Ind. J. Pharm. Edu. Res., 2026; 60(4):1379-1393.
https://www.ijper.org

Review Article

A Comprehensive Review on Outcome Based Education Framework (OBE) for Implementation in Indian Pharmacy Institutes

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ABSTRACT

Introduction: There has been a substantial paradigm shift in pharmacy education towards Outcomes-Based Education (OBE), which emphasizes the acquisition of industrial based competencies and skills among the graduates. **Objectives:** This review discusses the framework of an OBE, which will ensure redesigning of the teaching practices based on the industrial requirement and will create an opportunity for universities in India to produce marketable graduates. **Materials and Methods:** A total of 218 papers were identified, and 135 were utilized to compile the review paper. The research studies included in this process were those which contained at least three selected keywords. Any papers that did not correspond to these keywords were excluded from the review process. The study was conducted from March, 2023 to June 2024. **Results and Discussion:** The review highlights significant disparities between the current state of pharmacy education and the expectations of the industry, particularly in the areas of practical skills and employability. The review recommends the implementation of an OBE framework that includes well-defined Program Educational Objectives (PEOs) and Program Learning Outcomes (PLOs) to align educational outcomes with the demands of the industry. Continuous Quality Improvement (CQI) will ensure that the curriculum is regularly updated based on stakeholder feedback to enhance the level of competency among students in critical thinking, problem-solving, and practical application. **Conclusion:** This review offers a comprehensive framework for a possible implementation of OBE in Indian pharmacy universities and institutes, with the objective of aligning with industry needs and enhancing global competitiveness.

Keywords: Outcome Based Education (OBE), Program Educational Objectives (PEOs), Program Learning Outcomes (PLOs), Course Learning Outcomes (PLOs), Continuous Quality Improvement (CQI), Blooms taxonomy.

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Received: 27-03-2026;
Revised: 06-05-2026;
Accepted: 15-07-2026.

INTRODUCTION

The Indian pharmaceutical industry has been successful in its indigenous self-reliant development, but of late it faces challenges in terms of product development capabilities and global competitiveness.[1-3] The industry is undergoing a transformation in its business model towards emerging markets, which necessitates a re-evaluation of strategies and the identification of new opportunities.[4,5] The pharmaceutical and healthcare industries in India face similar landscapes. The Pharmacy Council of India

DOI: 10.5530/ijper.20261641

(PCI) has mandated all pharmacy colleges to implement a newly introduced curriculum for pharmacy programs, indicating a standardisation in educational requirements. This has led to uniformity in pharmacy education across all institutions in India. However, employability and readiness of pharmacy graduates in the job market are directly linked to the quality of education provided in pharmacy institutions.[6] A study suggested that current pharmacy teaching may not fully meet the demands and expectations of the industry, necessitating a re-evaluation of the curriculum to ensure alignment with the industry requirements.[7]

What is Outcome Based Education (OBE)

OBE is an educational approach that focuses on specifying the precise learning outcomes that students should attain at the end of a course or program. This approach emphasises the competencies and skills that students should acquire and these outcomes guide the design of the curriculum, teaching methods, and assessment strategies. The OBE represents a paradigm shift in education, as it emphasises what students can learn and demonstrate, rather than solely on what educators provide to students.[8-11] OBE has been applied to many higher education institutes in developed countries for curriculum improvement and quality assessment, with the aim of aligning educational programs with specific learning outcomes. OBE has reshaped the learning environment and pedagogical approaches in medical, nursing, and pharmacy schools in countries such as the United Kingdom, United States of America, Singapore, and Malaysia, leading to innovative shifts in curriculum and faculty development.[12-15] The importance of the OBE in pharmacy education lies in its ability to ensure that graduates are practice and team-ready, aligning educational outcomes with the evolving pharmacy curriculum.[16] The OBE-based curriculum can help produce graduates who are well equipped to contribute to new drug discovery, delivery, and optimal patient care, thereby improving therapeutic outcomes.[17] The OBE-based curriculum can also facilitate the development of research and development capabilities, which are essential for the Indian pharmaceutical industry to enhance its global competitiveness.[18,19]

The PCI should guide universities and institutes to align with the educational philosophy of the OBE, which focuses on defining training objectives, identifying professional programs and emphasising the outcomes based on industry needs. Moreover, as OBE requires continuous improvement in all phases of training, it acts as a recurring education transformation model.[20] PCI should plan to enhance its accreditation procedure by verifying not only tangible teaching facilities but also the educational methodologies employed. Institutions should be prepared according to the OBE concept requirements for accreditation in professional certification.[21] The council should mandate that accreditation be granted for durations of two, three, four, or five years, contingent upon the accreditation score, which would reflect a 360-degree institutional development. Curriculum for professional programs like pharmacy and engineering should strive to develop teaching factories with integrated content which should provide students with real-world case studies, projects, and practical examples developed by industry partners.[22] The OBE system allows for a comparison of educational offerings against established industry and pedagogy standards. This would enable universities to identify areas for improvement and make necessary adjustments to effectively align the curriculum with industry requirements.[23] The current pharmacy curriculum in India has yet to adopt innovative, outcome-centric methods for fostering critical clinical and professional competencies among graduates. Moreover, traditional curricular models currently predominant in India emphasize content delivery over competency assessment and lack the structured evaluation methods. The research gap, therefore, lies in both the theoretical and practical domains and it is required for the universities and colleges to benchmark against international best practices and outline a structured approach for curriculum reform that emphasizes measurable competencies, improved student self-efficacy, and enhanced clinical decision-making skills. In doing so, pharmacy education in India can better equip graduates with the competencies needed to succeed in the dynamic and evolving pharmaceutical industry.[24,25]

Objectives

This paper aims to highlight the importance of the implementation of an OBE, with a specific focus on how it will enhance the graduate competencies. The paper describes the salient features of an OBE and proposes comprehensive framework for integrating OBE into pharmacy curricula in India.

