

Supplementary Table S1. Executed search strategies.

Total items before duplicates removed: 4,816		Total items after duplicates removed: 2,636
Search	Query	Items Found
PubMed Search		
#1	("Education, Professional"[Mesh] OR "Education, Pharmacy"[Mesh] OR pre-licensure[tiab] OR intern[tiab] OR interns[tiab] OR internship[tiab] OR internships[tiab] OR resident[tiab] OR residents[tiab] OR residency[tiab] OR residencies[tiab] OR fellow[tiab] OR fellows[tiab] OR fellowship[tiab] OR trainee[tiab] OR trainees[tiab] OR student[tiab] OR students[tiab] OR "Students, Pharmacy"[Mesh])	706,520
#2	(Pharmacy[MeSH] OR "Schools, Pharmacy"[Mesh] OR pharmacy[tiab] OR pharmacists[tiab] OR pharmacist[tiab] OR pharmd[tiab] OR pharmacology[tiab] OR pharmacologist[tiab] OR pharmacologists[tiab])	181,903
#3	("Feedback"[Mesh] OR Feedback[tw] OR "Formative Feedback"[Mesh])	164,813
#4	#1 AND #2 AND #3	778
#5	#4 AND ("2000"[Date - Publication] : "3000"[Date - Publication]) AND English[Language]	733
PubMed after duplicates removed: 721		
Embase Search		
#1	('Education'/exp OR pre-licensure:ti,ab OR intern:ti,ab OR interns:ti,ab OR internship:ti,ab OR internships:ti,ab OR resident:ti,ab OR residents:ti,ab OR residency:ti,ab OR residencies:ti,ab OR fellow:ti,ab OR fellows:ti,ab OR fellowship:ti,ab OR trainee:ti,ab OR trainees:ti,ab OR student:ti,ab OR students:ti,ab OR 'pharmacy student'/exp)	1,947,351
#2	('pharmacy school'/exp OR pharmacy:ti,ab OR pharmacists:ti,ab OR pharmacist:ti,ab OR pharmd:ti,ab OR pharmacology:ti,ab OR pharmacologist:ti,ab OR pharmacologists:ti,ab)	223,704
#3	('feedback system'/exp OR 'constructive feedback'/exp OR feedback:ti,ab,de,tn)	231,487
#4	#1 AND #2 AND #3	2,460
#5	#4 AND [english]/lim AND [2000-2021]/py	2,379
Embase after duplicates removed: 1,644		
Scopus Search		
#1	TITLE-ABS("pre-licensure") OR TITLE-ABS("intern") OR TITLE-ABS("interns") OR TITLE-ABS("internship") OR TITLE-ABS("internships") OR TITLE-ABS("resident") OR TITLE-ABS("residents") OR TITLE-ABS("residency") OR TITLE-ABS("residencies") OR TITLE-ABS("fellow") OR TITLE-ABS("fellows") OR TITLE-ABS("fellowship") OR TITLE-ABS("trainee") OR TITLE-ABS("trainees") OR TITLE-ABS("student") OR TITLE-ABS("students")	1,505,881
#2	TITLE-ABS("pharmacy") OR TITLE-ABS("pharmacists") OR TITLE-ABS("pharmacist") OR TITLE-ABS("pharmd") OR TITLE-ABS("pharmacology") OR TITLE-ABS("pharmacologist") OR TITLE-ABS("pharmacologists")	231,325
#3	TITLE-ABS-KEY("Feedback")	664,733
#4	#1 AND #2 AND #3	973
#5	#4 AND (LIMIT-TO (LANGUAGE, "English") AND (INCLUDE (PUBYEAR, 2021-2000)))	918
Scopus after duplicates removed: 98		
Web of Science Search		
#1	TS=(pre-licensure OR intern OR interns OR internship OR internships OR resident OR residents OR residency OR residencies OR fellow OR fellows OR fellowship OR trainee OR trainees OR student OR students)	1,150,317
#2	TS=(Pharmacy OR pharmacists OR pharmacist OR pharmd OR pharmacology OR pharmacologist OR pharmacologists)	159,651
#3	TS=(Feedback)	470,888
#4	#1 AND #2 AND #3	828

#5	#4 AND PUBLICATION YEARS: (2021-2000) AND LANGUAGES: (ENGLISH)	786
Web of Science after duplicates removed: 173		

Supplementary Table S2. Description of included studies in didactic curricular setting.

