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## An Overview of Pharmacy Education and Training



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**Poonam K. Chavan\*, Prof. Yogita A. Wakchaure,  
Dr. Megha T. Salve**

*Shivajirao Pawar College of Pharmacy Pachegaon  
Dist – Ahmednagar, Maharashtra 422602 India*

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### ABSTRACT

Over the last two decades, e-learning has become a prominent method of instruction in the field of pharmacy education. As both students and educators increasingly turn to e-learning for its numerous educational and personal advantages, it is crucial to assess the effectiveness of these educational programs. In this systematic literature review, we aim to evaluate the quality of e-learning programs in pharmacy education. Pharmacy education in India encompasses a range of degree programs, including Diploma in Pharmacy (DPharm), Bachelor of Pharmacy (BPharm), Master of Pharmacy (MPharm), Master of Science in Pharmacy (MS(Pharm)), Master of Technology in Pharmacy (MTech (Pharm)), Doctor of Pharmacy (PharmD), and Doctor of Philosophy in Pharmacy (PhD). To gain admission to DPharm, BPharm, and PharmD programs, students typically complete 12 years of formal science education. The DPharm program consists of at least two years of didactic coursework, followed by 500 hours of mandatory practical training, usually finished within three months in either a hospital or community setting. BPharm programs involve four years of study at colleges affiliated with universities or within university departments. Graduates holding a BPharm degree can pursue an MPharm degree, which takes two years, with the second year dedicated to research and a dissertation in various pharmaceutical disciplines. In recent times, MPharm programs have expanded to include industrial pharmacy, quality assurance, and pharmaceutical biotechnology. To prepare graduate pharmacists for clinical services, the MPharm program in pharmacy practice was introduced in specific institutions. Additionally, India has established six National Institutes of Pharmaceutical Education and Research (NIPERs), offering MS (Pharm), MTech (Pharm), and higher-level degrees. Students with an MPharm degree can pursue a PhD with a minimum of three additional years of study and research. The PharmD program, which involves six years of full-time study, was introduced in 2008 to produce pharmacists with extensive training in clinical practice.

❖ **Introduction:**

The primary goal of pharmacy education is to equip students with the knowledge and skills needed to become proficient pharmacists and to ensure that pharmacists remain competent in their profession. In India, formal pharmacy education leading to a degree began with the introduction of a three-year Bachelor of Pharmacy (BPharm) program at Banaras Hindu University in 1937.



There is a pressing need to undertake an academic effort aimed at modernizing the curriculum to keep up with the ever-evolving trends in the field of pharmacy. <sup>[1]</sup>

Traditionally, online learning, using information and communication technologies, was one aspect of e-learning, while computer-based learning, involving standalone multimedia like CD-ROMs, was another. However, the definition of e-learning has evolved to encompass learning conducted through an Internet-based process. E-learning programs are now widely accessible, offering effective solutions for educating diverse populations spread across different geographical locations. <sup>[25]</sup> They facilitate the distribution and regular updating of standardized educational content, giving learners the flexibility to control when and where they learn, all while providing automated real-time feedback for both teachers and students.

Rather than replacing traditional teacher-centered pedagogy, educators are integrating e-learning opportunities to enhance and extend existing curricula, a shift embraced by learners. However, as e-learning becomes more common in pharmacy education, the necessity to demonstrate its effectiveness becomes increasingly important. <sup>[24]</sup>

## ❖ A FLASHBACK: GERMINATION OF PHARMACY EDUCATION

The roots of pharmacy education in India date back to the era when the nation was under British rule. During this time, there was a need for reform in the Indian Medical Services education system. Prior to the mid-19th century, pharmaceutical education and training were often neglected, leading to a dire situation in pharmacy practice. Prescription dispensing was primarily performed by individuals with minimal training, known as compounders.

The inception of pharmacy education in India can be attributed to the Medical College, Madras, in 1860. They initiated pharmacy classes to impart pharmaceutical knowledge and skills to students pursuing medical degrees, diplomas, or hospital assistant roles. This move was particularly beneficial for those aiming to become chemists and druggists, mirroring the educational practices of Britain during that time.

