPD-based activities, directly supporting Domain 3 (Program) and Domain 5 (Outcomes and Assessment) by fostering adaptability and continuous growth, enabling students to evaluate and address their learning needs.[8] However, only a few interventions demonstrated longitudinal learning across all years, as emphasized by the APC standards' expectation for continuous development.[8]

The majority of short-term and course-based interventions identified[24,27,34] and the limited evidence of systematic faculty support[25,33] indicate gaps between accreditation expectations and their implementation in practice. However, there are still exceptions, for instance, the Holistic Student Engagement Model (HSEM),[41] which reflect a more integrated approach consistent with APC expectations. Pharmacy schools should apply a progressive, longitudinal learning framework to reinforce lifelong learning behaviors across all educational years, using structured assessment frameworks and faculty capability development.

Interventions such as reflective essays, learning plans, and course-based assignments were commonly taught across studies yet lacked the essential developmental progression to foster lifelong learning habits over time.[24,27,34] These single-semester or co-curricular activities were beneficial for introductory foundational skills; however, such interventions are unlikely to promote sustained habits without continuous reinforcement and integration across the degree.[23,24,27,32] Most curriculum designs heavily relied on meeting assessment criteria rather than using innovative approaches to lifelong learning development, such as simulation-based activities, interprofessional education, and leadership electives.[9,13] The absence of longitudinal and innovative educational strategies indicates limitations in curriculum design and faculty resources. The additional grey literature record described a longitudinal, curriculum-wide framework integrated into educational activities for developing all three lifelong learning skills – indicate the needs for more of the integrated approaches published in peer-reviewed studies.[28] These limitations can impede the effective integration of lifelong learning culture into pharmacy education.[6,12,15,24] This finding highlighted the need for further research on a more comprehensive and innovative approach to support students in building lifelong habits during their degree.

All three core lifelong learning behaviors, self-directed learning, reflective practice and CPD, were integrated into 13 records through more longitudinal structured interventions such as portfolio-based mentoring, SMART goal planning and multi-stage reflection.[14,36,37] Self-directed learning was the most demonstrated behavior ($n = 17$) using rubric-based templates or self-assessment methods.[26,33,37] Nevertheless, only a few evaluated behavioral changes beyond these learning plans.[23,29] For instance, Briceland et al.[23] demonstrated that 78 % of students could rectify their performance deficiencies with one individualized success plan, reflecting an improved performance in their practice and improving self-directed learning skills. Reflective practice behavior was mainly carried out through short-term assignments, particularly during placement, with limited use of a strategically longitudinal development learning plan.[23,24,27] Despite being widely used as an instructional framework, CPD behaviors were not explicitly targeted, only in combination with the other two components ($n = 13$)[31,35,36]; reflecting previous studies' findings implied CPD was often used as a structure rather than an integrated behavior.[6,17,42] The entire cycle was rarely performed, primarily assessed in the "Reflect and Plan" phases, raising concerns about the disassociation between CPD policy and its implementation in educational practice.[4,33] The other two phases (Act and Evaluate) were not consistently assessed on whether students had performed those over time, possibly due to short-term implementation and limited time.[18,37] Only a few studies assessed behavior changes beyond the planning stage, even though these later stages are important to transform learning objectives into meaningful, sustained professional growth,[15,35,36] suggesting a weak correlation between the theoretical framework and the implementation of CPD as a measurable behavior.[6,17,30]

The crucial role of faculty in embedding lifelong learning culture into the curriculum is also emphasized in this review.[25,33] Pharmacy educators are considered critical facilitators for developing lifelong learning behaviors in students through teaching reflection cycles, evaluating goal setting progress, and encouraging critical thinking.[15,25,26] However, to build this capacity, only

changing the curriculum design is insufficient.[6,19] The faculty must also support their educators with the capabilities and resources to demonstrate and facilitate these behaviors with confidence in pharmacy schools. Studies have shown that several interventions implemented, including workshops on reflective assessment, structured training in CPD and feedback delivery, observation of peer-teaching, and time allocation for coaching students throughout a longitudinal learning plan, play a key role in further enhancing educators' ability to foster students' self-directed learning and reflection skills.[6,13,15,26,35] For example, one pharmacy faculty member scheduled monthly CPD sessions for faculty staff to practise goal setting, reflection, and then discuss learning outcomes, which resulted in staff reporting back with enhanced lifelong learning behaviors.[43] With this approach, pharmacy school can effectively strengthen students' lifelong learning behaviors while maintaining program quality over time.

The findings of this review align with lifelong learning trends in other health professions. Similarly, in medicine and nursing, students initially demonstrated self-directed learning and reflective practice behaviors during learning; yet found it difficult to apply those skills in long-term practice.[3,44] The need to apply more longitudinal and practice-based interventions in education is also highlighted by medicine and nursing educators across the field of education and remains a focus in practice.[3]

Limitations and strengths

Several limitations should be acknowledged for this scoping review. Firstly, the full-text screening was conducted by a single reviewer, which might introduce selection bias. However, the title and abstracts of screening phases involved two to three reviewers, followed by a discussion between reviewers during full-text screening. Furthermore, the full-text screening phase was based on clearly predefined inclusion and exclusion criteria, which helped mitigate this limitation and supported a rigorous methodology. A grey literature search was also carried out to map the educational interventions used in pharmacy schools for lifelong learning development, suggesting potential valuable interventions have already been implemented in practice but not reported in peer-reviewed studies or documented in grey literature resources.