METHODOLOGY

This narrative review was conducted from March 2023 to June 2024 to explore the relevance, structure, and potential implementation of an OBE framework in Indian pharmacy institutes. Literature was identified using keyword-based searches related to OBE, pharmacy education, Program Educational Objectives (PEOs), Program Learning Outcomes (PLOs), Course/Sibject Learning Outcomes (CLOs/SLOs), Bloom's taxonomy, assessment strategies, curriculum mapping, transferable skills, learning technologies, and Continuous Quality Improvement (CQI). A total of 218 papers and relevant documents were initially identified. After screening for relevance, 135 sources were included in the review. Studies and documents were considered eligible if they addressed at least three of the selected keywords and provided information relevant to OBE principles, curriculum design, assessment, competency development, quality assurance, or pharmacy education. Papers that did not align with the selected keywords or were not relevant to the objectives of the review were excluded. The included literature was reviewed narratively and organized into key thematic areas, including OBE principles,

PEOs, PLOs, CLOs, assessment strategies, curriculum mapping, transferable skills, educational technologies, and CQI.

Salient features of an OBE system

Vision and Mission of the University/Institute/Colleges

The university/Institute should develop a time-based vision and mission that aligns with the theme of OBE curricula. It may be advisable for the institution to adopt or endorse the nation's vision and mission, such as the Ministry of Chemicals and Fertilizers, Department of Pharmaceuticals, India.

Program Educational Objectives

The Institute/College of Pharmacy should establish Program Educational Objectives (PEOs) that are specific and designed for each program, whether it is a diploma, degree, or postgraduate course.[26] PEOs play a crucial role in defining and measuring the impacts of an educational program in an OBE curriculum. PEOs describe the expected achievements and contributions of graduates five (5) years after their studies are completed. They typically align with the overall objectives of the program and reflect the needs of various stakeholders such as students, employers, and society as a whole.[27] The Conceive, Design, Implement, Operate (CDIO) initiative was established by leading engineering schools in countries such as the United states of America, Europe, Canada, the United Kingdom, Africa, Asia, and New Zealand. This collaborative effort focussed to create a new vision for engineering education based on the premise that engineering graduates should possess the ability to conceive, design, implement, and operate complex engineering systems in a modern team-based environment. The CDIO framework provides a structured approach to outcome-based engineering education, which can serve as a guide for the development of PEOs.[28]

PEOs are designed to be specific and measurable, focusing on the knowledge, skills, and attributes graduates should possess. They serve as roadmaps for curriculum development, instructional strategies, and assessment methods to ensure that students are adequately prepared for their future roles. By clearly articulating PEOs, universities can tailor their educational programs to meet industrial needs and societal expectations effectively.[29] It is essential to implement a comprehensive and systematic evaluation approach for measuring PEOs at least five years after graduation from university/institute/colleges.[30]

The following strategies can be implemented to measure PEOs.

Longitudinal Alumni Surveys

A comprehensive survey should be conducted with alumni who graduated at least five years ago to collect feedback on their career progression, achievements, and the extent to which they believed the program prepared them for their professional roles. The feedback could be useful for assessing the educational programs delivered at the institute.[31]

Employer Feedback

The Institute should seek input from employers who have employed graduates to evaluate their performance, abilities, and competencies in the workplace. This feedback would offer valuable insights into the correlation between program outcomes and industry requirements.[32]

Peer Benchmarking

The institution can also compare the performance and accomplishments of other school alumni in relation to those of graduates from peer institutions as a means of assessing the effectiveness of the curriculum. Conducting such a comparative analysis would enable the identification of areas of excellence and areas in need of improvement with regard to achieving PEOs over the course of time.[33]

Alumni Interviews

The university/school/department should engage in and conduct structured interviews with alumni to understand their career trajectories, professional accomplishments, and the way their educational experiences have contributed to their success. This qualitative approach can yield substantial information on the impact of the OBE curriculum for graduates. Moreover, it will also allow the university to realise how the curriculum should be reviewed to achieve better outcomes for new graduates.[34]

Collaboration with Regulatory Bodies

The University should work in partnership with regulatory organisations or accreditation agencies such as PCI to evaluate the progress and accomplishments of graduates. This external validation offers an objective appraisal of the program's success in fulfilling its PEOs.[27]

Design of PEO

PEOs for pharmacy schools should be designed and written to ensure harmony with the broader objectives of the institution and the aspirations of relevant stakeholders, including students, faculty, employers, and the healthcare sector.[35] Ideally, pharmacy schools should have at least 4-5 PEOs.

The following are examples of objectives which an institute can frame:

PEO 1: To foster the development of pharmacy graduates who possess good understanding and skills in manufacturing medicines and patient care, empowering them to provide evidence-based pharmaceutical care.

PEO 2: To cultivate pharmacy professionals who exhibit cultural competence, ethical behaviour, and effective communication

skills in diverse healthcare settings, resulting in favourable patient outcomes and cooperative interactions between healthcare professionals.

PEO 3: To equip pharmacy graduates with the capacity to engage in continuous learning, critical thinking, and problem-solving, thereby enabling them to respond to the evolving healthcare landscape and contribute to advancements in the field.

PEO 4: To educate pharmacy professionals who serve as advocates for public health, medication safety, and health promotion, actively participate in the betterment of the community, and address healthcare disparities.

The formulation of clear, measurable, and aspirational Program Educational Objectives (PEOs) will enable pharmacy schools to provide dedicated and exceptional pharmacy education and progress in the pharmacy profession.

Programme Learning Outcomes (PLOs)

Learning outcomes are essential components of educational programs, serving as a means of evaluating the effectiveness of learning experiences and crucial elements in assessing teaching quality.[36] These outcomes are critical for accrediting bodies to measure student achievement and ensure program compliance with required standards.[37] The effectiveness of a program can be assessed and improved through the alignment of course learning outcomes with PLOs and graduate attributes.[38,39] The development of PLOs has a significant impact on curriculum design and teaching practices, shaping the organisation and delivery of educational content to students.[40] PLOs can provide a roadmap for both students and educators, outlining the knowledge and skills learners are expected to acquire throughout the program.[37] The alignment between PLOs and the teaching and learning process will ensure that students graduate with the required resources, skills, and experience.[41] These outcomes form the basis for competency-based programs, emphasising explicit learning outcomes, adaptable skill mastery timeframes, diverse instructional activities, and criterion-referenced testing to guarantee effective learner guidance and assessment.[42] Curriculum mapping involves linking course outcomes with program-level learning outcomes and aligning various course elements within a program to effectively enhance student learning. This strategic alignment ensures that the curriculum is structured thoughtfully, thereby promoting coherence and consistency in educational delivery.[43] Additionally, using student learning outcomes to evaluate orientation programs can help institutions tailor support services to meet diverse student needs during the transition process.[44]

The pharmacy school can design 10 to 12 learning outcomes, each of which should be prescribed for measuring the specific skills and outcomes of the graduates and the effectiveness of the overall program.[35] Based on the curriculum designed by the PCI, pharmacy schools may be able to develop PLOs under the following criteria.