Over the years, these pharmacy classes evolved, with the duration of study extended to two years and the entry qualification requirement raised to matriculation. By the mid-19th century, pharmacy professionals in India were becoming scientifically educated and trained. [12]

A significant turning point in the history of pharmacy education in India occurred when Professor M.L. Schroff, under the guidance of Mahamana Pt. Madan Mohan Malviya joined Banaras Hindu University (B.H.U) in July 1937. It was at B.H.U that Pharmaceutical Chemistry and Pharmacognosy were introduced as subjects for the B.Sc. degree program, marking a milestone in the field of pharmacy education.

From that point forward, pharmacy education in India gained recognition and established itself as a well-established course with promising prospects. [14]

## ❖ Educational programs variety of pharmacy degree programs are offered in India:

Pharmacy education in India offers a range of degree programs, including Diploma in Pharmacy (DPharm), Bachelor of Pharmacy (BPharm), Master of Pharmacy (MPharm), Master of Science in Pharmacy (MS(Pharm)), Master of Technology in Pharmacy (MTech (Pharm)), Doctor of Pharmacy (PharmD), and Doctor of Philosophy in



Pharmacy (PhD). The entry requirements for DPharm, BPharm, and PharmD programs involve having 12 years of formal education in the sciences.<sup>[30]</sup>

The DPharm program spans at least two years and combines didactic coursework with 500 hours of mandatory practical training, which is typically completed in three months within a hospital or community setting<sup>[2]</sup>. BPharm programs last four years and are conducted in colleges affiliated with universities or within university departments. Graduates holding a BPharm degree can pursue an MPharm degree in two years, with the second year dedicated to research and the completion of a dissertation in a specific pharmaceutical field, such as pharmaceutics, pharmacology, pharmaceutical chemistry, or pharmacognosy. Recently, MPharm programs specializing in industrial pharmacy, quality assurance, and pharmaceutical biotechnology have been introduced. To prepare graduate pharmacists for clinical-oriented services, the MPharm program in pharmacy practice was introduced at Jagadguru Sri Shivaratreeswara (JSS) College of Pharmacy in Mysore in 1996 and in Ooty in 1997.<sup>[3]</sup>

India boasts six National Institutes of Pharmaceutical Education and Research (NIPERs), offering advanced degrees including MS (Pharm) and MTech (Pharm). These institutions were established with the vision of providing excellence in pharmacy and pharmacy-related education. Students with an MPharm degree in any discipline can pursue a PhD, requiring a minimum of three additional years of study and research.

The PharmD program consists of six years of full-time study, while the PharmD (post-baccalaureate) program lasts three years. The PharmD program, introduced in 2008, aims to produce pharmacists who have undergone extensive training in practice sites.<sup>[23]</sup>

#### ❖ **Current Scenario:**

Pharmaceutical education plays a vital role in achieving sustainable and equitable development within a country. Currently, there is a significant gap between the education and practical application of pharmacy. The foundation of pharmacy education still largely focuses on the extra biological synthesis, physicochemical studies, drug analysis, and manufacturing processes. This orientation of pharmacy education has evolved over the last century.

In the 1940s and 1950s, India witnessed a rapid establishment of hospitals and pharmaceutical industries, leading to a growing demand for pharmacists and pharmaceutical chemists. Consequently, pharmacy education was tailored to meet the needs of these

industries and healthcare institutions. Short-term courses for compounders and D. Pharm. programs were introduced to fulfill the requirements of hospitals and medical stores, while B. Pharm. programs were designed to cater to the pharmaceutical industry. <sup>[16]</sup>

In contrast to the West, where pharmacy education emphasizes a patient-oriented approach and has a strong focus on healthcare management, pharmacy education in India is primarily industry-oriented. Approximately 55% of job opportunities exist in the pharmaceutical industry, while 30% are in the field of education. Only a small portion, approximately 3%, of job opportunities are found in healthcare-related roles. This highlights the current landscape of pharmacy education and practice in India. <sup>[22]</sup>

