

REVIEW

Mapping technical and non-technical clinical competence in pharmacy students via experiential education: A scoping review

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Keywords

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Abstract

Background: Pharmacy education today must strike a balance between technical expertise and non-technical skills such as communication and leadership. The purpose of this scoping review is to synthesise global evidence on educational interventions designed to cultivate these competencies in pharmacy students. **Methods:** Following Arksey and O'Malley's framework and PRISMA-ScR guidelines, searches were conducted across PubMed, Google Scholar, and AJPE for articles published between January 2007 and November 2024. Out of 406 screened articles, 28 were included. Most originated from North America between 2011 and 2019. **Results:** Simulation-based training and interprofessional collaboration were the most effective strategies, improving clinical skills and confidence. Significant gaps were identified in leadership training and theoretical integration, with barriers including resource and faculty constraints. **Conclusion:** While pharmacy education is increasingly student-centered, there is a critical need to integrate leadership concepts and expand experiential learning. Enhancing geographic diversity in research is essential to building context-responsive, global, evidence-based pharmacy education.

Introduction

Pharmacy education has undergone substantial evolution in response to the increasingly complex healthcare environment, where pharmacists are expected to perform not only traditional roles like dispensing medications but also to provide clinical and patient-centred care (Hussain *et al.*, 2017). Pharmacy programmes worldwide have therefore emphasised experiential learning, particularly through pharmacy practice experiences, which are a critical component of student development (Akel *et al.*, 2021). These experiences are considered essential for bridging the gap between academic knowledge and professional practice by facilitating the acquisition of both technical and non-technical skills among pharmacy students

(Akel *et al.*, 2021; Jackson, 2015). In pharmacy practice, while technical skills refer to competencies directly associated with clinical and pharmaceutical knowledge, such as prescription processing, medication therapy management, drug information provision, and patient counselling (Sales *et al.*, 2013; Coons *et al.*, 2019), non-technical skills, also known as soft skills, include skills such as communication, teamwork, leadership, ethical reasoning, adaptability, and professionalism (Fejzic *et al.*, 2016; Tucci *et al.*, 2019). These competencies are typically cultivated through hospital, community, and interprofessional placements, where students engage with real-life scenarios under the supervision of experienced practitioners and are exposed to routine and non-routine patient care activities, institutional

procedures, and interdisciplinary collaboration (Hall *et al.*, 2012; Jackson, 2015).

Evidence shows that several factors support the development of these competencies during practice experiences. Structured placements with clearly defined learning objectives and active student participation have been shown to enhance clinical competence (Hardisty *et al.*, 2025), and interprofessional education components within placements are particularly effective in fostering non-technical competencies such as collaboration and communication across disciplines (Vyas, McCulloh, *et al.*, 2012). The level of student integration into clinical teams also matters. Ashjian *et al.* (2021) found that early clinical experience increased students' confidence in ambulatory care practice, and that students are treated as active contributors rather than passive observers (Ashjian *et al.*, 2021). When pharmacy students are viewed and treated as active contributors rather than passive observers, they gain more opportunities to apply theoretical knowledge, make clinical decisions, and receive real-time feedback, which strengthens both technical proficiency and interpersonal capabilities (Sletvold *et al.*, 2025). Structured reflective practice further supports this process by allowing students to critically assess their own performance, recognise areas for improvement, and internalise lessons learned, thereby bridging the gap between what students know and what they practice (Tsingos *et al.*, 2014).

Despite this evidence, there is a lack of standardisation in how technical and non-technical skills are defined, developed, and assessed within pharmacy education. Variability in preceptor engagement, placement settings, and reflective practices means that students' learning outcomes may differ significantly depending on contextual factors (Litten *et al.*, 2023), which may in part reflect preceptors being unprepared, experiencing burnout, or being unable to effectively manage students in difficulty, including those experiencing mental health crisis (Litten *et al.*, 2023; Mnatzaganian *et al.*, 2025). This gap is compounded by the increasing complexity of healthcare systems, which requires pharmacists to possess a balanced blend of clinical expertise and interpersonal relationship skills as they take on expanded roles within interprofessional teams and general practice settings (Ryan *et al.*, 2018; Fusco *et al.*, 2024).

Pharmacy practice experiences remain the most promising educational strategy to cultivate this balance. Advanced Pharmacy Practice Experiences (APPEs) that focus on direct engagement with the medication use system are considered vital for preparing practice-ready pharmacists, and experiences

lacking patient care focus may not sufficiently develop proficiency (Svensson, 2016). However, given the standardisation gap identified above, there remains limited synthesis of how these experiences translate into specific technical and non-technical skill outcomes across different practice contexts. This study, therefore, seeks to map how pharmacy practice experiences contribute to the development of technical and non-technical skills in pharmacy students, to assess the roles of various placement factors, and to identify educational best practices, with the ultimate goal of enhancing the preparedness of pharmacy graduates to meet contemporary professional challenges and deliver high-quality patient care across diverse healthcare settings.

Methods

The search was conducted in November 2024 for relevant English-language articles published in three electronic databases (PubMed, Google Scholar, AJPE). The aim of this scoping review is to provide a comprehensive overview of the literature from January 2007 to November 2024. The scoping review is well-suited to mapping the breadth and evolution of research on this topic over time, providing a detailed and comprehensive understanding of the existing literature. The scoping review was conducted following the methodological framework by Arksey and O'Malley (Arksey & O'Malley, 2005) and adhered to the guidelines of Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) extension for scoping reviews (PRISMA-ScR) checklist (Tricco *et al.*, 2018) (Supplementary Appendix A). The review was registered with Open Science Framework (DOI: <https://doi.org/10.17605/OSF.IO/EG8AX>).

