

# The Impact of Mobile-Learning on Pharmacy Education during COVID-19 Pandemic

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## ABSTRACT

The present study highlights the impact of Mobile-learning (M-learning) on a global scale during the COVID-19 pandemic. The government has executed lockdown to meet the guidelines of social distancing and to prevent its further wide spreadability. It resulted in the suspension of all activities globally. Significantly, the education system has been affected to a large extent. Amid this epidemic, M-learning has played an imperative role in the education system, especially in the pharmacy sector. Technological integration in learning and education is an integral part of the ever-changing technological world. In this article, we discussed the role of mobile technology in higher education, especially in the research areas. The study aims to explore and emphasize different strategies of mobile learning used to promote student education. It mainly acts by integrating various M-learning tools (Knowledge software, mobile applications) with the future view on education using informatics. This study analyzes the existing literature based on M-learning perspectives, benefits, limitations and challenges.

**Keywords:** Mobile learning (M-learning), E-learning (Electronic learning), D-learning (Digital or distance learning), Smartphones, Mobile technology, Pharmacy education, COVID-19, mHealth, Telehealth, Gamification.

## INTRODUCTION

Coronavirus disease 2019 (COVID-19) was firstly originated in China in December 2019. The World Health Organization declared it a pandemic on 11<sup>th</sup> March 2020. With immediate effect, suspended physical attendance in all educational institutions and move the offline classroom to online platform. Due to this transition to online learning, educational institutions and academic staff had to make significant adjustments to their teaching and assessment methods.<sup>1</sup> This situation affects almost all the sectors of the education system but affects pharmacy education to a great extent. Amid this pandemic, the role of mobile technology has been expanding very rapidly. Mobile learning (M-learning) has surpassed other e-learning tools in popularity. It refers to the ubiquitous learning via personal electronic devices such as smartphones, tablets, etc.<sup>2</sup>

Situated learning and ubiquity mobility are two essential features of mobile technology. Situated learning introduces learners with authentic examples of knowledge that are compatible with the learner's learning context. It has been utilized to enhance their learning experience. Collaborative and cooperative conferences on smartphones make M-learning, the best learning tool in formal and informal learning contexts. The wireless network technology has expanded their arms day by day. Recently, the scope of IT (Information technology) has been enhanced due to the COVID-19 pandemic situation. Nowadays, the utilization of mobile devices is obligatory to perform every task of daily life. The features of mobile phones such as their flexibility, control, autonomy help the learners to learn anywhere without the wastage of time and money. Smart education has become the best way to transform the education system from

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classical classrooms to online virtual platforms. The main objective of smart education is to empower students, educators more effectively. Most parents don't allow the students to use mobile phones during their study time. But due to the corona epidemic, mobile technology has been adopted for learning purposes. Later, students and parents realized that this smart career assistance system (SCAS) is good as compared to offline classrooms.<sup>3</sup>

### Mobile Learning and Smart Education System

Smart education has been effective learning tool when smart technologies are clubbed with novel pedagogical techniques.<sup>4</sup> In this manner, smart technologies provide an opportunity to adopt novel lecture delivery techniques.<sup>5</sup> Some institutions have reached a higher level by providing quality education to students by enforcing advanced pedagogical techniques. Further, cloud-based applications facilitate smart classroom learning where the students can be present, assess learning material anytime and anywhere.<sup>6</sup> In developing countries like India, the adoption of Information and Communication Technology (ICT) is also essential for the development of the nation. The features of mobile devices, such as being easy to use, their usefulness, and low learning cost, promote their adoption process. When social media has combined with mobile learning, it acts as an excellent tool for pedagogical transformations. It is an excellent platform that encourages the students to participate in collaborative learning without hesitation and fear of laughing.<sup>7</sup> Multinational virtual conferences has been organized by different organizations which has two intrinsic benefits. a) Self-confidence: Participation in online virtual conferences, lectures foster the participant's self-confidence. b) Enjoyment: Sharing the ideas and concepts helpful for all nations and experiencing a high degree of happiness.<sup>8</sup> Factors affecting the adoption of mobile technology by learners are the preferred learning style of learners, image of mobile technology, role, and the altitude of mobile technology for supporting the learning process.<sup>9</sup> After the adoption of mobile devices for learning, teachers and students realized that it could be very valuable in near future.<sup>10</sup> Different studies had conducted to explore the impact of mobile technology on the education system. They realized that digital learning platform has displayed a positive impact on student learning but the extent varies from subject to subject. In mobile learning, the internet is a prominent source of information. Online learning via mobile devices promotes both collaborative and self-directed learning. But combining it with social networking sites provides more dexterity in the thinking leads to a pool of novel ideas that enhances their professional, communication and, IT skills.<sup>11</sup> They also reveal that mobile technology