#### ❖ **Admission Criteria:**

Entry requirements for pharmacy programs in India vary significantly, particularly between private and public institutions and depending on the degree program. Private institutions, in most cases, do not have a formal application process. Unfortunately, there is no centralized database to track the number of applicants to private and public institutions in India. <sup>[4]</sup>

#### • **D Pharm Program:**

Entry into the first-year DPharm program in government colleges is typically based on performance in the higher secondary examination. Private colleges have their own admission procedures in compliance with the Pharmacy Council of India's (PCI) regulations. <sup>[22]</sup> Students often choose the DPharm program as an alternative when they can't secure admission to their preferred degree program. The DPharm curriculum adheres to the regulations outlined in the Pharmacy Act of 1991 (ER91), and it is consistent across the country.

#### • **B Pharm Program:**

Admission to the first year of the BPharm program is generally based on marks obtained in the higher secondary examination or through entrance examinations administered by public institutions. Some public institutions, such as Banaras Hindu University, conduct entrance examinations. <sup>[5]</sup> The selection process, including the preparation of merit lists, varies, with some institutions emphasizing entrance examination scores and others relying solely on grades from the higher secondary examination.

- **M Pharm Program:**

Entry into the MPharm program is typically based on academic performance in the BPharm, an entrance test, or a combination of both. Currently, there is a higher demand for MPharm programs than available slots in the country. [21] A high Graduate Aptitude Test for Engineering (GATE) score can qualify a student for a government scholarship during their MPharm studies, although this is optional for admission to the first-year MPharm program.

- **Pharm D Program:**

Admission to the PharmD program is based on successful completion of the higher secondary examination or the DPharm program. Students who pass the higher secondary examination with specific subjects can enter the PharmD program. BPharm degree holders can join the PharmD program in the fourth year. [6]

- **Regulations and Quality Issues:**

Pharmacy education in India is regulated by two organizations, the Pharmacy Council of India (PCI) under the Pharmacy Act of 1948 and the All India Council for Technical Education (AICTE) established under the AICTE Act of 1987. The PCI sets regulations for the minimum education standards required for pharmacy qualifications and handles the registration of pharmacists. The PCI governs the DPharm and PharmD programs, but the BPharm program needs PCI recognition only for registration purposes. The PCI doesn't have jurisdiction over MPharm and other higher-level degree programs. [7]

- ❖ **Flaws in the present system:**

Challenges in Pharmacy Education in India:

1. **Entry of Underqualified and Non-Meritorious Students:** The issue of admitting students who don't meet the necessary qualifications or academic standards into pharmacy courses.
2. **Lack of Specialization and Focus:** Some pharmacy education programs lack specialization and a clear focus, resulting in a broad and unspecialized approach to learning.
3. **Outdated Curriculum and Educational Regulations:** The presence of outdated curriculum and regulations that may not align with current industry requirements and standards. [8]

4. **Insufficient Industrial and Clinical Exposure:** Students often lack exposure to real-world industrial and clinical settings, which is vital for practical learning.

5. **Inadequate Practical and Laboratory Training:** The methods of practical and laboratory training in many institutes are often inadequate and may not equip students with the necessary skills. [20]

6. **Limited Commercialization of Research:** Research efforts in Indian educational institutions often do not lead to commercialization and revenue generation, limiting their impact on industry and society.

7. **Teaching Priority Over Research:** Due to the demand for a skilled workforce in the job market, teaching takes precedence over research in universities, potentially hampering the growth of research initiatives. [26]

8. **Narrow Base for Research:** Serious research is primarily concentrated in a few "elite" institutes, indicating a limited institutional foundation for research in India. [9]

#### ❖ **How to improve the situation?**

Every educational institution should create an environment that encourages students to nurture their inner talents and qualities. There should be a well-structured system in place to ensure that every student has the freedom to think independently and develop their skills to the fullest. The cultivation of professionalism hinges on rational thinking and performance.