Step one: Identification of the research question

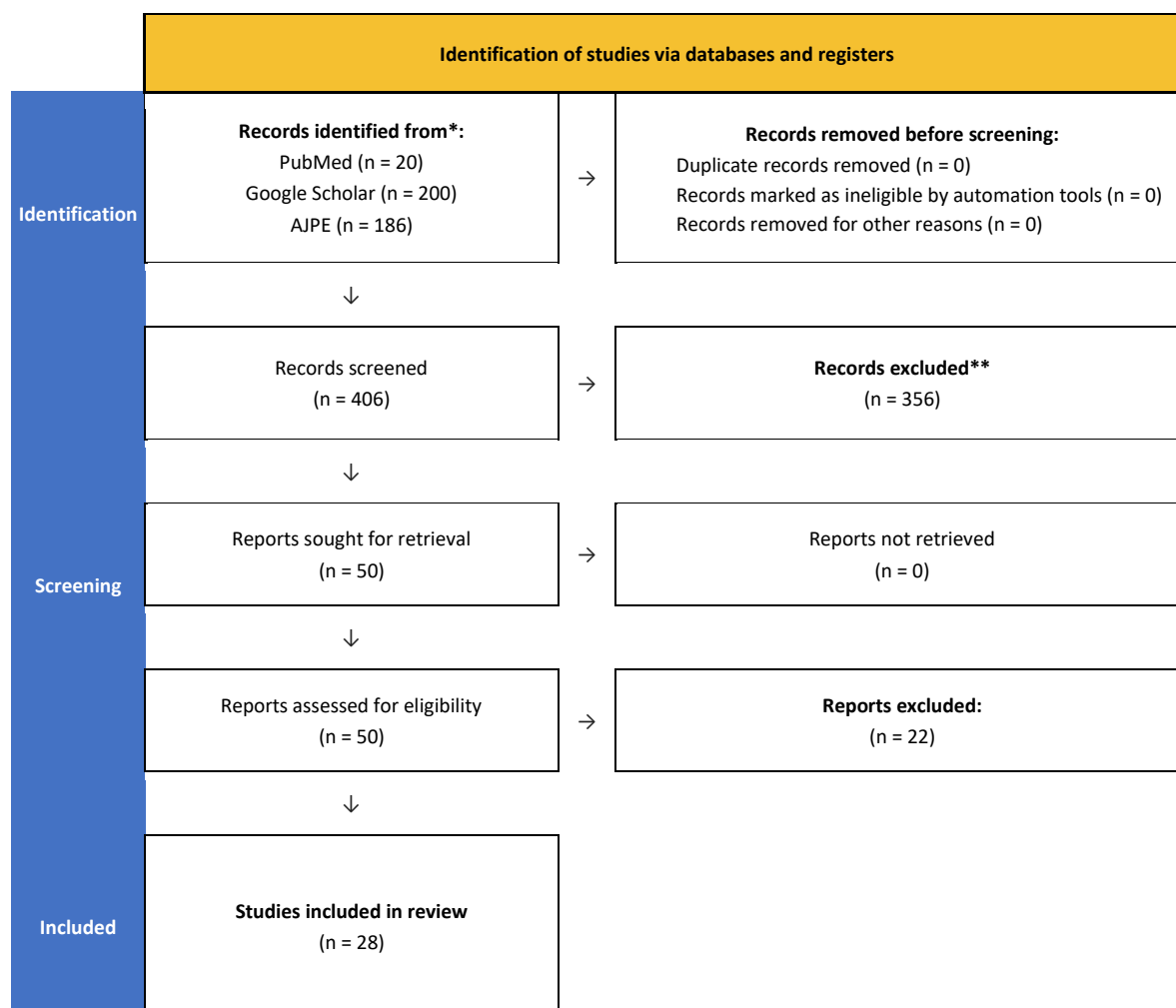
The study is guided by the central research question: How do pharmacy practice experiences contribute to the development of technical and non-technical skills in pharmacy students?

The objectives are as follows: First, identify the key technical skills developed by pharmacy students during their pharmacy practice experiences. Second, it seeks to identify the key non-technical skills that are similarly cultivated through these experiences. Third, the review intends to examine the role of various pharmacy practice settings such as community pharmacies, hospital pharmacies, and clinical environments in facilitating the development of these skills. Finally, it aims to assess pharmacy students' perspectives on the impact of their practice experiences on their overall skill development.

Step two: Identification of relevant studies

A comprehensive literature review was conducted to identify studies focusing on the development of technical and non-technical skills by pharmacy students

during their pharmacy practice experiences. The search included the following databases: PubMed, Google Scholar and AJPE (Figure 1).



* Records identified from three electronic databases: PubMed (n = 20), Google Scholar (n = 200), AJPE (n = 186)

** Records excluded based on title and abstract screening; did not meet predefined inclusion criteria

Figure 1: PRISMA showing the flowchart for screening process

The search strategy involved a combination of keywords and search terms including but were not limited to: "Pharmacy students" AND "pharmacy practice experience" OR "experiential learning" OR "practice-based learning" AND "technical skills" OR "clinical skills" OR "professional competencies" OR "skill development" OR "competency mapping" AND "non-technical skills" OR "communication skills" OR "interpersonal skills" OR "teamwork" OR "problem-solving" AND "student outcomes" OR "curriculum" OR "competency assessment" OR "learning outcomes" (complete search strategy in Supplementary Appendix B).

Step three: Selection of studies for review

Studies were included in the study screening if they: 1. involved pharmacy students at any level of education; 2. assessed the pharmacy practice experiences, including internships, placements, and clerkships; 3. assessed technical skills such as medication dispensing, clinical decision-making or non-technical skills such as communication, teamwork, and problem-solving developed through practice experiences; 4. reported on skill development (technical or non-technical) as a result of pharmacy practice experiences, student

competencies, learning outcomes, or professional development with practice-based education. 5. are written in English.

Studies were excluded from the study screening if they: 1. are opinion-based, non-peer reviewed, and not published; 2. do not involve original research, such as editorials or commentaries that lack empirical data; 3. do not focus on pharmacy students, or concentrate solely on knowledge acquisition without addressing skill development. Specifically, any study that does not examine the development of either technical or non-technical skills, such as those that focus exclusively on theoretical knowledge without assessing competencies, is excluded. The obtained literature was saved and downloaded into the reference management software Zotero, and Rayyan, an online platform for managing literature reviews, was used for screening and data extraction. Each stage of the screening was performed by two independent reviewers (EOM and DIA) using predefined inclusion and exclusion eligibility criteria. A third reviewer (M.O.A.) resolved the conflicts. The list of excluded studies is in Supplementary Appendix C.