PLO 1: Measuring knowledge and understanding of basic concepts in pharmaceutical sciences.[45]

PLO 2: Measuring comprehensive thinking skills for advanced concepts of pharmaceutical sciecnes.[46]

PLO 3: Measuring hands-on/lab/practical/practice/dispensing skills in a pharmaceutical settings.[47]

PLO 4: Measuring inter-professional, social skills and responsibilities among health care professeionals.[48,49]

PLO 5: Measuring leadership, and communication skills in a pharmaceutical and healthcare settings.[50]

PLO 6: Measuring scientific, problem solving, and critical thinking skills in assisting decision making process in a pharmaceutical settings.[51]

PLO 7: Measuring the use of artificial intelligence/digitisation in pharmacy.[52]

PLO 8: Measuring the ethical and professional behaviour in pharmacy settings.[53]

PLO9: Measuring integrity in lifelong learning and management skills.[54]

PLO 10: Measuring entrepreneurship and business skills.[50]

By incorporating these PLOs into the pharmacy curriculum in India, educational institutions can ensure that graduates are well prepared to meet the evolving demands of the healthcare sector and contribute effectively to the pharmacy profession in the country.

Course/Subject Learning Outcome (CLO/SLO)

A Course or Subject Learning Outcome (CLO/SLO) refers to the specific knowledge, skills, or competencies that students are expected to acquire or demonstrate upon completing a particular subject or course in a pharmacy program.[39] These outcomes are derived from the course objectives, which are aligned with the PLOs and POs.[55] To ensure that CLOs are effectively structured, it is essential to incorporate specific components that encompass a Verb (V), Condition (C), and Standard (S) (Figure 1).[56,57] These components are crucial as they align with Bloom's Taxonomy (BT), which provides a framework for categorizing educational objectives based on the level of difficulty associated with different verbs.[58] A well-crafted CLO statement should clearly define the specific knowledge, skills, or competencies that students are expected to acquire by the end of the course. CLO statements should be written with the level of difficulty aligned with BT or Miller's triangle. CLOs would allow faculty and educators to design and incorporate active learning strategies and simulations to enhance student engagement and the retention of core content in

a pharmacy program. By utilising active learning methodologies, educators can create a learning process that promotes student participation, critical thinking, and the application of knowledge in real-world scenarios.[59] Learning outcomes that focus on population health management skills can help pharmacy students develop competencies to address public health challenges and promote community well-being. The technique will build population health management skills and contribute effectively to preparing students to address population health needs in their future pharmacy practice.[60] Figure 1 shows an example of the modified CLOs for Human Anatomy and Physiology -1, which is taught to year 1 BPharm students in India.

Blooms Taxonomy (BT)

BT is a widely recognised educational framework that categorises learning objectives into cognitive, affective, and psychomotor domains. This taxonomy differentiates between various levels of cognitive skills, emphasising the importance of promoting deeper learning and the transfer of knowledge to different contexts.[61,62] It has been widely used in education to structure learning objectives and assessments, aligning with the classical structure of knowledge, attitude, and skills.[63] The taxonomy's hierarchical levels, ranging from basic knowledge recall to complex evaluation and synthesis, make it a versatile and effective model for designing learning activities and measuring learning outcomes.[64] The taxonomy comprises six levels: remembering, understanding, applying, analysing, evaluating, and creating, each representing a different cognitive skill.[65] The cognitive domain focuses on intellectual skills; the affective domain pertains to emotions, attitudes, and values; and the psychomotor domain involves physical skills and coordination.[66] It provides a structured approach to classifying educational objectives, which is useful for lesson planning, assessment, and the measurement of learning outcomes.[67] BT categorises affective learning into five levels: receiving, responding, valuing, organising, and internalising.[68] In the psychomotor domain of BT, skills progress from basic imitation to automatic integration at the highest level of naturalisation. At the imitation level, individuals demonstrate basic understanding by observing and replicating a skill or action. Precision signifies a higher level of skill refinement, where individuals demonstrate accuracy and consistency in executing a task (Figure 2).[69]

Assessment strategies

Assessment strategies are very important in an OBE-based curriculum, as a course should be able to assess the criteria identified in the course learning outcomes and competencies. CLOs statements direct the type and difficulty level of an assessment strategy (Figure 2).[70] By incorporating assessment strategies that target the cognitive, psychomotor, and affective domains, educators can ensure that students develop the comprehensive skill set necessary for pharmacy practice. One approach to designing assessment components in a pharmacy program is to align them with established competencies and outcomes, such as those outlined by the CAPE.[71] By mapping assessment tasks to these competencies, educators can ensure that assessments are directly linked to the essential skills and knowledge areas pharmacy students need to acquire during their education. Assessments in a pharmacy program should not only focus on cognitive skills, but also assess students' professionalism and attributes in the affective domain. Incorporating competency mapping into assessment design can help pharmacy students develop a range of skills, including critical thinking, problem-solving, and effective communication, which are essential for success in the field.[72] Assessments that evaluate professionalism, ethical behaviour, situational judgment tests, and other assessments that target professionalism and scientific problem-solving skills can ensure that students develop the necessary values and attitudes required in the pharmacy profession.[73]

Question papers for OBE based curriculum (*Blue print for assessment*)

The development of a blueprint or OBE-compliant Table of Specifications (TOS) allows teachers and educators to attain equilibrium in assessments, identify the learning domains being evaluated, and ensure equity in the assessment distribution across coursework and final exams. The TOS helps ensure the level of difficulty and time required for assessment based on learning outcomes for a particular course or subject.[74] Table 1 shows an example of how a blueprint/TOS should be designed so that the assessment is realistic. The table serves as a detailed blueprint or TOS, essential for ensuring alignment between teaching, learning, and assessment within a course or module. It systematically organizes key instructional components, beginning with topics, which are the various subjects covered within the curriculum, each assigned specific teaching lecture hours. These lecture hours determine the percentage of marks based on lecture hours, which helps in proportionately allocating marks to each topic based on its relative importance and coverage in the curriculum. Additionally, the example of the blueprint outlines four distinct assessments (assessment 1 to assessment 4), which may include quizzes, assignments, practical evaluations, or exams, with their corresponding marks and percentage distributions clearly indicated. Furthermore, the table incorporates various domains of learning, including the Cognitive domain (C1-C6), which follows bloom's taxonomy levels ranging from basic knowledge recall (C1) to advanced critical thinking and evaluation (C6). The Affective domain (A1-A5) assesses learners' attitudes, values, and emotional growth throughout the course, while the Psychomotor domain (P1-P5) evaluates practical and skill-based competencies. By providing a comprehensive overview of these domains, the blueprint ensures that the assessment strategy is well-balanced and appropriately addresses all aspects of learning. This structured approach ensures coherence and clarity in curriculum planning,

facilitating a holistic assessment of students' knowledge, skills, and values.[75,76]