is an indispensable tool for transforming input-based education into an outcome-based education system. But software implementation in mobile phones is a difficult challenge for a technology-integrated approach.<sup>12</sup> Moreover, videos have become the most popular learning aid that improves clinical and pharmaceutical skills.<sup>13</sup> Videos clips have enhanced the learning retention power in comparison to texts, and pictures. It found that ICT had a positive impact on overall academic achievements.<sup>14</sup> Students who utilized mobile technology had better results than students who don't use this technology.<sup>15</sup> On another side, smartphones distract the students from their learning path and weaken their concentration power.<sup>16,17</sup> Addiction to social media sites has been becoming the main pitfall in mobile learning.<sup>18</sup> This addiction imparts negative impacts on student education and behaves like a stone in the path of the development of the technological world.<sup>19</sup> In today's journey, mobile phones have been recognized as a powerful tool for learning. But the misuse of these smartphones can cause serious interference.<sup>20</sup> Learning can also be posed by its low battery capacity; less network bandwidth of mobile devices.<sup>21</sup> Moreover, the major challenge in mobile learning is the security and privacy of data, professional documents, etc. Therefore, the security and privacy of the information would be imperative subsets for promoting the learning environment more effectively.<sup>22</sup>

### Impact of Mobile Technology on Pharmacy Education

Pharmacy education provides a base for the pharmacy student to become a successful pharmacist in the future. They are playing a vital role in building a healthy nation. Therefore, amid the COVID-19 epidemic, mobile technology plays a pivotal role in the life of pharmacy students both in the education system and health care sector. Pharmacy educators are responsible for providing pharmacy graduates with the knowledge, skills, and attitudes required for future practice. In pharmacy education, the integration of gamification and simulation techniques is most prominent. It allows for situated learning without putting the patient's life at risk. The primary goal of immersive gamified simulation in pharmacy education is to motivate pharmacy graduates to pursue a career in their field. When a gamified simulation is linked to intrinsic motivation, it increases the power of acquiring knowledge and skills. Furthermore, it boosts confidence and professional identity. Gamification is extremely important in the education of health care professionals. It makes learning more engaging and gives pharmacy graduates the opportunity to learn from their mistakes.<sup>23,24</sup> Students enhance their learning skills by listening and visualization of real experimental work

performed in the lab. Furthermore, mobile technology also enhances their learning experience via the practice of medicines and healthcare via mHealth and telehealth.<sup>25</sup> Various mobile applications have been launched to ensure that the study has continuous during epidemic situation. It can further improve with better collections of ideas and thoughts by listening perception of medical experts in pharmaceutical sciences. YouTube, Twitter, Whatsapp, Facebook, and other virtual applications have been utilized to improve technological, conversational skills and finding the solution to any problem.<sup>26</sup> Moreover, M-learning helps the students to choose the right profession at the right time without any deprivation of knowledge. Or we can say that mobile is the source that moves the person from dark to light by providing a quality education to pharmacy graduates.

### Impact of Mobile Technology on Pharmaceutical Research

Recently, the role of mobile technology in research areas has been advancing at a rapid pace. Back in 10-12 years, no one could even imagine that today's generation would utilize mobile devices to perform almost every daily life task, such as learning, socializing, and business work. It plays an essential role in the field of drug discovery and development. A large number of research-oriented software's are available which can easily download on their smartphones. With the help of mobile technology, we can explore drug-target interaction of any drug by docking simulation. Moreover, various ADME parameters have been analyzed to ensure that the drug is safe for human intake. It deduces the time and money that is expended to find out their *in-vivo* ADME properties. It is mainly used to avoid the unwanted mortality of animals. These innovations in the education and research areas evidence that more novel technology has developed that fosters the pharmacy students towards research areas in the future. In a lockdown, several online national and international conferences have been conducted by different universities/countries. The main objective of these conferences is to familiar the world with innovative technologies during the period of pandemic. It further addresses and motivates the students towards a creative world.<sup>27</sup>