Step four: Charting key information

Data were extracted from the selected studies using Rayyan and a standardised extraction form in MS Excel (Supplementary Appendix D). We extracted data on study characteristics (author, year, country, study design), study setting (university/faculty-based or hospital/clinical), type of intervention (e.g., simulation-based training, virtual learning environments, peer learning, team-based learning, case-based learning), perspectives of students on the intervention, challenges encountered in skill development, and role of specific practice settings in facilitating technical and non-technical skill development.

Step five: Collating, summarising and reporting the results

To synthesise findings for this scoping review on skill development among pharmacy students, each author independently reviewed the extracted data from the included studies. The validity of the findings was strengthened through triangulation, where the individually appraised data were cross-checked and discussed collectively. Both qualitative and quantitative elements were analysed to address the core objectives of the review. Qualitative data were organised into thematic areas such as perceived benefits of training, challenges to implementation, and institutional support mechanisms. Quantitative data, including participant numbers and demographics, where available, provided context for the scale and generalisability of each intervention.

By integrating qualitative insights with available quantitative data, the review provides a robust overview of the current landscape of pharmacy skill development. The findings highlight the importance of structured, contextually relevant educational strategies and the value of student-centred feedback in refining such programmes. This synthesis offers meaningful implications for improving curriculum design and delivery in pharmacy education.

Results

Characteristics of the selected studies

Table I presents the general characteristics of the studies analysed in this research. In total, 28 published papers were reviewed, with publication years ranging from 2007 to 2025. Two studies (7.14%) were published before 2011, and the remaining 26 (92.86%) were published from 2011 onward. A spike in publications was also observed in 2019, with five papers (17.2%) published that year.

Table I: Summary of included studies examining educational and interventional approaches for developing technical and non-technical skills among pharmacy students

S/N	Author	Country	Study setting	Study population	Type of study	Study design
1	Wongwiwatthanakut et al. (2013)	United States	University/Faculty Setting	Second- and third-year pharmacy students	Quantitative (interventional)	Quasi-experimental pre-post intervention study
2	Buring et al. (2007)	Canada	University/Faculty Setting	First-year pharmacy students	Quantitative (interventional)	Quasi-experimental pre-post intervention study
3	McDowell et al. (2016)	Australia	University/Faculty Setting	First Year Pharmacy students	Mixed-methods	Cross-sectional survey with descriptive performance analysis

S/N	Author	Country	Study setting	Study population	Type of study	Study design and qualitative feedback
4	Porter <i>et al.</i> (2023)	United States	University/Faculty Setting	graduating classes of 2018 to 2020.	Quantitative (observational/survey)	Retrospective cohort study
5	Sales <i>et al.</i> (2013)	United States	University/Faculty Setting	Second-year pharmacy students	Quantitative (interventional)	Quasi-experimental pre-post intervention study (3-arm comparison)
6	Fejzic <i>et al.</i> (2016)	Australia	University/Faculty Setting	First Year Pharmacy student	Mixed-methods	Mixed-methods study (pre-post quantitative surveys with qualitative content analysis)
7	Vyas, McCulloh, <i>et al.</i> (2012)	United States	University/Faculty setting	Undergraduate students, graduate students, and students in professional programmes	Quantitative (interventional)	Quasi-experimental pre-post intervention study
8	Bravo <i>et al.</i> (2019)	Canada	Hospital Setting	Fourth Year Pharmacy student in Four-year Doctor of Pharmacy programme	Qualitative	Qualitative study (semi-structured interviews)
9	Rotz <i>et al.</i> (2016)	United States	University setting	First-year and second-year pharmacy and medical students	Quantitative (observational/survey)	Cross-sectional survey with performance-based behavioral assessment
10	Coons <i>et al.</i> (2019)	United States	University setting	Fourth-professional year students,	Quantitative (interventional)	Quasi-experimental pre-post intervention study
11	Theodorou <i>et al.</i> (2018)	United States	Facility-based	Third-year pharmacy and both third- and fourth-year dental students	Quantitative (interventional)	Quasi-experimental pre-post intervention study (interprofessional)
12	Tucci <i>et al.</i> (2019)	United States	Facility-based	First to fourth year Pharm. D students	Quantitative (descriptive/cross-sectional)	Cross-sectional survey with curriculum mapping
13	Pittenger <i>et al.</i> (2019)	United States	University setting	Third year pharmacy Students	Quantitative (interventional)	Quasi-experimental pre-post intervention study
14	Bray <i>et al.</i> (2011)	United States	University setting	Pharmacy Students	Review	Narrative review
15	Bullock & Horne (2019)	United States	University setting	Second and third year pharmacy students	Quantitative (interventional)	Quasi-experimental pretest-posttest study
16	Morbitzer <i>et al.</i> (2021)	United States	University setting	First-year to fourth-year pharmacy students	Review	Mapping review
17	Hussainy <i>et al.</i> (2012)	Australia.	University/Facility-based	Second- and third-year pharmacy students	Mixed-methods	Mixed-methods study (cross-sectional survey with qualitative focus groups)
18	Conway & Ahmed (2012)	United States	University setting	Third-year PharmD students	Quantitative (interventional)	Quasi-experimental educational intervention study
19	Bowers <i>et al.</i> (2017)	United States	University setting	First-year pharmacy students	Quantitative (experimental/RCT)	Cluster randomised controlled trial
20	Baalmann <i>et al.</i> (2023)	United States	University setting	Second and third year pharmacy students	Quantitative (interventional)	Quasi-experimental pre-post intervention study

S/N	Author	Country	Study setting	Study population	Type of study	Study design
21	Tofil <i>et al.</i> (2010)	United States	University setting	Third Year Pharmacy student	Quantitative (interventional)	Quasi-experimental pretest-posttest study
22	Trujillo <i>et al.</i> (2016)	United States	University setting	First professional year PharmD curriculum students	Quantitative (interventional)	Quasi-experimental pre/post-test intervention study
23	Vyas, Bhutada, <i>et al.</i> (2012)	United States	University setting	PharmD students and clinical faculty members	Quantitative (interventional)	Quasi-experimental pre/post intervention study
24	Donovan <i>et al.</i> (2020)	United States	University setting	First year Pharmacy students	Qualitative	Qualitative descriptive study
25	Tsingos <i>et al.</i> (2014)	Australia	University-based	Pharmacy students (Undergraduate, Postgraduate, Interns)	Review	Literature review
26	Rao (2011)	Australia	Educational (University-based)	Undergraduate pharmacy students (first-year)	Quantitative (interventional)	Quasi-experimental study (role-play intervention)
27	Lin <i>et al.</i> (2011)	United States	Educational (University-based, some references to hospital settings)	PharmD students (Introductory Pharmacy Practice Experience - IPPE)	Review	Literature review and feasibility analysis
28	Zakaria & Awaisu (2011)	Malaysia & Qatar	Facility-based (Hospital)	Undergraduate pharmacy students (Third-year and Fourth-year students)	Quantitative (observational/survey)	Survey-based observational study