Author(s), Year Country	Objectives of study	Number of learners	Method of feed- back	Focused area of feedback	Results of study
<i>Moderate Theory Talk</i>					
(Beal et al., 2020) United States	To determine pharmacy students' preferences for and perceptions of in-person and video evaluations	P1: 152 P2: 148 P3: 144	Multi-modal	Patient encounter (counseling, interviews) Provider communication	99.3% of students perceived in-person feedback more positively than video feedback except for "nervousness." Students who experienced video technology felt significantly less positive toward video evaluations in terms of quality (total mean difference 1.24 vs. 0.83) and amount (total mean difference 1.14 vs 0.77) of written feedback. Although students valued the interaction with a larger, more diverse pool of evaluators that was made possible by video evaluations, they did not view video technology as applicable to their future practice.
(Bond, Donohoe, Jakeman, Davis, & Morgan, 2017) United States	To implement a mock rounds activity designed to introduce students to case presentations and let them practice presentation skills.	P3: 621	Written	Patient case presentations	Students scored highly in respectfulness and completion time and lowest in logical flow and ability to answer questions.
(Brown, Kotlyar, Conway, Seifert, & St Peter, 2007) United States	Integrate an internet-based medical chart system into pharmacotherapy course to facilitate evaluation and feedback processes, foster documentation skills, and prepare students for EMR documentation systems	P3: 158	Written	SOAP notes	Student performance on documentation improved across the semester. Students found the EMR easy to use and helpful.
(Buring, Brown, Kim, & Heaton, 2011) United States	Evaluate the implementation of motivational interviewing in Doctor of Pharmacy curriculum by assessing student knowledge and perceptions and ability to use	P1-3: 75	Written	Health behavior change counseling Motivational interviewing	Student motivational interviewing performance improved each year. Repeated, formative assessments and feedback assist student performance.

	motivational inter-viewing					
(Burnworth, 2013)	To create, implement, and assess an elective course on the pharmacist's role in rare and interesting disorders and cases.	P2/3: 43	Written	SOAP notes and oral presentations	All students met or exceeded minimum competency levels on assessments.	Almost all students rated the course favorably, and course became a popular elective.
United States						
(Gogineni, Aranda, & Garavalia, 2019)	To apply Gagnes' instructional design model to teaching liver pharmacotherapeutics.	P2: 84	Multi-modal	SOAP notes	Significant student improvement from pre- to post-knowledge assessment and on SOAP performance with Gagnes' instruction model.	Course evaluations reflected effectiveness of the instructional format.
United States						
(Hanya, Yonei, Kurono, & Kamei, 2014)	Assess the educational effectiveness of a phased, simulation role-playing communication program.	B4: 158	Written	Student communication during simulation activities	Deeper reflection levels of communication skills were displayed during transcription stage compared to role-playing with feedback or re-viewing videos.	
Japan						
(Hernick, 2015)	Develop a series of active learning modules to improve pharmacy students' performance on summative assessments in immunology and infectious disease.	P1: 146	Written	Immunology and infectious disease information	Student performance on module questions improved with repeated attempts and was predictive of student performance on summative assessments.	Module use had the most impact on low performing students.
United States						
(Kalata & Abate, 2013)	Assess the use of a student portfolio to provide student feedback on self-assessment skills	P1-2:158	Written	Self-assessment skills	Differences were found between P1 and P2 students for specific questions in the self-assessment assignment.	Students and faculty mentors felt the portfolio feedback system helped improve self-assessments.
United States						
(Kawaguchi-Suzuki, Fuentes, Gibbard, Backus, & Marcus, 2018)	Assess feasibility of mentored, self-directed learning for case presentation on curricular content and new, non-lectured information.	P2: 187	Verbal	Case presentation performance	Faculty ranked course activities as valuable for student learning.	Students ranked the group presentation valuable.
United States						
(Kelsch & Werremeyer, 2011)	Assess implementation of a requirement for developing a poster on a public health topic.	P3: 71	Verbal	Public health research poster development	Grading of posters by faculty was high with 17% getting perfect scores.	Course was well received by students and faculty.
United States						