Students should be encouraged to express their ideas and suggestions on all aspects of education, with a particular focus on fostering innovative research. Many students may lack an initial push, which should ideally come from their teachers or the college itself. Additionally, students should receive training to enhance their presentation skills and improve their overall personality. [10][11]

#### ❖ **CONTROL OF PHARMACY EDUCATION BY THE PCI:**

The Pharmacy Council of India (PCI) plays a pivotal role in overseeing and enhancing the standards of pharmacy education in India. The primary objectives of PCI are as follows:

1. **Prescribing Minimum Education Standards:** PCI establishes and regulates the minimum educational requirements for individuals aspiring to become pharmacists. This involves

formulating Education Regulations that define the conditions institutions must meet to obtain PCI approval for offering pharmacy education.

2. Ensuring Nationwide Uniformity: PCI's mission includes ensuring consistent implementation of these educational standards across the entire country. This helps maintain a uniform level of quality in pharmacy education.

3. Approval of Courses and Institutions: PCI is responsible for approving the courses of study and examinations required for pharmacists. This includes evaluating and granting approval to academic institutions that provide pharmacy programs. The curriculum for pharmacy education is designed to prepare professionals in various categories. <sup>[18]</sup>

#### ❖ FUTURE: AN OVERVIEW:

Looking ahead, the future of drug treatment will be marked by a growing emphasis on personalized medicine, aided by specific diagnostics. This approach will allow for the customization of drug therapies to individual patients. New drugs will increasingly be administered parenterally and designed to target specific diseases.

Pharmacists must be ready to adapt to these evolving trends and position themselves as integral members of the healthcare team in the eyes of patients. Despite existing shortcomings in the pharmacy education system, it's important to acknowledge the remarkable progress made in the realm of new drug discovery and research. Research centers affiliated with pharmaceutical institutions have played a pivotal role in advancing these efforts. Notable examples include BRNCRC in Mandsaur, TIFAC CORE at JSS College of Pharmacy in Ooty, and TIFAC CORE and ACCUNOVA at Manipal College of Pharmaceutical Sciences in Manipal, among others.

These ongoing initiatives to enhance pharmacy education are crucial for the continued growth and effective utilization of the pharmacy profession in the future.

The text discusses a study that focused on pharmacy faculty members' perceptions of Interprofessional Education (IPE) and the challenges they perceived in implementing it at an American university. This study included faculty from various healthcare programs, with a significant representation from the College of Pharmacy. The findings indicate that while



these faculty members were generally less eager to act as IPE preceptors, they recognized the need for additional faculty development in the realm of IPE. [19]

The top five IPE activities preferred by the College of Pharmacy faculty were identified as follows: students from different disciplines taking courses together (58.8%), clinical rotations (55.9%), student competitions (52.9%), case reviews together (52.9%), and faculty members from other disciplines teaching a course (52.9%). Overall, faculty members from various disciplines expressed a positive attitude toward the potential benefits of IPE and believed in its feasibility. Notably, faculty from the pharmacy and physician assistant programs exhibited more enthusiasm compared to the medical program, emphasizing that IPE promotes team-based learning and enhances the efficiency of patient care. Furthermore, they were more inclined to emphasize the importance of IPE to their students and the wider college community, and they favored more IPE opportunities within their respective colleges.

Pharmacists have a wide range of opportunities within the pharmaceutical industry to apply their specialized skills in diverse roles. They can explore career paths in various domains, including pharmaceutical formulation development, clinical manufacturing, research and development (R&D), quality assurance, project management, regulatory affairs, pharmacokinetics and drug metabolism, medical informatics, as well as marketing and sales. [18]

#### ❖ **Pharmaceutical Research and Development:**

Pharmaceutical Research and Development (R&D) encompasses a broad range of activities aimed at enhancing existing resources, generating new knowledge, confirming established facts, and creating novel products and technologies. Within pharmaceutical companies, R&D spans from the initial search for or modification of molecules for treating specific diseases to the final stages of making these products available in the market.