Designing questions based on BT is crucial for creating assessments that target different levels of cognitive complexity and promote higher-order thinking skills among students. Kim incorporated BT into multiple-choice examination questions for a pharmacotherapeutics course by introducing sample questions representing each learning domain within BT to students during lectures and discussions. This approach allowed students to engage with questions that spanned various cognitive levels, from knowledge and comprehension to analysis, synthesis, and evaluation, providing a comprehensive assessment of their understanding and application of the course content.[77] Similarly, Verenna *et al.* examined the role of comprehension in performance at higher levels of BT through assessments of professional healthcare students. Quiz questions based on the first four levels of BT, focusing on gross anatomy, histology, and physiology of the gastrointestinal system, enabled educators to evaluate students' mastery of complex concepts and their ability to apply knowledge at different cognitive levels.[78] In another study, Zahra *et al.* conducted a descriptive analysis of the types of questions asked by novice teachers during the mathematics learning process, considering both objective and BT-based classification of questions. This research highlights the importance of aligning question types with BT to ensure that assessments target specific cognitive skills and promote critical thinking among students.[79] Wankhede discussed the challenges associated with classifying question items according to BT and the importance of developing effective classifier systems for this purpose.[80] This study emphasised the need for robust methodologies to accurately categorise questions based on BT, ensuring that assessments align with intended learning outcomes and cognitive levels.

The laboratory, practice, and dispensing skills should be assessed using Objective Structured Practical Examinations (OSPE) and Objective Structured Clinical Examinations (OSCE). OSPE and OSCE ensure that assessments target different levels of psychomotor or affective complexity which would promote higher-order thinking skills among students. Yaqinuddin *et al.* highlighted the importance of incorporating higher psychomotor skills in OSPE assessments by ensuring that questions align with curriculum.[81] Dissabandara *et al* emphasised that OSPEs allow for the assessment of the application of anatomical knowledge and cover a wider range of learning objectives at different levels of BT.[82] This comprehensive approach to question design ensures that assessments measure students' abilities to effectively apply anatomical knowledge and demonstrate proficiency across various cognitive levels. Yarhere *et al* highlighted the importance of aligning OSCE questions with BT levels to assess different aspects of learning, including psychomotor ability, knowledge, and attitude. By structuring OSCE questions based on BT, educators can evaluate students' performance in clinical scenarios and effectively assess their psychomotor and dispensing abilities.[83]

The use of rubrics in assessing critical thinking, presentation skills, laboratory skills, and clinical competencies is a good practice in OBE-based education. The rubrics include elements of high-order practical skills for assessments that effectively measure students' laboratory abilities. Chen *et al* reported rubrics to measure students' experimental skills in organic chemistry, the rubrics outlines the specific lab skills and subskills required for performing experiments effectively. The assessment criteria were divided into detailed descriptions of experimental skills through which educators could evaluate students' proficiency in practical tasks. BT ensures that rubrics can be used to assess high-order thinking skills in pharmacy students.[84] Reynders *et al* assessed critical thinking and information processing skills in undergraduate Science Technology Engineering and Mathematics (STEM) courses using rubrics that explicitly evaluated critical thinking skills at various cognitive levels. Affective skills in pharmacies are mostly assessed at hospitals with the aid of a clinical presentation and group case discussion. Patient cafés, problem-based learning, and active learning strategies during the hospital/clinical pharmaceutical industry attachment.[85] A well-designed rubric measuring skill and increasing level of difficulty will ensure that the students have gained the necessary practice to work as pharmacists. Pancorbo *et al* conducted a formative assessment of social-emotional skills using rubrics, which can create rubrics to provide performance level descriptions for assessing a comprehensive taxonomy of the human body. The descriptors in the rubrics accurately describe the increasing mastery of skills that measure students' professionalism and interpersonal competencies in various pharmacy settings.[86] Harwood *et al* designed rubrics to assess hands-on laboratory skills, conduct experiments, handle equipment, and apply theoretical knowledge in practical settings within pharmacy courses.[87] One approach to designing rubrics for analysing critical and scientific thinking in a pharmacy course is to align the criteria with specific tasks or activities that require students to analyse, synthesise, and evaluate information to solve complex problems/cases. Villa *et al* developed clinical rubrics within pharmacotherapy problem-based learning courses, breaking down the assessment criteria into detailed descriptions of problem-solving strategies and documentation quality to effectively apply theoretical knowledge to real-world scenarios.[88]

Mapping of learning outcomes

Mapping learning outcomes in an OBE curriculum is a crucial process that involves aligning CLOs with PLOs, defining teaching and learning methods, selecting appropriate assessment tools, and establishing robust reporting practices in education (Figure 3).[89] This mapping ensures that the curriculum is designed to target the specific skills, knowledge, and attributes that

students are expected to acquire by the time they graduate.[30] In a transformational OBE framework, CLOs are interconnected with POs and extend across various disciplines, creating a cohesive path towards the desired learning outcomes.[90] Curriculum mapping is instrumental in OBE, as it helps in identifying gaps, redundancies, and inconsistencies within the curriculum, ensuring alignment between learning objectives, assessment methods, and competencies.[91] By associating course outcomes with program-level learning outcomes, curriculum mapping ensures that the curriculum is strategically structured to enhance student learning.[43] OBE emphasises outcome measurement over curriculum coverage, focusing on what students should be able to demonstrate at the end of a course or program.[92] This student-centred approach aims to develop new skills that prepare students at a global level, emphasising the importance of achieving stated objectives and outcomes in teaching and assessment.[93] The OBE model requires a clear identification of outcomes and mapping them to expected student capabilities, thereby ensuring a shift from traditional knowledge-based education methods.[94] This comprehensive system emphasises the importance of proper teaching, learning activities, assessment practices, and mapping outcomes to graduate attributes for the effective implementation of OBE.[95] Moreover, curriculum mapping in OBE involves aligning elements of courses within a program to systematically enhance student learning.[43]