(Lewis & Sewell, 2007)	To examine the effectiveness of providing formative feedback for summative computer-aided assessment	M1: 132	Written	Simulated pharmacology experiment	Students agreed that the feedback was positive and all tests should have formative feedback.
United Kingdom					Most students had positive thoughts about the video podcasts (76%) saying they were useful (75%), helpful for learning (79%).
(Maher, Hayden, Strawbridge, Gallagher, & Flood, 2020)	To develop a theory-informed video podcast-based method of providing formative feedback and evaluate student perceptions	M1: 53	Multi-modal	Pharmacy calculations	Majority of students preferred receiving both video and typed feedback compared to video feedback only. Typed feedback was used for quick verification while video feedback was used for further explanation and clarification.
Ireland					
(Melody, Harris, & Grover, 2018)	Describe the development and evaluation of a MTM elective and assess changes in students' perceived abilities, values, knowledge, and performance conducting MTM services	P3: 24	Written	Patient encounter (interviews)	Students reported improved abilities in a survey and reported higher agreement on MTM value statement.
United States					Course grades improved and indicated achievement of aims.
(Mpotos, De Wever, Cleymans, et al., 2013)	Test efficiency of CPR training with short self-learning and automated assessment/feedback to achieve pre-defined competency and retention after 5 months	"Novice": 404	Verbal	CPR skills	99% of participants achieved competence within 4 sessions. 48% retention rate of correct CPR technique at 5 months.
Germany					
(Persky, Greene, Anksorus, Fuller, & McLaughlin, 2019)	Development and implementation of a multiday module on assessing and providing feedback on student cognitive and interpersonal skill development and practice readiness	P1: 75	Verbal	Patient encounter (interviews and counseling)	Capstone pilot provided insights into students' knowledge and skills and gave them feedback on areas to improve.
United States					
(Planas & Er, 2008)	Implement a communication skills development system and evaluate its effectiveness in a clinical communications course	P3: 123	Multi-modal	Patient encounter (interview) SOAP notes	Students' patient communication skills improved as evidenced by course assessment scores.
United States					
(Pittenger et al., 2019)	To examine the feasibility and	P3: 12	Verbal	Patient work-up:	Quantitative and qualitative analyses demonstrated that

United States	effectiveness of combining whole-task and guided reflection educational design principles with cloud-based learning technologies to simulate the clinical psychiatric APPE in the classroom to begin to close the theory to practice gap			psychiatric pharmacotherapy	students progressed in their readiness for APPEs and gained additional psychiatric pharmacy knowledge and evidence-based medicine
(Powers & Bright, 2010)	To describe how webcams and notebook computers were used as an alternative method to VHS recording for recording students during communication exercises in professional practice development laboratory in a PharmD program	P2: 103	Verbal	Patient encounters	61.2% of students reported watching the recorded counseling session outside of class. The majority (75%) of teaching assistants reported a perceived time savings with the webcams. All teaching assistants and faculty perceived a benefit in providing the students with a digital recording for immediate feedback as compared with a 2-week delay in distributing VHS recordings of patient counseling sessions.
United States					
(Sibbald, 2011)	To create, implement, and assess a course based on 3 critical reasoning principles to develop pharmacy students' skills in literature appraisal, content, metacognition, and assessment	P4: 50	Verbal	Evidence appraisal	Students reported perceptions and self-assessments showing improvement in their learning approaches, sense of responsibility for individual and community learning, skills, and confidence.
Canada					
(Skelley, Wulz, & Thibodeaux, 2018)	To evaluate introduction of an EMR simulation activity aligned with steps of the PPCP in ambulatory care elective course	P3: 18	Written	SOAP notes	Students demonstrated significant changes in their knowledge, skills, and confidence in documenting clinical activities using an EMR.
United States					Shown the benefits of EMR integration into coursework.
(Strohfeltdt & Grant, 2010)	To introduce a new approach to PBL for a renal therapeutics course.	M2: 100	Written	Care plan on patient case study	Changes in the course structure and grading schemes better reflected the learning progress of students.
United Kingdom					
(Valdez, Shea, Knutsen, & Hoody, 2014)	Implement a student-directed activities and faculty formative feedback	P1: 160	Written	Patient encounter (counseling)	Students valued receiving personalized formative feedback from faculty and thought