Globally, pharmaceutical companies invest billions of dollars in R&D annually. This investment is geared towards advancing knowledge by exploring new molecules, altering existing ones, and refining production methods. The quest to discover new molecules and develop medications for a wide array of diseases is a lengthy and multifaceted process, involving the expertise of various professionals, including biologists, chemists, pharmacologists, statisticians, toxicologists, geneticists, and others. [25]

To work in Research and Development (R&D), individuals are required to engage in a variety of tasks. These tasks encompass conducting laboratory experiments to create new products, which involves pre-formulation and formulation studies. They are also involved in the scaling-up and technology transfer of these products, troubleshooting existing products, and launching new ones. Maintaining laboratory equipment and instruments is essential, along with an understanding of operational safety precautions. R&D professionals are expected to conduct literature reviews and research while adhering to Good Manufacturing Practices and Good Laboratory Practices.

When it comes to education, a comprehensive foundation is essential for R&D roles. This includes a pharmacy education that integrates various disciplines. Undergraduate pharmacy education covers basic sciences like biochemistry and biology, as well as pharmaceuticals. Understanding the physical chemistry of pharmaceutical systems is vital for optimizing the properties of drug delivery systems. Biopharmaceuticals delves into the biological effects of drugs and dosage form factors. Pharmacokinetics and pharmacodynamics explore the relationship between drug concentration and therapeutic effects within the body. [28]

Furthermore, proficiency in pharmaceutical calculations is crucial for providing patient care in pharmacy practice. This entails a deep understanding of mathematical and analytical skills, including concentration, titration, and dilution, which are integral for dispensing prescriptions and determining patient-specific drug dosages. R&D professionals also possess knowledge of the physicochemical properties of drugs, evaluation of drug dosage forms, chemical kinetics, principles of solubility, and drug delivery systems.

Graduating with a pharmacy degree opens up a diverse array of career possibilities for students. Pharmacy graduates can explore roles in community pharmacies, hospital pharmacies, drug information centers, research facilities, the pharmaceutical industry, manufacturing, and pharmaceutical companies. PharmD graduates also have the advantage of entering clinical practice.

It's noteworthy that the majority of pharmacy graduates typically start their careers in community pharmacies, followed by opportunities in hospitals, the pharmaceutical industry, and, to a lesser extent, academia. In the Middle East, the roles of medical representatives and marketing within pharmaceutical companies are particularly appealing to many pharmacy graduates due to the perceived profitability of this sector.

A study conducted in the United Kingdom in 2006 surveyed students in their preregistration year before they entered pharmacy school and then in their final year to understand their career aspirations. <sup>[29]</sup>

❖ **Insight into the concept of innovation ecosystem:**

The concept of an innovation system underscores the importance of the flow of technology and information among individuals, businesses, and institutions in driving the process of innovation. This interaction among these elements is crucial in transforming an idea into a tangible process, product, or service, ultimately contributing to national economic growth. <sup>[19]</sup>

Innovation ecosystems encompass the various inter-organizational, political, economic, environmental, and technological systems that create an environment conducive to the growth of businesses. These ecosystems serve to catalyze, sustain, and support such growth, offering an integrated approach to development. <sup>[13]</sup>

Innovation, at its core, is about generating value. Innovators are tasked with the challenge of creating solutions that fulfill society's needs. A simplified representation of how an innovative ecosystem operates is depicted Innovative ideas or research with potential and real-world implications must be nurtured and promptly put into practice. It's when inventions yield results that benefit humanity that they truly become innovations. <sup>[14]</sup>

❖ **The role of universities in creating regional innovation ecosystems:**

Emphasis on Significant Challenges: Prioritize tackling major societal challenges. Crucial Role of Universities: Universities play a pivotal role in fostering the Knowledge Triangle, which involves the synergy of research, education, and innovation. <sup>[27]</sup>

Revitalize Collaboration in the Triple Helix Model: <sup>[15]</sup> Strengthen the partnership between universities, industry, and cities. Explore the concept of living labs and user-driven innovations, placing a focus on human and process development.