An analysis of the countries where the studies reviewed in this paper shows that an overwhelming number of these studies were produced in North America (78.57%, $n = 22$). In the United States of America alone, twenty studies (71.43%) were carried out, while two studies were done in Canada (7.14%). A significant number of studies were also carried out in Australia (17.86, $n = 5$), while one study was done in Malaysia and Qatar (3.57%). Looking at the data, in recent years, there have been no related studies carried out in Europe, South America, and Africa. All the studies reviewed were conducted exclusively with pharmacy students at various stages of learning, from undergraduates to postgraduate students. Most studies (85.71%, $n = 24$) were conducted in a university/faculty setting, while others (14.29%, $n=4$) were conducted in a hospital or other medical facility. In terms of study design, the majority of included studies were quantitative interventional studies, most often using quasi-experimental or pre-post designs (53.57%, $n = 15$). The remainder comprised review studies, including literature and mapping reviews (14.29%, $n = 4$); quantitative observational or survey-based studies (14.29%, $n = 4$); mixed-methods studies combining quantitative and qualitative approaches (10.71%, $n = 3$); and qualitative studies (7.14%, $n = 2$).

Technical and non-technical skills identified across studies

Across the included studies, the technical skills most frequently identified included medication dispensing (McDowell *et al.*, 2016), clinical decision-making (Bray *et al.*, 2011; Lin *et al.*, 2011; Zakaria & Awaisu, 2011; Pittenger *et al.*, 2019), patient assessment (Lin *et al.*, 2011; Zakaria & Awaisu, 2011; Rotz *et al.*, 2016), documentation (Rao, 2011), counselling (Buring *et al.*, 2007; Bowers *et al.*, 2017), disease-state management such as diabetes care (Wongwiwatthanakul *et al.*, 2013), and evidence-based medicine application (Pittenger *et al.*, 2019). The non-technical skills most frequently identified included communication (Lin *et al.*, 2011; Rao, 2011; Zakaria & Awaisu, 2011; Hussainy *et al.*, 2012; Donovan *et al.*, 2020;), teamwork and interprofessional collaboration (Zakaria & Awaisu, 2011; Vyas, McCulloh, *et al.*, 2012; Theodorou *et al.*, 2018), leadership (Tucci *et al.*, 2019; Morbitzer *et al.*, 2021), cultural competence (Sales *et al.*, 2013), reflective practice, critical thinking and problem-solving (Zakaria & Awaisu, 2011; Tsingos *et al.*, 2014), and professional attitudes (Rao, 2011). Most studies did not target these domains in isolation. Simulation- and role-play-based interventions in particular were commonly reported as developing technical proficiency and non-technical competence concurrently.

Type of intervention and perspective of student participants in the study

The studies used a wide range of interventions to both assess and teach participants a range of technical and non-technical skills relevant to pharmacy practice. Some studies combined multiple interventions and might appear multiple times in this analysis. The most prevalent type of intervention used across all 28 papers reviewed is simulation-based training, which occurred in eight studies (28.57%) (Tofil *et al.*, 2010; Bray *et al.*, 2011; Lin *et al.*, 2011; Vyas, Bhutada, *et al.*, 2012; Vyas, McCulloh, *et al.*, 2012; McDowell *et al.*, 2016; Morbitzer *et al.*, 2021; Baalman *et al.*, 2023). The Simulations leveraged sophisticated software to introduce students to real-life scenarios. Human simulations, Standardised patients, and role-playing are some other types of simulations used. Four studies developed virtual environments for the participants (14.29%) (Lin *et al.*, 2011; Hussainy *et al.*, 2012; McDowell *et al.*, 2016; Bravo *et al.*, 2019). About two studies involved peer learning, which included the use

of portfolios, blogs, journals, diaries, and peer assessment (7.14%) (Rao, 2011; Tsingos *et al.*, 2014).

A limited number of studies employed distinct, single-use instructional strategies within the dataset. Performance-based assessment was reported in one study, representing 3.57% (Porter *et al.*, 2023). Likewise, team-based learning (structured small-group activities in which students collaboratively work through clinical problems) (Bray *et al.*, 2011), case-based learning (guided analysis of real or simulated patient cases to develop clinical reasoning) (Pittenger *et al.*, 2019), interactive modules (Bravo *et al.*, 2019), and skills laboratory approaches (supervised, hands-on practice of technical procedures in a simulated pharmacy setting) (McDowell *et al.*, 2016) were each documented in one study, accounting for 3.57%, respectively.

The analysis of student perspectives across the reviewed studies reveals several recurring themes regarding the perceived impact of educational interventions (Table II).

Table II: Intervention outcomes and common challenges to the development of technical and non-technical skills among pharmacy students

S/N	Author	Skills	Number of participants	Student perspective	Challenges to skill development	Role of Specific practice setting
1	Wongwiwatthananukit <i>et al.</i> (2013)	diabetes care.	175	10-hour classroom lectures on diabetes care. 4-hour hands-on workshop, including five rotating practical stations: Blood glucose monitoring. Insulin administration (self-injection with saline). Diabetic foot examination (using monofilament testing). Insulin delivery devices (pens/syringes). A1c interpretation and education.	Significant increase in confidence scores for both 2nd- and 3rd-year students ($p < 0.001$). Third-year students had higher baseline confidence, but both groups improved significantly. Example: Total confidence scores improved from 2.7 to 4.2 (third-year) and 1.9 to 4.0 (second-year).	Initial lack of practical exposure before workshop. Resource intensity: Faculty time and coordination for hands-on stations were substantial. Survey complexity: Multiple instruments may have led to some student confusion or survey fatigue
2	Buring <i>et al.</i> (2007)	Counselling skills	64	Introduction and instruction on the QuEST/SCHOLAR process — a structured, sequential self-care counseling framework.	They felt better equipped to assess and counsel patients on self-care issues using a structured method. After learning and applying the QuEST process	Difficulty applying theoretical knowledge to practice
3	McDowell <i>et al.</i> (2016)	Dispensing skills	199	A development team used an Agile software development method to create MyDispense, a web-based simulation. Modeled on virtual learning environments elements, the software employed widely available standards-based technologies to	In the student view During exercises, students see virtual representations of patients, prescriptions, products on shelves, products for labeling, dispensary and ancillary labels, and note-taking tools.	Implementing the software presented many challenges. The short development timeframe to version 1 required fast responses to unanticipated complications.