The use of radar charts, also known as spider web graphs, to visualise learning outcomes is a valuable tool in educational settings. Radar charts provide a visual representation of multiple variables on a two-dimensional surface, with each variable represented by a spoke radiating outwards from a central point. This visualisation method allows for the simultaneous display of various dimensions or criteria, making it ideal for mapping and comparing learning outcomes across domains or competencies.[96] Educators can use radar charts to enhance transparency and accountability in the educational process by visually demonstrating the extent to which learning objectives have been achieved. This visual representation aids in identifying discrepancies and serves as a tool for communicating student progress to stakeholders including students, parents, and administrators. By presenting data in a visually appealing format, radar charts facilitate a deeper understanding of student performance and learning outcomes, fostering a culture of data-driven decision making in education.[97] Moreover, radar charts can guide instructional practices and curriculum design by highlighting areas where adjustments may be necessary to better align the intended learning outcomes with student achievement.[98] Educators can track individual student progress over time using radar charts and identify trends and patterns in skill development and competency acquisition. This personalised approach to visualising learning outcomes enables educators to provide targeted support to students based on their specific needs, ultimately enhancing their overall learning experiences.[99] For instance, in a study conducted on pharmacy education, radar charts were employed to map curricular competencies against student performance. This visualization enhanced the transparency of the educational process and facilitated feedback to both students and faculty, promoting data-driven decision-making.[100] By mapping curricular content to explicit learning outcomes, educators can identify gaps in student performance and curate proactive strategies to address these deficiencies. Similarly, a study evaluating the impact of radar charts on healthcare communications found that visualization of outcomes and costs fostered more informed discussions among stakeholders, thereby increasing accountability and facilitating deeper understanding of healthcare value.[101]

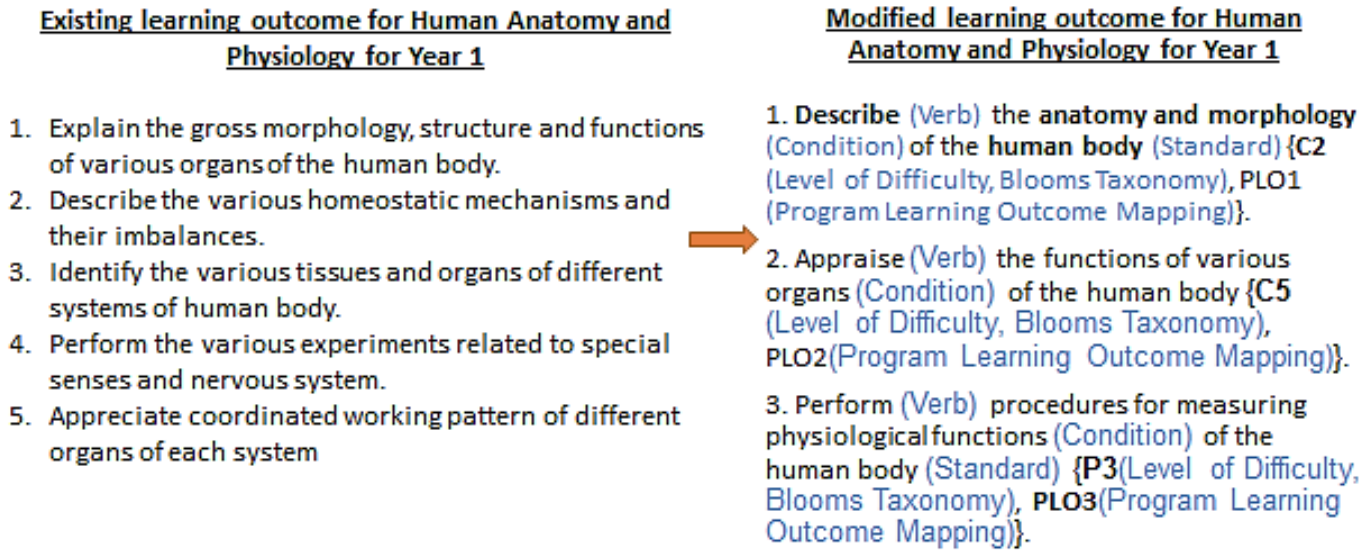

Figure 1: Rewriting CLO/SLO for HAP in Year 1.