United States	as methods to develop interviewing, assessment, SOAP note writing, patient presentation, and patient counseling skills					personalized formative feedback should be continued.
(Villa, Sprunger, Walton, Costello, & Isaacs, 2020)	To evaluate a clinical documentation rubric for pharmacotherapy PBL courses using IRR among different evaluators	P2: 234 documents P3: 83 documents	Written (rubric)	SOAP note		The mean initial evaluation score was 9.1 (SD 0.9) and the mean second evaluation score was 9.1 (SD 0.9), with no significant difference found between the two. The overall ICC. was 0.7 across multiple graders, indicating good IRR.
United States						
<i>Major Theory Talk</i>						
(Barnett, Gallimore, Kopacek, & Porter, 2014)	To evaluate student and instructor attitudes regarding consistency of SOAP note grading and feedback following changes in SOAP note submission and grading in Pharmacotherapy Laboratory series	P2: 36 P3: 54	Written	SOAP notes		Electronic feedback provided by instructors promoted improvements with future SOAP notes. Facilitated positive and constructive instructor feedback.
United States						For instructors, mean scores perceived inter- and intra-individual grading consistency improved between the two semesters.
(Basheti, Qunaibi, AbuRuz, Samara, & Bulatova, 2013)	Evaluate effectiveness of conducting MMRs and home medication reviews on improving undergraduate pharmacy students' pharmaceutical care skills and clinical knowledge	B5: 133	Written	Findings and recommendations from MMR and home medication review		Pre- post-course scores on same MMR case improved from 33.5 to 62.9. Self-assessment questionnaire all significantly improved.
Jordan						
(Basheti, Ryan, Woulfe, & Bartimote-Aufflick, 2010)	Investigate whether pharmacy students' anonymous peer assessment of a MMR was constructive, consistent with feedback provided by an expert tutor, and enhanced the student's learning experience; determine whether feedback from students was constructive, whether it was consistent with expert feedback, extent to which the use of peer feedback	B5: 182	Written	Findings and recommendations from medication management review report		Students gave higher marks compared to experts. No difference in quality of feedback. Majority of students agreed the activity was useful learning experience.
Australia						

	enhanced students' learning					
(Denton, Madden, Roberts, & Rowe, 2008)	To ascertain the value of an electronic feedback free-ware compared to handwritten feedback comments	First year PSP: 169	Written	Practical, numeracy	Handwritten feedback performed worse than electronic feedback in "amount of feedback," "identification of errors," and "highlighting of pleasing aspects."	
United Kingdom				Report-writing skills		
	To evaluate electronic vs paper counseling rubric to facilitate timely student feedback and explore differences in student performance, anxiety, and self-perceived preparedness in high stakes practical exam	P3: 201	Multi-modal (rubric)	Patient encounters (counseling)	No difference in student performance or anxiety. Perceived preparedness was higher in students who used electronic rubric during practice - timing of feedback was the mediating process to increase preparedness. Electronic rubrics resulted in more timely receipt of feedback.	
(Haack et al., 2017)						
United States						
	To determine the amount and type of feedback needed to improve pharmacy students' problem-solving skills using team-based learning and a problem-solving rubric	P2: 108 P3 written: 121 P3 written & verbal: 121	Multi-modal (rubric)	SOAP notes	Providing pharmacy students with written and verbal explanations may help them improve their problem-solving skills overall.	
(Medina, Conway, Davis-Maxwell, & Webb, 2013)						
United States						
	Compare self-learning using video and voice feedback and traditional instructor to learn CPR skills	"Novice": 120	Verbal	CPR skills	Self-learning with voice feedback was noninferior to traditional instructor for compression depth; inconclusive for other skills.	
(Mpotos et al., 2011)						
Germany						
	Assess efficacy of self-learning through video training and computer exercises (Voice feedback) for CPR skills	"Novice": 104	Verbal	CPR skills	After voice feedback a significant improvement was found for all compression and ventilation related outcome measures, except compression rate. Differences between gender and skill success resolved with voice feedback.	
(Mpotos, De Wever, Calle, et al., 2013)						
Germany						
	To evaluate recorded audio feedback to written feedback				Audio feedback provided significantly more feedback in regard to word count and cognitive process domain.	
(Nemec & Dintzner, 2016)	To assess student perceptions regarding use of recorded audio feedback	P1: 75	Multi-modal	Drug information	No significant differences between audio and written feedback regarding affective processes.	
United States						
	To determine				Significantly more negative	