S/N	Author	Skills	Number of participants	Student perspective	Challenges to skill development	Role of Specific practice setting
				create a virtual community pharmacy environment.		
4	Porter <i>et al.</i> (2023)	critical thinking.	403	Students were coded as APPE poor performers (final course grade ,83%) or acceptable performers. Assessments in pharmacy practice didactic and skills-based courses in students' second and third years were included in the analysis, with thresholds correlating to grade cutoffs. The association between poor performance mean examination scores and performance-based assessments with APPE performance was calculated.	In the student view During exercises, students see virtual representations of patients, prescriptions, products on shelves, products for labeling, dispensary and ancillary labels, and note-taking tools.	Resource intensity: Faculty time and coordination for hands-on stations were substantial.
5	Sales <i>et al.</i> (2013)	Cultural competency skills	108	Lecture Group: A 50-minute formal lecture on cultural competence, including 2 patient case descriptions. Written Case Scenarios Group: 10-minute lecture on cultural competence. Group work on written case studies. Simulated Patient Group: 10-minute lecture on cultural competence. Participation in 2 simulated patient encounters (played by pharmaceutical sciences graduate students from diverse backgrounds).	Students recognised improvement in specific components of cultural competency after participating in the educational interventions. For example: Simulation and lecture groups felt more confident in adjusting their communication styles and interviewing techniques to meet diverse cultural needs. Students in the simulation group expressed a desire to learn more about the health beliefs and practices of different cultures, showing increased cultural curiosity and openness. Case-scenario group students became more aware of the importance of mastering cultural competency as a skill in healthcare.	Time limitation, Domain-specific improvements suggest that a single intervention may not cover all facets of cultural competence.
6	Fejzic <i>et al.</i> (2016)	Core Knowledge	93	Six Simulated Learning Models scenarios were created by the teaching team who drew on their professional experience as educators and practitioners.	Students expressed increased in clinical skills and confidence to deal with patients	Some practice group sizes were big, which perhaps limited students' opportunity to engage and made time management more challenging. Actors' abilities sometimes varied, which could have affected the dynamic and quality of the role-plays and

S/N	Author	Skills	Number of participants	Student perspective	Challenges to skill development	Role of Specific practice setting
						subsequent debriefing.
7	Vyas, McCulloh, et al. (2012)	Teamwork	280	Simulation Exercise	Students expressed some confusion about their roles and responsibilities during the simulation, especially the health management students.	Students with little or no clinical experience were noted to have the most difficulty and stress during the simulation.
8	Bravo et al. (2019)	Information Gathering	10	Explore Student Perceptions on the Use of Virtual Interactive Cases	Virtual Interactive Cases Facilitated Student Skills in Information gathering,	Strength of prior clinical Knowledge, student preceptor learning styles, experiential site continuity,
9	Rotz et al. (2016)	knowledge of the medication use process, use of information related to drugs and human diseases currently being taught in class, basic patient assessment skills, apply drug information analytical skills, team based care,	163	Performance Assessment of Communication and Teamwork (PACT) novice tool and the student Perceptions of Physician-Pharmacist Interprofessional Clinical Education (SPICE) Instrument	Student perceptions to the study were generally positive, larger percentage of students agreed that they understood the roles of other professionals within the interprofessional team	coordination of logistics, scheduling, and satisfaction of accreditation requirements for two distinct academic institutions. Additionally, limited space and resources, including financial and personnel, are expected barriers in any free, student-run clinic environment.
10	Coons et al. (2019)	Clinical Skills, Patient Care roles	68	Pharmacotherapy Scholars Programme was created and designed to be an intensive training experience integrated into the PharmD curriculum as an area of concentration.	Students agreed to have gained valuable experience in data management, analysis, and interpretation.	Resource intensive, and increase in competition to enter into the programme.
11	Theodorou et al. (2018)	Interprofessional collaboration	188	Students Perception of Interprofessional Clinical Education-Revised (SPICE-R)	Most students agreed that the learning objective of this practice experience was achieved which was to satisfy IPE accreditation standards as well as to better prepare students to build more effective collaborative health care teams	Variability in student engagement, work flow disruptions in dental clinic
12	Tucci et al. (2019)	Leadership competencies, self-efficacy in leadership, engagement in	362	Curriculum mapping of leadership competencies in pharmacy education, Survey on leadership engagement and self-efficacy and Comparison of students with active leadership roles versus those without.	Nan	Leadership education mostly limited to a single course (Pharmacy Care Management), Lack of vertical and horizontal integration of leadership