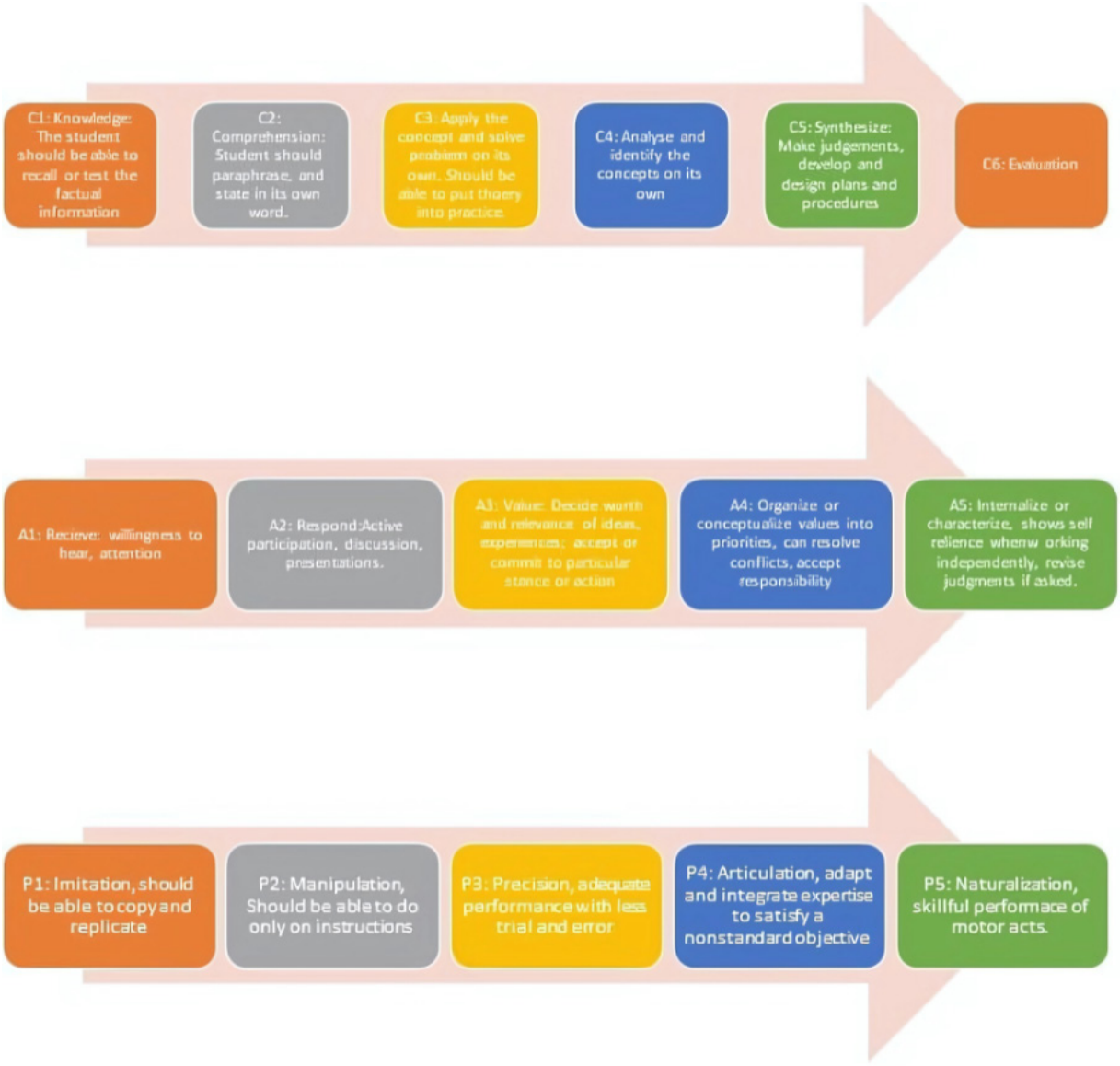

Figure 2: Blooms taxonomy hierarchy for different quality domains.

Mapping transferable skills

In an OBE curriculum for pharmacy graduates, it is crucial to incorporate transferable skills that equip students with the competencies needed to excel in their professional roles. One key transferable skill which a pharmacy graduates should have is the importance of interpersonal and communication skills while dealing with patients and other healthcare workers. These skills are vital to building effective relationships with patients, understanding their needs, and providing optimal pharmaceutical care. Incorporating opportunities for students to engage in direct patient-care activities during their education can help develop these essential skills.[102] Postgraduate pharmacy fellowships are designed to prepare pharmacy graduates to function as scientific leads or independent investigators in specific clinical specialties or practice settings.[103] Skills such as critical thinking, problem solving, and the ability to work independently are essential for success in these roles. Including opportunities for students to engage in research projects or specialised clinical experiences can help cultivate these skills in pharmacy graduates.[104] These skills enable individuals to adapt to different situations, think critically, and communicate efficiently, thus making them valuable assets in the workforce. The types of transferable skills identified in vocational education include communication, planning, interpersonal skills, work attitudes, organizational skills, financial management, and critical thinking.[105] Transferable skills are not limited to specific disciplines, but can be applied across various fields and contexts. They provide support across disciplines and have the potential to be transferred to different settings in educational or workplace environments.[106] This versatility makes transferable skills highly sought after by employers, as individuals who possess these skills can navigate diverse challenges and effectively contribute to organizational success.

Volmer *et al.* explored the pharmacy curriculum at the University of Tartu using the PHAR-QA framework, gathering feedback from stakeholders, including community and hospital pharmacists, which highlighted the need for enhanced collaboration with healthcare professionals and integrated training to improve communication and patient care competencies.[107] Ryan *et al* reported that integrating science and practice at the first-year pharmacy level fostered professional attributes, improving critical thinking and communication skills through real-world applications.[108] Jin *et al* emphasized the importance of early and continued communication training to enhance students' confidence, competence, and attitudes toward patient interactions.[109] Furthermore, an emergency department simulations activity may promote teamwork, problem-solving, and interprofessional collaboration, highlighting the value of scenario-based learning in preparing pharmacy students for contemporary healthcare practice.[110] Collectively, these studies demonstrate that experiential learning, integrated training, interprofessional collaboration, and early skills development are essential for enhancing pharmacy students' competencies and preparing them for effective practice.

Suggestive learning technologies

The integration of technology in implementing OBE plays a pivotal role in enhancing learning experiences and outcomes for students. The following discussion explores recent advancements in educational technology, including learning analytics and adaptive learning platforms, tailored to support the effective implementation of OBE principles across diverse educational contexts.

Learning analytics involves the measurement, collection, analysis, and reporting of data about learners and their contexts, thereby providing insights that can significantly improve educational outcomes. This technology can support OBE by allowing educators to track student progress toward specified learning outcomes systematically. Learning analytics can enhance student engagement through continuous monitoring of students' achievements against defined outcomes. The educators can adjust instruction in real-time to address individual learning needs, ensuring that all students reach the desired competencies.[111] Adaptive learning platforms may also complements OBE by customizing learning experiences for each. These algorithm adaptive learning models foster learner-centered education by ensuring that all content is relevant to achieving the specified

Table 1: Example of a blueprint for preparing assessment strategies and questions based on difficulty level.

Blueprint or Table of Specification																											
Topics	Teaching lecture hours	Percentage of marks based on lecture hours	Assessment 1		Assessment 2		Assessment 3		Assessment 4		Cognitive domain						Affective domain					Psychomotor domain					Total marks
			Marks	%	Marks	%	Marks	%	Marks	%	C1	C2	C3	C4	C5	C6	A1	A2	A3	A4	A5	P1	P2	P3	P4	P5	
																											0
																											0
																											0
																											0
																											0
																											0
																											0
																											0
Total		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
											0						0					0					0