	impact of providing audio vs written feedback on faculty time				emotion-related words found in written feedback compared to audio, but no differences in positive emotions were noted.
					Students felt audio feedback was more personal than written feedback and audio feedback was more useful for indicating organizational and content issues.
					Providing audio feedback took 1.5 min longer, on average, however students received more feedback.
					There were significant improvements from C10 to C12 and C13, but no difference C10 and C14 or C11 and C12-14 in course grade.
(Nutan & Demps, 2014)	To evaluate the effectiveness of an online approach to carrying out and providing feedback on formative assessments and assess student preferences	P1: 410 over 5 years	Written	Pharmacy calculations	Average C11-C14 course grade was 89.49-90.52%.
United States					Majority of students preferred online approach compared to Scantron for timely return of assignments, thoroughness of feedback, and overall convenience.
					Scores for the standardized patient evaluations improved for the 2nd and 3rd cases compared to the first ($F=27.48$, $p<0.0001$).
(Sherman & Johnson, 2019)	To determine if the patient care and documentation skills of pharmacy students improved in the P3 year using objectively developed SOAP note grading rubric and standardized patient checklist rubric during sequential system of case scenarios	P3: 126	Written (rubric)	SOAP notes	The SOAP note rubric use had a statistically significant increase in scores over all three cases.
United States					There was an increase in scores with each successive case scenario for: Treatment goals, monitoring/follow-up, and total score, but no other sections.
(Strohfelddt & Khutoryanskaya, 2015)	To introduce a new approach to problem-based learning in a medicinal chemistry practical class for pharmacy students	MPharm: 150	Written	Medicinal chemistry practical	New PBL design appeared to engage students with feedback and integration of knowledge.
United Kingdom					Average examination grade increased significantly.
P1: first-year Doctor of Pharmacy; P2: second-year Doctor of Pharmacy; P3: third-year Doctor of Pharmacy; EMR: electronic medical record; SOAP: Subjective/Objective/Assessment/Plan; B4: fourth-year Bachelor of Pharmacy; MTM: medication therapy management; CPR:					

cardiopulmonary resuscitation; APPE: advanced pharmacy practice experience; VHS: video home system; P4: fourth-year Doctor of Pharmacy; PPCP: Pharmacist Patient Care Process; PBL: problem based learning; M2: second-year undergraduate Master of Pharmacy; IRR: inter-rater reliability; SD: standard deviation; MMR: medication management review; B5: fifth-year Bachelor of Pharmacy; PSP: pharmaceutical science and pharmacy; C10-14: classes of 2010-2014; MPharm: Master of Pharmacy

Supplementary Table S3. Description of included studies in objective structured clinical examination/simulation curricular setting.

Author(s), Year Country	Objectives of study	Num- ber of learners	Method of feed- back	Focused area of feed- back	Results of study
<i>Moderate Theory Talk</i>					
(Bajis, Chaar, Basheti, & Moles, 2019) Jordan	Investigate the impact of an in-classroom simulation- and feedback-driven training activity on students' medication reconciliation skills, self-perceived confidence, and overall student satisfaction	B4-5: 144	Multi-modal	Medication reconciliation skills	Assessment-based competency scores demonstrated significant improvement in student performance during the activity. Self-perceived confidence scores significantly improved after the medication reconciliation training intervention. Focus group content analysis yielded positive responses such as students valuing receiving feedback on performance and recommendations for future training.
(Evans, Alinier, Kostrzewski, Lefteri, & Dhillon, 2011) United Kingdom	Describe the development and design of formative and summative OSCE program across a 4-year curriculum	NA	Multi-modal	20-station OSCE of real-life pharmacy practice scenarios (focus on communication and problem solving)	The school set up a 20-station circuit of five-minute stations that cover a range of practice-based scenarios. The process of setting up the first OSCE is described, including developing and validating stations, staff training, room and equipment logistics, and tutor and student feedback.
(Gums, Kleppinger, & Urick, 2014) United States	Determine the effectiveness of an individualized teaching method in as pharmacy skills laboratory (formative feedback)	P3: 150	Verbal	Patient encounter (counseling)	Ophthalmic OSCE station scores were higher after the individual formative feedback intervention.
(Kubota et al., 2018) Japan	Discuss and evaluate the features of this	P2: 242	Verbal	Patient communication skills training program	The available evidence suggests that simulated patients are suitable for use in communication-skills training.