S/N	Author	Skills	Number of participants	Student perspective	Challenges to skill development	Role of Specific practice setting
		leadership activities				development across the curriculum and limited formal leadership training opportunities outside student organisations
13	Pittenger et al. (2019)	Psychiatric pharmacotherapy, clinical decision-making, evidence-based medicine application, and APPE readiness	12	A one-credit elective psychiatric pharmacotherapy course, case-based learning with whole-task and guided reflection educational principles, use of cloud-based learning technologies (Google Docs, Cisco Meeting Server), student-led case work-ups evaluated by board-certified psychiatric pharmacists, weekly complex patient cases with evidence-based justifications, pre-class personal learning objectives and post-class reflections and self-assessment using Entrustable Professional Activities (EPA) framework.	Increased awareness of clinical judgement gaps, enhanced understanding of evidence-based medicine beyond guidelines, improved appreciation of patient-centered care in psychiatric pharmacy, greater excitement and confidence about beginning APPEs, and some students reported increased interest in psychiatric pharmacy specialisation	Limited prior exposure to psychiatric pharmacy practice settings
14	Bray et al. (2011)	Simulation-based learning, critical thinking, clinical decision-making, interprofessional collaboration and self-efficacy	nan	Review of different stimulation-based learning methods, including human simulation, standardized patients and role-playing; assessment of existing simulation-based learning tools in pharmacy curricula; categorisation of assessment tools into satisfaction/self-efficacy surveys, knowledge assessments, performance-based skill evaluations, problem-solving evaluations, and team-based behavior assessments	Positive feedback on simulation-based learning for improving confidence, clinical reasoning and decision-making; improved self-efficacy in interprofessional collaboration after participation in simulated team exercises and some students also reported that limited exposure to simulation negatively affected knowledge retention	Lack of validated tools to assess simulation-based learning outcomes and faculty limitations in developing structured simulation assessments
15	Bullock & Horne (2019)	Clinical skills and business management knowledge	20	A 15-week, two-credit elective course	Significant improvement in knowledge of pharmacist-led patient care, public health, communication, leadership and legal aspects and an increased confidence in performing clinical services and patient care in community pharmacy	Difficulty in understanding financial and business components
16	Morbitzer et al. (2021)	Leadership-related competencies	nan	Team based learning, interprofessional simulations, workshop	Nan	Lack of standardized teamwork training programmes, variability in assessment methods
17	Hussainy et al. (2012)	Communication skills	108	The use of virtual practice environment in Communication skills development	Most students believed the virtual practice environment was a useful teaching resource and that the video	Learning could be less engaging

S/N	Author	Skills	Number of participants	Student perspective	Challenges to skill development	Role of Specific practice setting
					component enabled them to contextualize patient problems.	
18	Conway & Ahmed (2012)	Clinical and professional skills	160	Active learning and problem-based learning	Students agree that the course integrated material across the curriculum and improved their clinical writing skills	Time-intensive case creation and grading complexity
19	Bowers <i>et al.</i> (2017)	Insulin injection technique and counselling skills	103	Use of standardized simulated patients and teach-back method for counselling	Improved counselling skills and knowledge retention	Time constraint and lack of long-term follow-up
20	Baalmann <i>et al.</i> (2023)	Interprofessional communication	282 (145 pharmacy and 137 medical students)	Telecommunication consultation simulation	Improved use of telecommunication consultation	Acknowledging errors and anticipating patient questions
21	Tofil <i>et al.</i> (2010)	Knowledge and application skills	42	Use of Simulation to Enhance Learning in a Pediatric Elective	Students felt the learning experiences were positive and realistic	shortage/lack of pediatric pharmacy education resources
22	Trujillo <i>et al.</i> (2016)	Achievement, preparedness and attitudes	319	Standalone, Patient-centered Communication Course Series	Students felt more positive that the evaluation format used in the course series was patient-centered and an effective way to evaluate course outcomes	Time constraint and integration of the curricula into content-heavy courses without sufficient emphasis on communication
23	Vyas, Bhutada, <i>et al.</i> (2012)	Assess student's competencies in core pharmacy domains before they begin advanced pharmacy practice experiences (APPEs)	88	Simulation based intervention with a pre/post assessment to evaluate students competencies in core pharmacy domains before they begin advanced pharmacy practice experience (APPEs)	100% of the students felt that the course increased their awareness of patient safety	Lack of real-world experience, time constraints, resource limitations
24	Donovan <i>et al.</i> (2020)	Communication skills	124	Applied improvisational pharmacy communication workshop	The P1 students who participated in the communication workshop expressed that they valued the chance to establish relationships within their cohort, learn about audience-centered communication, practice explaining complex information in creative ways, and extend and apply what they learned through discussion	It relied on self-report questionnaire data. Also, not all students who participated in the workshop provided comments.
25	Tsingos <i>et al.</i> (2014)	Reflective Practice, Critical	NaN	Reflective practice tools (portfolios, blogs, journals,	Reflective practice helps bridge theory with practice, enhances	Lack of motivation, lack of structured frameworks, and

S/N	Author	Skills	Number of participants	Student perspective	Challenges to skill development	Role of Specific practice setting
		Thinking, Problem-Solving		diaries, self-assessments, peer assessments)	communication, and encourages self-directed learning.	difficulty in assessing reflective learning.
26	Rao (2011)	Patient-care skills, communication, history-taking, active listening, documentation, professional attitudes	130 in semester 1, 129 in semester 2	Role-play model, peer observation, patient-pharmacist interactions, self-assessment, formative and summative assessment, structured feedback	Found role-play useful for communication, patient interactions, and self-assessment but less effective for documentation skills.	Students struggled with case note documentation; some found group size and repetitive nature of cases a limitation.
27	Lin <i>et al.</i> (2011)	Clinical decision-making, patient assessment, communication, pharmacy practice skills	nan	High-fidelity patient simulation, standardized patients, virtual reality simulations, full environment simulations, task trainers	simulation provides a risk-free environment to practice, enhances confidence, and allows repeated exposure to clinical scenarios.	High cost, faculty training requirements, lack of real-world emotional and environmental factors, and unclear integration into IPPE requirements
28	Zakaria & Awaisu (2011)	Communication, teamwork, problem-solving, patient assessment, clinical decision-making	138 (87 third-year, 51 fourth-year)	Shared learning through mentorship (fourth-year students mentoring third-year students), Clinical pharmacy practice experience in a hospital setting, Group-based learning and patient case discussions, Ward rounds and bedside case discussions and	Majority found shared learning improved teamwork and communication skills, some students felt they could learn clinical problem-solving skills just as well with peers from their own group.	Some students were uncomfortable working with a different student group, Differences in knowledge levels between third- and fourth-year students created imbalances, some students felt one hospital assignment per disease state was not enough.