	Course	PLO1	PLO2	PLO3	PLO4	PLO5	PLO6	PLO7	PLO8	PLO9	PLO10	PLO11
	Human Anatomy and Physiology I– Theory	√	√									
	Pharmaceutical Analysis I – Theory				√	√						
	Pharmaceutics I – Theory	√	√									
	Pharmaceutical Inorganic Chemistry – Theory											
	Communication skills – Theory *											
	Remedial Biology/ Remedial Mathematics – Theory*	√	√									
	Human Anatomy and Physiology – Practical			√								
	Pharmaceutical Analysis I – Practical											
	Pharmaceutics I – Practical											
	Pharmaceutical Inorganic Chemistry – Practical											
	Communication skills – Practical*											
Year 1	Remedial Biology – Practical*											
	Human Anatomy and Physiology II – Theory											
	Pharmaceutical Organic Chemistry I – Theory											
	Biochemistry – Theory											
	Pathophysiology – Theory											
	Computer Applications in Pharmacy – Theory											
	Environmental sciences – Theory											
	Human Anatomy and Physiology II –Practical 4 - 2											
	Pharmaceutical Organic Chemistry I– Practical											
	Biochemistry – Practical											
	Computer Applications in Pharmacy – Practical*											
Year 2												
Year 3												
Year 4												

Figure 3: Mapping of PLO and CLO.

educational outcomes.[112,113] The flipped classroom model, is another effective educational approach integrating technology within OBE. In this model, traditional learning paradigms are reversed; students engage with instructional content outside the classroom and apply knowledge in collaborative problem-solving activities during class time. This approach encourages active learning, critical thinking, and communication among students-skills essential to the OBE philosophy. Using video lectures and interactive online resources enables students to familiarize themselves with core concepts at their own pace, ensuring that in-class time is dedicated to exploring complex applications of learned material.[114]

Continuous Quality Improvement (CQI)

The CQI is a fundamental aspect of an educational model, particularly in OBE. This ensures that educational programs consistently meet academic standards and evolve to address the changing needs of students and industry stakeholders. CQI processes involve systematic feedback and data analysis to identify areas for improvement, leading to the enhanced quality and effectiveness of educational programs (Figure 4). This continuous cycle of assessment, feedback, and improvement aims to achieve better educational outcomes and higher standards for graduate competencies. Implementing the CQI in educational settings faces challenges, as indicated by international studies highlighting variability in impacts and limited understanding of factors that hinder or enhance its effectiveness.[115] However, the involvement of frontline staff and the iterative nature of the CQI, which includes monitoring performance, problem identification, solution implementation, and staff engagement in the improvement process, distinguishes it from traditional program evaluation approaches.[116] This iterative approach aligns well with the principles of OBE, in which outcomes are central to the educational process. In the healthcare sector, where the CQI has been extensively studied, it is defined as a structured organizational process involving personnel in continuous improvements to deliver quality healthcare that meets or exceeds expectations.[117] This definition can be extrapolated to educational contexts, emphasising the importance of involving all stakeholders in the improvement process to ensure that educational programs are continuously refined to meet the desired outcomes. Positive experiences with the CQI in healthcare have been linked to collective efficacy, contributing to the effectiveness of CQI initiatives in educational settings. Accreditation bodies, such as the Liaison Committee on Medical Education (LCME), have formalised requirements for ongoing planning and CQI processes to enhance programmatic quality and compliance with standards.[118] This integration underscores the importance of the CQI for maintaining and improving educational quality. Building capacity for CQI is particularly important in public health and community-based organisations to ensure the successful implementation and long-term sustainability of quality improvement initiatives.[119] Organisations can improve their adaptability and achieve better results by cultivating a culture of continuous learning. This is evident in the successful implementation of CQI frameworks in diverse fields such as physical therapy and engineering-based medical schools. These instances illustrate the versatility and effectiveness of the CQI in driving quality improvement initiatives.[120,121] CQI can be customised to address specific challenges and enhance overall performance in various contexts. It is important to note that the CQI goes beyond making small modifications; instead, it involves fostering a culture of innovation and growth in educational institutions. By integrating CQI methods into annual evaluations and institutional processes, organisations can ensure that they are continually evolving to meet stakeholders' needs.[122] This strategy relies on data, and hence, is vital for the success of program CQI initiatives, as it lays the groundwork for recognising

Student ID	Last Name	First Name	PLO Rating				
			PLO1	PLO2	PLO3	PLO4	PLO5
100001	Student	A		Excellent	Excellent		Poor
100002	Student	B		Excellent	Excellent		Satisfactory
100003	Student	C		Excellent	Excellent		Poor
100004	Student	D		Excellent	Excellent		Satisfactory
100005	Student	E		Excellent	Satisfactory		Poor
100006	Student	F		Excellent	Good		Poor
100007	Student	G		Excellent	Good		Poor
100008	Student	H		Excellent	Excellent		Satisfactory
100009	Student	I		Excellent	Satisfactory		Satisfactory
100010	Student	J		Excellent	Excellent		Poor

Figure 4: CQI cycle for every semester/year.

areas of improvement and monitoring progress continuously. Moreover, the CQI's emphasis on participatory methods aligns with collaborative learning and shared governance principles in education. By involving students, teachers, and industry partners in quality improvement initiatives, educational programs can gain from diverse viewpoints and shared expertise, leading to more efficient and long-lasting outcomes.[123] CQI is critical for providing feedback to students through a combination of direct and indirect assessment methods. Direct assessments such as tests, exams, tasks, and projects provide concrete measures of student performance.[124] These assessments are essential for evaluating the attainment of course and program outcomes, allowing educators to gather substantial data for analysis and detailed feedback from students.[125] The staff can use direct assessments to provide feedback to students about their strengths and areas they may need to improve. In addition to direct assessments, indirect assessments such as surveys and feedback from stakeholders such as students, peers, alumni, and employers may also significantly contribute to the feedback process.[126] Student satisfaction surveys, for example, are vital for monitoring education quality and collecting feedback to drive improvement initiatives in the teaching and learning processes.[127] Indirect assessment feedback allows educators to gain a comprehensive understanding of students' experiences and perceptions, thereby enhancing the overall quality of educational programs. Furthermore, the integration of technology applications, such as sentiment analysis-based smartphone applications, enhances the feedback process by continuously evaluating student feedback and monitoring course quality and learning experiences.[128,129] By leveraging technology to collect and analyse student feedback, real-time insights into students' perceptions and experiences can be provided, enabling timely interventions and improvements to enhance overall educational quality.[130]