	communication-skills training program				
(O'Reilly, Moles, Boukouvalas, & El-Den, 2019)	To use a novel MHFA assessment approach involving simulated role-plays enacted by people with a lived experience of mental illness and explore MHFA participants' and simulated patients' views of participating in simulated role-plays of mental health crises.	B5: 22	Verbal	Patient encounter (MHFA)	Student appreciated the ability to receive immediate feedback from someone with a lived experience of mental illness to improve their MHFA communication skills.
Australia					
Major Theory Talk					
(DeLucenay, Conn, & Corigliano, 2017)	To compare grades of students receiving immediate feedback verses delayed feedback	P3: 153	Multi-modal	Patient encounter (counselling)	Although more students preferred immediate feedback, overall grades did not differ based on method of feedback.
United States					
(Tait et al., 2018)	Investigate student experiences, satisfaction, and feedback preferences between three scenario simulation modalities (paper-, actor-, and computer-based)	PG2 : 20	Multi-modal	Patient encounters (medication history and patient triage)	Participants reported similar levels satisfaction across all three modalities.
Australia					
B4-5: fourth- and fifth-year Bachelor of Pharmacy; OSCE: objective structured clinical examination; NA: not applicable; P3: third-year Doctor of Pharmacy; P2: second-year Doctor of Pharmacy; MHFA: mental health first aid; PharmD: Doctor of Pharmacy; APN: advanced practice nursing student; PG2: 2 year post-Master of Pharmacy					

Supplementary Table S4. Description of included studies in experiential curricular setting.

Author(s), Year	Objectives of study	Number of learn- ers	Method of feed- back	Focused area of feedback	Results of study
Country					
<i>Moderate Theory Talk</i>					
(Bailey, Curington, Brown,	Implement and assess students' perception of and satisfaction with a	P4: 13	Multi-modal	MI	Improvements were seen in pre to post test in students' knowledge, perceived ability

Hegener, & Espel, 2017)	formal orientation training program for APPE students focusing on skills related to MI; determine students' ability in using MI compared to published standards					and perceived need to incorporate MI in practice.	MI ability showed significant improvements MITI scores increased from week 1 to week 4.	VASE-R score at week 3 was higher than benchmark standard).
(Bates et al., 2016)	To explore use of pharmacy learners as a means to explain pharmacy services in a LLPM; to examine whether an LLPM environment precludes achievement of knowledge-based learning objectives (using a pre and post experience test); to explore learner perception of the experience	P4: 8 PGY1: 1 PGY2- Oncology: 7	Multi-modal	Patient work-up		All learners improved scores from pre to post-test (mean +15%). Students mean +18% Resident mean +12.5%	All learners "passed" the experience.	Learner feedback on the experience overall was positive.
(Flood, Hayden, Bourke, Gallagher, & Maher, 2017)	Evaluate worked example video podcasts as method of providing feedback to pharmacy interns for an online and formative pharmaceutical calculations assessment	Interns: 162	Multi-modal	Pharmacy calculations		Majority of students found video podcasts were clear, helpful, easy to understand, and useful as method of feedback.	Learners felt positively about standard written solutions.	Distinct benefits for each kind of feedback.
(Korayem & Alboghdadly, 2020)	To evaluate the impact of integrating SBE into APPE on students' learning outcomes, training costs, and satisfaction	P4: 57	Written (rubric)	Patient work-up		Clear explanations, step-by-step approach and synchronization of audio and visual information was useful of podcasts.	Mean grades in both SBE and hospital-based blocks were mostly above 90% in all learning outcomes. Cognitive skills and affect learning outcomes mean grades were higher in the simulation-based group.	This newly structured experience provided fourteen direct patient care training seats per rotation and saved around 25,000 Saudi Riyals per rotation.
							Most of the students being satisfied with the simulation scenarios.	