Improved skill development was identified in 14 studies (50.00%) making it the most frequently reported benefit (Bray *et al.*, 2011; Lin *et al.*, 2011; Zakaria & Awaisu, 2011; Conway & Ahmed, 2012; Vyas, Bhutada, *et al.*, 2012; Vyas, McCulloh, *et al.*, 2012; Sales *et al.*, 2013; Wongwiwatthananut *et al.*, 2013; Tsingos *et al.*, 2014; Fejzic *et al.*, 2016; Bowers *et al.*, 2017; Bullock & Horne, 2019; Pittenger *et al.*, 2019; Baalman *et al.*, 2023). Students often noted that interventions strengthened their practical abilities and clinical competencies, especially in communication, counselling, and technical application. The second most mentioned outcome was increased confidence reported in six studies (21.43%), where students described feeling more prepared to handle real-world pharmacy challenges after participating in structured learning sessions (Bray *et al.*, 2011; Lin *et al.*, 2011;

Wongwiwatthananut *et al.*, 2013; Fejzic *et al.*, 2016; Bullock & Horne, 2019; Pittenger *et al.*, 2019).

Communication improvement was explicitly reported in eight studies (28.57%) (Rao, 2011; Zakaria & Awaisu, 2011; Vyas, McCulloh, *et al.*, 2012; Sales *et al.*, 2013; Tsingos *et al.*, 2014; Bullock & Horne, 2019; Donovan *et al.*, 2020; Baalman *et al.*, 2023), with students acknowledging that their verbal and interpersonal skills had been enhanced through activities such as simulation exercises and peer collaboration. Four studies (14.29%) (Bray *et al.*, 2011; Zakaria & Awaisu, 2011; Coons *et al.*, 2019; Morbitzer *et al.*, 2021), made reference to gains in teamwork, as participants engaged in group tasks or role-play scenarios that emphasised collaborative practice. Positive feedback or satisfaction with the learning experience was reported in four studies (14.29%) (Tofil *et al.*, 2010; Bray *et al.*,

2011; McDowell et al., 2016; Coons et al., 2019), suggesting that learners were generally receptive to the instructional methods and found them engaging.

Application of knowledge, as reflected in theoretical learning transfer to practical settings, was noted in two studies (6.9%) (Buring et al., 2007; Donovan et al., 2020), indicating a potential gap between classroom-based instruction and hands-on pharmacy practice.

Common challenges encountered by students in the development of technical and non-technical skills

Challenges to skill development among pharmacy students across the 28 studies are shown in Table II. Time constraint was reported in eight studies (32.14%), making it the most frequently mentioned challenge (Conway & Ahmed, 2012; Vyas, Bhutada, et al., 2012; Vyas, McCulloh, et al., 2012; Wongwiwatthanakul et al., 2013; Fejzic et al., 2016; McDowell et al., 2016; Bowers et al., 2017; Porter et al., 2023). These included limited time for hands-on activities, rushed curricula, and insufficient time for reflective learning, which may hinder the depth of skill acquisition.

Resource constraints were identified in five studies (17.86%). Challenges such as lack of access to training materials, physical facilities, or simulation tools required to deliver effective practical learning were pointed out (Tofil et al., 2010; Vyas, Bhutada, et al., 2012; Wongwiwatthanakul et al., 2013; Coons et al., 2019; Porter et al., 2023). We identified in four studies (14.29%) the issue of poor faculty support or time, which could be a result of the heavy workload on the staff in the academic environment and practice setting (Bray et al., 2011; Lin et al., 2011; Wongwiwatthanakul et al., 2013; Porter et al., 2023).

Technical difficulty in the form of software implementation in a virtual environment was observed in a study (3.57%) (Buring et al., 2007). Other challenges identified were lack of practical exposure (1, 3.57%) (Wongwiwatthanakul et al., 2013), curriculum structure issues (1, 3.57%) (Tucci et al., 2019), and assessment-related challenges (2, 7.14%) (Bray et al., 2011; Morbitzer et al., 2021). Together, these findings suggest that while instructional interventions are beneficial, their effectiveness is often limited by structural and logistical issues, particularly time, resources, and instructional capacity, which should be addressed through targeted educational reforms and increased institutional support.

Role and significance of practice setting in the development of technical and non-technical skills by students.

Most studies were conducted in a university/faculty setting (85.71%, n = 24), while the remaining four (14.29%) were conducted in a hospital or other clinical facility (Zakaria & Awaisu, 2011; Theodorou et al., 2018; Bravo et al., 2019; Tucci et al., 2019). The hospital/facility-based studies skewed toward interprofessional and relational competencies. Theodorou et al. (2018) and Zakaria & Awaisu (2011) reported gains in interprofessional collaboration and teamwork, Tucci et al. (2019) focused on leadership competencies, and Zakaria & Awaisu (2011) additionally reported communication, problem-solving, patient assessment, and clinical decision-making. By contrast, university/faculty-based studies covered a broader range of both technical skills (e.g., dispensing, insulin injection technique, diabetes care management) and non-technical skills, reflecting the wider variety of simulation and classroom-based interventions available in that setting.

The review revealed the important role of practice settings in the development of technical and non-technical skills in both undergraduate and postgraduate pharmacy students (Table II). From the studies, one of the most frequently cited contributions was the enablement of practical skill development, which was reported in 5 studies (17.86%) (Zakaria & Awaisu, 2011; Wongwiwatthanakul et al., 2013; Tsingos et al., 2014; Bullock & Horne, 2019; Porter et al., 2023).

Equally, five studies (17.86%) identified that practice settings enhanced collaboration or teamwork, often through peer-to-peer learning, group-based simulations, and structured interprofessional engagement - activities in which pharmacy students worked alongside students or practitioners from other health professions on shared patient-care tasks (Bray et al., 2011; Vyas, Bhutada, et al., 2012; Vyas, McCulloh, et al., 2012; Pittenger et al., 2019; Morbitzer et al., 2021).

Five studies (17.86%) emphasised the value of controlled learning environments, where students could safely engage with complex scenarios under supervision (Buring et al., 2007; Bray et al., 2011; Sales et al., 2013; Wongwiwatthanakul et al., 2013; Theodorou et al., 2018) another five (17.86%) focused on communication skills enhancements through practice settings (Bray et al., 2011; Hussainy et al., 2012; Vyas, McCulloh, et al., 2012; McDowell et al., 2016; Donovan et al., 2020). Exposure to patient simulations and real-time feedback loops provided

meaningful opportunities to refine verbal and non-verbal communication in a professional context.