CQI has been used to systematically assess and evaluate Program Outcomes within their curricula. It ensures not only measures graduates' competencies but also fosters an environment of continuous improvement. The OBE Analytical Tool, developed by Tunku Abdul Rahman University College, demonstrated effectiveness in automating report generation, integrating institutional documents, and categorizing student outcomes based on achievement levels.[131] At MAN Insan Cendekia Gowa and SMA Islam Athirah Makassar, CQI implementation through internal quality assurance systems involved fulfilling the Eight National Education Standards. Schools conducted regular evaluations using school self-evaluation documents, resulting in significant improvements in educational quality. CQI contributes to improved student performance, better alignment of program outcomes, enhanced retention rates, and increased preparedness for professional practice. Continuous evaluation and improvement efforts led to better compliance with national standards and greater student satisfaction.[132] Moreover, Al-Shargabi discusses how CQI frameworks ensure that academic programs not only comply with quality standards but also demonstrate accountability towards stakeholders, thereby enhancing the credibility of educational institutions.[133] This alignment of learning outcomes with educational delivery effectively contributes to improved student learning experiences and outcomes. By fostering critical thinking, skill development, and emotional well-being, CQI creates a more inclusive and engaging learning environment that prepares students for real-world challenges. Integrating technology into CQI processes allows for real-time feedback, data-driven insights, and improved monitoring of progress. Collaboration among educators and sharing best practices enhance curriculum design and assessment.[134,135]

OBE based principles, coupled with competency-based assessments, have been integral in shaping educational approaches to ensure that students possess the necessary skills and knowledge required in their respective fields. Papa and Alexander highlighted that a feedback loop involving course evaluations was critical for identifying areas where faculty could improve their teaching and for enhancing the overall curriculum. The study demonstrated that by employing automated systems for collecting and analyzing student performance data, institutions could make informed decisions about curriculum design and instructional strategies, ultimately leading to better student outcomes and a higher standard of educational quality.[135] Barbaric *et al.* emphasized the importance of designing assessments that not only measure theoretical knowledge but also evaluate practical skills and competencies. This approach resulted in improved student performances and successful accreditation outcomes, demonstrating the effectiveness of CQI in developing a quality education culture.[120]

CONCLUSION

Enhancing pharmacy education through curriculum redesign, faculty development, and stakeholder engagement is essential for producing competent and adaptable pharmacy graduates. The review highlights the urgent requirement for the Indian pharmaceutical educational system to adopt an OBE approach to bridge the existing gaps between academic training and industry expectations. The adoption of the well-developed framework which should include the clearly defined PEOs and PLOs, would markedly improve the critical thinking, problem solving, scientific thinking, lifelong learning, managerial skills of the pharmacy graduates. It is also expected that the graduates will develop exceptional soft skills which is one of the most important criteria when dealing with patients. The OBE framework will allow tactical assessment of each of the required attributes further realizing the increased employability of pharmacy graduates. The OBE framework should be immediately adopted as most of the developed countries have already modified and upgraded the teaching methodologies. The framework will allow the universities and institutes to impart competency-based learning at par with the rest of the world. The learning outcomes will be measured by periodical CQI thus making the universities and institutes producing well equipped students with the necessary abilities to succeed in a rapidly changing and competitive industry. Integrating technology into learning environments, incorporating active learning strategies, and fostering collaboration between students and educators are critical steps in preparing students for real-world challenges. Faculty development remains a crucial factor in successful curriculum implementation. Providing training in inclusive teaching practices and promoting continuous professional development help educators adopt innovative teaching methods aligned with OBE principles. Additionally, partnerships with practicing pharmacists and healthcare professionals contribute valuable insights that inform curriculum design and improve student preparedness for the workforce. Collaboration with health professionals, involving students in curriculum development, and promoting community engagement initiatives provide comprehensive learning experiences that extend beyond the classroom. By adopting these recommendations, pharmacy programs can cultivate a learning environment that produces skilled, resilient, and adaptable graduates ready to excel in a dynamic healthcare landscape. This proposed model offers a solid foundation for the ongoing development and refinement of pharmacy education in India, ensuring that it aligns with both national and international industry standards. While the shift to OBE in Indian pharmacy institutes is a progressive step towards ensuring that pharmacy graduates possess the necessary competencies for effective practice, it is imperative to address the ethical implications surrounding equitable access to education. By redesigning curricula with inclusivity in mind, investing in faculty training, engaging stakeholders, and leveraging technology, policymakers and pharmacy educators can create an environment that promotes fairness and equality in pharmacy education. Such actions will not only enhance the competency of pharmacy graduates but also contribute to a more equitable healthcare system in India.

ACKNOWLEDGEMENT

The authors gratefully acknowledge the University of Nottingham Malaysia for providing the necessary facilities and software support, including access to BIORENDER, during the preparation of this review. The authors also express their sincere appreciation to the Institute of Postgraduate Studies, Universiti Kuala Lumpur, for providing financial support toward the publication of this manuscript.

ABBREVIATIONS

BT: Blooms Taxonomy; **CDIO:** Conceive, Design, Implement, Operate; **C:** Condition; **CQI:** Continuous Quality Improvement; **CLO/SLO:** Course or subject learning outcome; **LCME:** Liaison Committee on Medical Education; **OSCE:** Objective Structured Clinical Examinations; **OSPE:** Objective Structured Practical Examinations; **OBE:** Outcome-Based Education; **PCI:** Pharmacy Council of India; **PEOs:** Program Educational Objectives; **PLOs:** Program learning outcomes; **STEM:** Science technology engineering and mathematics; **S:** Standard; **TOS:** Table of Specifications; **V:** Verb.

CONFLICT OF INTEREST

The authors declare that there is no conflict of interest.

DECLARATION OF AI TOOL

The authors hereby wish to disclose that they have utilized PAPERPAL as an English language tool to enhance the quality of the manuscript in terms of grammar, spelling, and overall language proficiency. The authors have reviewed the contents and take full responsibility of the manuscript.

SUMMARY

The manuscript aims to describe the key features of an Outcomes-Based Education (OBE) framework. It highlights the importance of an OBE-based curriculum, which may enable pharmacy universities and institutes in India to achieve their programs' vision and mission. The manuscript also discusses the significance of innovative teaching pedagogies in a pharmacy program. It is crucial for pharmacy institutes to adopt the concept of OBE to produce marketable graduates and remain competitive on a global scale.

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Cite this article: Kaur H, Sami F, Murtuja S, Hasan N, Kumar A, *et al*. A Comprehensive Review on Outcome Based Education Framework (OBE) for Implementation in Indian Pharmacy Institutes. Indian J of Pharmaceutical Education and Research. 2026;60(4):1379-93.