United States	(Muzyk et al., 2020)	To implement and assess the effectiveness of an IPE course designed to provide pharmacy and nursing students with opportunities to improve their understanding of SUDs, assess their attitudes toward patients with SUDs, receive instruction and feedback on behavior change counseling, and engage in interprofessional education	P4: 13 Nursing: 14 Other: 51	Verbal	Patient encounters (counseling)	Pharmacy and nursing students demonstrated significant improvements in their attitudes toward patients with SUDs and toward IPE collaboration, as measured by the SAAS and SPICE-R2. Approximately 93% of pharmacy and nursing students counseled a patient with a SUD, with 96% of counseled patients reporting their intent to receive follow-up care.
United States	(Nisly, Nifong, Coble, & Mihm, 2021)	To assess pharmacy resident mentorship and feedback skills through participation in a longitudinal pharmacy student and resident seminar series	PGY1: 11 PGY2: 6 HSPA: 4	Verbal	Provision of student feedback	Student and resident survey responses were similar and provided favorable feedback on resident mentorship.
Australia	(Wigmore, Collins, Schneider, Arias, & Moles, 2018)	Ascertain how students in an experiential setting compared to experienced staff' respond to a childhood fever scenario using a simulated patient interview including assessment and recommendation to the patient	B2: 65 B5: 51	Multi-modal	Patient encounter (interview) Patient assessment, and recommendation	Second year students performed better than staff at questioning. Fifth year and staff achieved appropriate outcomes (92 and 65%) with smaller proportion of second year students performing well (52%). Staff achieved improvements over time in median questioning scores from feedback provided.
<i>Major Theory Talk</i>						
United States	(Andrus et al., 2018)	To develop and establish validity for a grading rubric to evaluate diabetes SOAP note writing in primary care APPEs and to assess reliability and student perceptions of the rubric.	P4: 51	Written (rubric)	SOAP notes	Student scores on SOAP notes increased over the 10 month period (3 SOAP notes per student). Correlations exist between scores and APPE grade, pharmaceutical care ability profile scores, and global impression scores. For faculty scorers, inter-rater reliability (0.59-fair), intra-rater reliability (0.98-1.00-excellent). Students stated rubric improved their ability (84.9%) and

						confidence (92.4%) on SOAP note writing.
						97% of students achieved ability-based outcomes; using the Kirkpatrick model: 93% of students and 100% of faculty felt the course was valuable.
(Blackmer, Thompson, Brunner, Patel, & Saseen, 2018)	To provide a novel culminating experience (2-week intersession course after 5 of 7 APPEs) that assesses student competence and achievement in 5 curricular ability-based outcomes during the P4 year	P4: 149	Written	Student competence of 4 ability based curricular outcomes using clinical case, drug information, clinical pearl, reflection		80% of students and 85% of faculty felt learning occurred from the course. Student feedback by faculty led to increased student performance on pre-work compared to in-class work.
United States						The course complemented learning from previous courses and met the intended purpose.
						Significant differences in total score, general score, and interpersonal score between first and second counselling sessions for both video and verbal groups were noted but not for control group.
(Chiau, Ali, Bakry, Azmi, & Paraidathatu, 2016)	Evaluate the effect of video recording feedback in comparison to verbal feedback in communication and counseling among pharmacy students	B4: 45	Multi-modal	Patient encounter (counseling)		communication skills in video and verbal group were improved compared to control group.
Malaysia						Academic performances (cumulative GPA) did not influence the results however gender has significant influence on student performance in general communication (females had higher scores on the second video following feedback).
	To evaluate and compare students' ability to perform in each area of the SOAP note during APPEs within an academic year					No difference in SOAP note performance based on time of year of APPE.
(Nguyen, Wong, Wang, & Goldberg, 2019)	To compare the quality of SOAP notes between semesters: summer (1-3 rotation blocks), fall (4-6 rotation blocks), and spring (7-9 rotation blocks)	P4: 128	Written	SOAP notes		Students did better on SOAP note 2 than the first SOAP note after feedback was provided (S/O 3.8 vs 4.2 p=0.0015; A 3.3 vs 3.6 p=0.0072; P 3.6 vs 4 p=0.0007)
United States						

					Comparing the control to the intervention group, the intervention group had a significantly higher
(Teply, Spangler, Klug, Tilleman, & Coover, 2016)	To investigate whether instruction and feedback on reflective responses are beneficial in developing pharmacy students to become more reflective practitioners.	P4: 34	Written	Self-reflections (instruction on how to do reflections/intervention group vs no instruction: control group)	proportion of responses rated as reflective compared to the control group, 83.3% compared to only 37.5% from the control group (p=0.006). Based on the analysis of the pre/post-APPE surveys and the study group assignment, the only factor found to have a significant effect on whether a student's week 4 response was categorized as reflective was the assignment to the intervention group (p=0.011).
United States					

APPE: advanced pharmacy practice experience; MI: motivational interviewing; P4: fourth-year Doctor of Pharmacy; MITI: motivational interviewing treatment integrity; VASE-R: video assessment of simulated encounters-revised; LLPM: layered learning practice model; PGY1: post-graduate year 1; PGY2: post-graduate year 2; IPE: interprofessional education; SUD: substance use disorder; HSPA: health-systems pharmacy administration SAAS: substance abuse attitudinal scale; SPICE-R2: Student Perception of Interprofessional Clinical Education; B2: second-year Bachelor of Pharmacy; B5: fifth-year Bachelor of Pharmacy; SOAP: subjective/objective/assessment/plan; B4: fourth year Bachelor of Pharmacy; GPA: grade point average.