Discussion

This scoping review mapped how pharmacy practice experiences contribute to technical and non-technical skill development in pharmacy students, addressing four objectives: the technical skills developed, the non-technical skills developed, the role of practice settings, and student perspectives on this development. Across 28 included studies, simulation-based training and interprofessional collaboration emerged as the dominant and most effective strategies, improving both technical competencies (e.g., dispensing, clinical decision-making, patient assessment) and non-technical competencies (e.g., communication, teamwork), while leadership training and theory-practice integration remained comparatively underdeveloped. By synthesising evidence across nearly two decades and multiple practice settings, this review adds a consolidated, cross-context picture to the pharmacy education literature, which until now has largely comprised single-institution or single-intervention studies; it is, to our knowledge, among the first to map both skill domains together against practice-setting type rather than treating technical and non-technical outcomes separately. The distribution of studies suggests increased attention to pharmacy education and its reforms in light of the evolving role of the pharmacy profession. Similar trends have been recorded in previous studies, which attributed them to accreditation reforms and increased emphasis on patient-centred care and interprofessional practice (Wongwiwatthanakul et al., 2013; Pittenger et al., 2019).

The dominance of articles published in the North American region suggests a stronger funding structure and earlier adoption of simulation-based technologies (McDowell et al., 2016). The limited number of articles from low- and middle-income countries highlights a persistent gap in the literature and reinforces calls for increased research on pharmacy practice and education in these regions.

Simulation-based education emerged as the most frequently employed intervention. This is consistent with previous studies where simulations including standardised patients, virtual platforms, and role-play were effective in enhancing communication, clinical reasoning, and confidence by offering immersive, low-risk learning environments (Tofil et al., 2010; Bowers et al., 2017). Virtual learning environments further supported skill acquisition in dispensing and

communication, particularly where access to physical simulation facilities was limited (McDowell et al., 2016). This finding is consistent with a broader scoping review of simulation training in pharmacy education, which similarly found simulation most impactful for communication, counselling, and interprofessional collaboration across the wider literature (Gaspar et al., 2024). Self-directed learning and critical reflection were further promoted through the use of peer learning, reflective exercises, and team-based methods, indicating a significant shift toward student-focused learning (Fejzic et al., 2016; Donovan et al., 2020).

The studies reflected an increasing attention to technical and non-technical skills. Technical competencies such as pharmacotherapy, diabetes care, and medication dispensing, as well as non-technical skills such as communication, teamwork, cultural competence, and professional identity formation, were identified. This trend aligns with contemporary competency frameworks, which emphasise that effective pharmacy practice extends beyond clinical knowledge to collaborative healthcare provision and improved decision-making (Sales et al., 2013; Tucci et al., 2019).

In contrast, building leadership skills was not adequately documented; although several studies acknowledged the need for leadership capabilities, they seem to be more emphasised in elective courses or extracurricular activities than in core curricula (Tucci et al., 2019; Morbitzer et al., 2021). This gap is not isolated to the present review: a broader literature review of pharmacy competency assessment similarly identified a scarcity of simulation-based approaches specifically targeting non-technical skills such as communication, teamwork, and clinical decision-making, indicating a persistent and field-wide gap rather than a limitation of this dataset alone (Croft et al., 2019). This fragmented learning approach could delay skill development or lead to insufficient preparation for leadership roles in increasingly complex healthcare systems. Studies show that experiences from extracurricular and experiential learning are quite beneficial in student development (Eddy et al., 2023; Aly et al., 2025). Pharmacy students and early-career pharmacists have highlighted the need to introduce more leadership experiences by reviewing the curriculum to include more practical leadership opportunities and support (Anunwa et al., 2025). Addressing this challenge requires intentional curricular design that integrates leadership development throughout the training years.

A theory-practice gap was observed from the relatively low proportion of studies demonstrating effective transfer of knowledge from theory to real-world

practice. Similar concerns have been raised in prior research, suggesting that experiential learning opportunities may be insufficiently aligned with academic objectives or may be insufficient to support clinical application (Conway & Ahmed, 2012).

Structural barriers, including time constraints, resource limitations, and faculty workload, have been identified and reported in the literature (Bray *et al.*, 2011; Porter *et al.*, 2023). These challenges disproportionately affect simulation-based and interprofessional interventions, which require varying levels of institutional commitment. It is, however, unclear whether the interventions, such as faculty development and curricular adjustment, are scalable and sustainable without adequate financing. Hence, a need to address the various structural barriers impacting learning.

Finally, practice-based and interprofessional settings were critically involved in consolidating both technical and non-technical competencies. Clinical and hospital environments facilitated authentic application of skills, while structured simulation labs provided safe spaces for formative learning. This is corroborated by a systematic review by Huon *et al.* (2024), where simulation-based training was shown to improve pharmacy students' confidence in performing clinical activities such as counselling, information gathering, and decision-making (Huon *et al.*, 2024).

Limitations of the study

The following limitations are identified in this scoping review. First, the predominance of quasi-experimental and exploratory study designs limits the strength of conclusions regarding intervention effectiveness. Second, the heavy geographic concentration of studies from North America may limit global applicability, particularly in resource-limited settings where educational infrastructure appears to differ. Third, variability in outcome measures, intervention duration, and assessment tools hindered direct comparison across studies. Additionally, many studies relied on self-reported outcomes, which may overestimate perceived skill gains. Finally, consistent with the scoping review methodology, a formal quality or risk-of-bias appraisal of included studies was not conducted; this is a recognised limitation of the scoping review approach, but it means the strength of individual study findings could not be independently weighted in this synthesis, and the reported effectiveness of the educational interventions discussed should be interpreted with this in mind.

Conclusion

This scoping review provides a global perspective on educational and intervention approaches to strengthen both technical and non-technical competencies among pharmacy students. This reflects a growing transition toward simulation-based and student-centred pedagogies. The various approaches promote communication, clinical decision-making, teamwork, and professional identity. Despite that, identified gaps include leadership training and theoretical alignment with clinical practice. Addressing these challenges will require a more coherent curriculum design, strengthened faculty, infrastructure development, expanded experiential learning opportunities, and greater international collaboration to advance an inclusive, practice-ready pharmacy education framework.

Conflict of interest

The authors declare no personal or financial conflicts of interest that could inappropriately influence the study.

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