❖ **International players and their strategies:**

In our current research, we have delved into the strategies employed by international organizations dedicated to reforming education and research. We have identified esteemed organizations with a unique mission of evaluating educational systems and policies to align

them with contemporary standards. We firmly believe that implementing their strategies in the Indian context can bring about a much-needed transformation.

One such organization is the International Association for the Evaluation of Educational Achievement (IEA), which comprises independent, international cooperative entities, including national research institutions and governmental research agencies. IEA conducts comparative research and assessment projects with the following objectives: <sup>[16]</sup>

- Providing international benchmarks to help policy-makers identify strengths and weaknesses in their educational systems.
- Supplying high-quality data to enhance policy-makers' comprehension of the factors influencing teaching and learning, both in and out of school.
- Offering high-quality data as a resource for pinpointing areas of concern, informing actions, and evaluating educational reforms.
- Enhancing the ability of educational systems to partake in national strategies for educational monitoring and improvement.
- Contributing to the global community of researchers in educational evaluation. <sup>[28]</sup>

Another valuable assessment program is the Programme for International Student Assessment (PISA), which is internationally standardized and serves as a tool for improving educational policies and outcomes. It is coordinated by the Organization for Economic Co-operation and Development (OECD) <sup>[29]</sup>. In addition, the National Assessment of Educational Progress (NAEP) is a periodic evaluation of student progress conducted in the United States, reporting statistical information on student performance and related educational factors. <sup>[17]</sup>

We would like to draw the attention of national policymakers in the field of pharmacy to the urgent need for similar revitalization efforts. We strongly recommend adopting the policies and strategies followed by these associations and establishing national-level organizations to assess the progress of pharmaceutical education and evaluate pharmacy students in our country. This proactive approach is vital to safeguard the integrity of the pharmacy profession and prevent any potential decline. <sup>[18]</sup>

❖ **Conclusion:**


Faculty members in the field of pharmacy often find themselves juggling two roles: one as a pharmacist and the other as an educator. Existing literature on the development of teachers in pharmacy predominantly focuses on training residents rather than nurturing faculty members. While teacher development programs are highly regarded by program directors and participants, there's a lack of substantial data to confirm their effectiveness in improving teaching practices. The Accreditation Council for Pharmacy Education (ACPE) is continually raising the standards for knowledge and skills in pedagogy, instructional design, and student learning assessment. This results in a growing disparity between current teaching methods and the expertise required to advance pharmacy education. More information is essential to design efficient faculty development programs that enhance teaching. Future research should emphasize measuring the outcomes of these programs and documenting the progress of existing faculty members in their teaching roles.

E-learning has been a subject of study in pharmacy education for various topics and contexts for many years. However, there have been no comprehensive reviews on the effectiveness of e-learning in pharmacy education until now. Our review revealed that e-learning is effective in enhancing knowledge immediately after training, regardless of the topic or context. This suggests that e-learning can generally enhance knowledge in any educational setting.

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	<p>Author Name – Poonam K. Chavan Author Affiliation- Department of B Pharmacy Author Address/Institute Address- Shivajirao Pawar College of Pharmacy Pachegaon Dist – Ahmednagar, Maharashtra 422602 India.</p>
	<p>Author Name- Prof. Yogita A. Wakchaure Author Affiliation- Department of B Pharmacy Author Address/Institute Address- Shivajirao Pawar College of Pharmacy Pachegaon Dist – Ahmednagar, Maharashtra 422602 India.</p>
	<p>Author Name- Dr. Megha T. Salve Author Affiliation- Department of B Pharmacy Author Address/Institute Address- Shivajirao Pawar College of Pharmacy Pachegaon Dist – Ahmednagar, Maharashtra 422602 India.</p>