Supplementary Table S5. Description of included studies in co-curricular setting.

Author(s), Year Country	Objectives of study	Number of learn- ers	Method of feed- back	Focused area of feedback	Results of study
<i>Moderate Theory Talk</i>					
					Each cohort's final mean overall, self-awareness, self-management, and social awareness EIA scores were higher than their corresponding mean initial scores.
(Buckley et al., 2020) United States	To determine student pharmacists' perceptions of a leadership development program for student organization officers and report the changes in their EIA scores	P1: 166 over 3 years	Written	Student reflections/emotional intelligence	All respondents (61%) either strongly agreed or agreed that participating in the program enhanced their leadership skills. The majority of respondents additionally rated each of the program's activities as being either beneficial or very beneficial. The emotional intelligence assessment and strengths-based leadership assessment were the activities that were most frequently cited as being very beneficial.
(Bushell, Austin, Moore,	To determine if formative assessment is an effective method for	B5: 9	Written	Interview prep	8/9 students reported the formative assessment task helped them identify their

Hendry, & Adams, 2015)	increasing students' odds of obtaining an intern pharmacist position					areas of weakness and allowed them to prepare in their actual interviews.
Australia						8/9 indicated that the feedback helped them perform in their actual interviews.
(Caballero et al., 2012)	To develop a RIPS	P4: 10	Multi-modal	Journal club	CV and personal statements	Students stated the course improved their application materials, interview skills, and confidence in their ability to obtain a residency.
United States				Verbal case presentation		78% of RIPS participants matched with a residency program.
(Knutson, Hanselin, Lalama, & Moote, 2018)	Evaluate value of a residency bootcamp in preparing for residency application	P4: 21	Multi-modal	Post-grad training prep		Students ranked bootcamp experience from 4.62 to 4.69 out of 5 in various areas.
United States						92% of students felt the mock interview improved their skills.
(Koenigsfeld et al., 2012)	Assess student opinion about mock interview activity for residency and impact on match rates	P4: 25	Verbal	Interview prep		88% felt they understood interview questions better.
United States						Match rates higher in mock interview group compared to national rates.
(Lucas, Gibson, & Shum, 2019)	To assess pharmacy students' perceptions of the benefits and utility of a novel online reflective-writing tool	M2: 39	Written	Reflective writing		A comparison of students' responses on the pretest with those on the posttest, which was administered four weeks after the workshop, suggest a noticeable increase in agreement with AWA's benefits as an effective, online tool for improving their reflective learning skills.
Australia						
(Medina, Schwier, Miller, Miller, & Skrepnek, 2018)	Assess student knowledge of six career skills areas, and perceptions/confidence in these skills	P4: 106	Multi-modal	Business attire/dining etiquette	CV/resume/interviewing skills	Knowledge improved by 7.1 points over baseline.
United States				Networking		Confidence improved in career skills areas.
(Ray, DuBrava, & Jacks, 2020)	To create a portfolio meeting multiple needs, including learning improvement, curricular	P1-4: 103	Written (rubric)	Student portfolio		This course provides a wealth of opportunity for student growth and generation of assessment data, but it is best suited for programs with
United States						

	assessment, and accreditation					ample support resources to maintain its integrity as designed.
(Wolfgang, 2019)	Describe a comprehensive design of mock residency interviews intended to closely mimic the environment and variety of interview settings commonly seen in post-graduate year 1 interviews	P4: 24	Written	Interview prep		Precise scheduling and widespread participation of faculty and pharmacists is key for success of interview prep program.

EIA: Emotional Intelligence Appraisal; P1: first-year Doctor of Pharmacy; B5: fifth-year Bachelor of Pharmacy; RIPS: residency interviewing preparatory seminar; P4: fourth-year Doctor of Pharmacy; CV: curriculum vitae; M2: second/final-year Master of Pharmacy; AWA: Academic Writing Analytics.