Most included studies were US-based and focused on PharmD students, making it challenging to fully reflect the pharmacy training in a global context with different regions targeting different educational pathways such as Bachelor or Master of Pharmacy programs.[18,35] Accordingly, most interventions were integrated in the final year of the degree, with limited insights into how lifelong learning behaviors develop from the early stages of higher education to graduation.[26,37] The aim of this scoping review was to include various educational interventions regardless of evidence types, such as blogs, websites, studies, or opinions, so critical appraisal was not undertaken.[20] As standard in scoping reviews (where critical appraisal of included sources is treated as optional, as quoted from the PRISMA-ScR checklist), the variety of study designs and sample sizes combined with format variations may limit the applicability of study findings. For instance, outcomes from a structured CPD course in Australia[29] may not directly apply to a one-week group project in Belgium[32] due to context differences. Furthermore, studies mainly relied on descriptive and self-reported outcomes, with only a few evaluating progressive behavioral changes following educational strategies or using a longitudinal assessment method.[27,36]

Future research should expand to evaluate long-term behavioral change through interventions across diverse pharmacy education systems.[4,6,25] More standardized, context-sensitive evaluations of lifelong learning strategies should be studied to understand how contextual factors affect lifelong learning development.[19,25] Additionally, future studies should incorporate more rigorous outcome measures to assess students' behaviors embedded in the complete CPD cycle over time.[14,18,33]

Conclusion

The reviewed interventions show developing progress in integrating lifelong learning culture into pharmacy education with diverse formats implemented across global pharmacy schools.[6,9] Fostering lifelong learning habits in pharmacy education is to help students build flexible, progressive and self-sustaining habits for advancing healthcare practices. Therefore, there is a need for the design of a longitudinal, identity-forming educational experience across all years of study until graduation.[4,40] This approach should be supported by behavior-based assessment frameworks, faculty improvement and innovatively authentic learning experiences to promote lifelong learning behaviors.[6,33] With such adoption, pharmacy education can align with evolving global standards and better prepare graduates to become adaptive, reflective, and self-directed professionals in a dynamic healthcare system.

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Declaration of competing interest

The authors declare that they have no competing interests.

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Appendix A. Search strategy

Table A.1. Search strategy of scoping review into pharmacy educational interventions to foster lifelong-learning skills.

1. lifelong learn*.mp.
2. life-long learn*.mp.
3. continu* learn*.mp.
4. continu* educat*.mp.
5. professional development.mp.
6. lifelong learning/
7. continuing education/
8. 1 OR 2 OR 3 OR 4 OR 5 OR 6 OR 7
9. pharmac* education.mp.
10. pharmac* school*.mp.
11. school of pharmacy.mp.
12. pharmac* college*.mp.
13. pharmacy education/
14. pharmacy school/
15. 9 OR 10 OR 11 OR 12 OR 13 OR 14
16. pharmac* student*.mp.
17. student* of pharmacy.mp.
18. pharmacy student/
19. 16 OR 17 OR 18
20. 8 AND 15 AND 19

Appendix B. Websites searched

Table B.1. List of websites screened during the grey literature search.

No.	Website/Organization	URL
1	International Pharmaceutical Federation (FIP)	https://www.fip.org
2	Pharmaceutical Society of Australia (PSA)	https://www.psa.org.au
3	Accreditation Council for Pharmacy Education (ACPE)	https://www.acpe-accredit.org
4	Australian Pharmacy Council (APC)	https://www.pharmacycouncil.org.au
5	General Pharmaceutical Council (GPhC)	https://www.pharmacyregulation.org
6	World Health Organization (WHO)	https://www.who.int
7	Department of Health – Australia	https://www.health.gov.au
8	Department of Health – UK	https://www.gov.uk/government/organisations/department-of-health-and-social-care
9	Department of Health – USA (HHS)	https://www.hhs.gov
10	University of Sydney School of Pharmacy	https://www.sydney.edu.au/medicine-health/schools/school-of-pharmacy.html
11	Monash University Faculty of Pharmacy and Pharmaceutical Sciences	https://www.monash.edu/pharm
12	University College London (UCL) School of Pharmacy	https://www.ucl.ac.uk/pharmacy
13	University of North Carolina (UNC) Eshelman School of Pharmacy	https://pharmacy.unc.edu

Appendix C. Continuing professional development (CPD) cycle

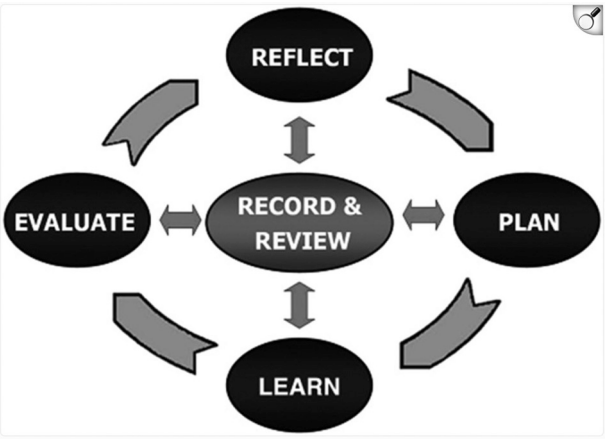

Fig. C.1. The Continuing Professional Development (CPD) cycle adopted from Janke & Tofade (2015)[6] with permission to reprint from the Accreditation Council for Pharmacy Education (ACPE).

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