### Role of Mobile Technology on Pharmacist Services

Telehealth refers to all the instances of health care via using modern technology. It includes live video conferencing with physicians, pharmacists, and remote patient monitoring, etc. These features of telehealth provide instant instructions to the patient or health caregiver at the time of emergency. As we all know that

in most the cases, death of the patient is due to not reached at right time to the hospital. As a result, timely treatment is critical for the patient's survival, which can be facilitated by telehealth and mHealth tools. Mobile health (mHealth) is a major component of telehealth in which medicine and healthcare practices are carried out *via* mobile devices such as PDAs, tablets, smartphones, and so on. In other words, we can say that it is a self-care promoted by using mobile technology.<sup>28</sup> These modern technologies in the healthcare system have played a vital role during coronavirus outbreaks. Patients are no longer required to visit doctor's clinics or hospitals to have their blood pressure, blood glucose levels, and other vital signs checked. It can be tested at home using mHealth and telehealth tools. It can also lower treatment costs and save time. Furthermore, as in developing countries, the field of mHealth has evolved at a rapid pace due to increased accessibility. MHealth apps such as Mychart, Mayo clinic, Care Passport, Clot MD, *etc.* are used for collecting, gathering community and clinical health data. Later, sharing the patients' drug history and response will be very helpful for researchers. Researchers identify the most prevalent diseases and attempt to develop novel compounds that more effectively mitigate/treat a variety of conditions. Pharmacists motivate patients and the community hedonically by providing knowledge of drug dosage and how to take drugs at what time intervals. The trend of mHealth has been evolving rapidly. Therefore, modern IT has revolutionized the healthcare system. The pharmacist has also played multiple roles such as in pharmaceutical industries and health care sectors. It controls and maintains the automated dispensing cabinet. ADC (Automated Dispensing Cabinet) is a computerized drug storage device designed in hospitals to reduce human error and utilized that time to focus on patient medication history. Furthermore, Medication Therapy Management (MTM) is another digital platform designed for the management of a patient's medication profile. In MTM, the pharmacists review all the prescriptions of patients prescribed by different physicians. Then, it identifies the essential medication for patients and excludes the unnecessary medicines. He also provides detailed information regarding the disease, medication use, proper medication intake schedule. Now, there are various devices available in the market embedded with smart medication reminder features. This technology helps the patient to take a medication at a proper time interval. It alerts the patient regarding their dose, timing indicated by alarms, and flashing lights. It also shows us the next scheduled dose. The following are the novel technology implemented for enhancing healthcare. For instance, these devices were embedded with blister packing of tablets. When the tablet has popped out, all

the information is recorded and received in the connected device. Additionally, in developed countries, the smart pill is designed in such a manner, when the pill is ingested by the patient, all the information *such as* their body temperature, heart rate, *etc.* is noted. These technological innovations help both the patient and pharmacy staff. In the future, its scope will be enhanced to improve patient health and safety.

### Advantages of Mobile Learning

A mobile device is one of the great inventions in the world of science and information technology. It broadens the area of thinking beyond their classroom study and helps in achieving the goals by employing virtual platforms. It provides more flexibility in learning at your desired time and place. The benefits of mobile learning arise from its ease of access, information at your fingertips, and ability to stay connected through social networking. They are primarily used to access the internet, schedule homework, and create timetables. The following are the significant benefits of mobile learning (Table 1), which is used to improve knowledge and skills in all sectors, particularly education. Wireless connectivity is one of the imperative advantages that make it portable. It is used ubiquitously to access up-to-date information worldwide. The market demand for mobile phones or smartphones is higher than computers, PCs, and tablets due to low prices, wireless, smaller in size, portable. Due to their portability, virtual conferences and meetings can attend anytime and anywhere without geographical location.<sup>29</sup>

### Disadvantages of Mobile Learning

Every coin has two sides: the head and the tail. Similarly, mobile learning has a plethora of benefits but also some

drawbacks. The most prominent disadvantages are described here and illustrated in Table 2. People have sitting in the same room, and all have glued to their smartphones screens instead of talking to each other. According to one survey report given by doctors, as we touch screen of mobile phones regularly, it reduces our finger cells. Mobile learning courses can quickly drain the battery and cause conflicts in areas of poor networking, inadvertently disrupting the learning experience. In the upcoming years, more research should be conducted, how to reduce /avoid distraction and facilitate the learning process. The government is also trying to give its best by providing better internet connections in rural areas to avoid hindrance in the education of students living in rural areas.<sup>30</sup> Following are some of the major pitfalls (discussed in Table 2) that need to be resolved to enhance the learning process and encourage the students to achieve knowledge.

Other disadvantages of mobile learning are limited storage capacities in PDAs, less robust, limited bandwidth, difficult to use moving graphics, short battery life and require immediate charging, nomophobia (feeling of fear or stress when you don't have a mobile phone and are seen in college students), and distraction. According to the CDC (Centre for Disease Control and Prevention) survey report, every day the road accident has happened due to distractions caused by mobile phones during driving.

### Challenges of Mobile Learning

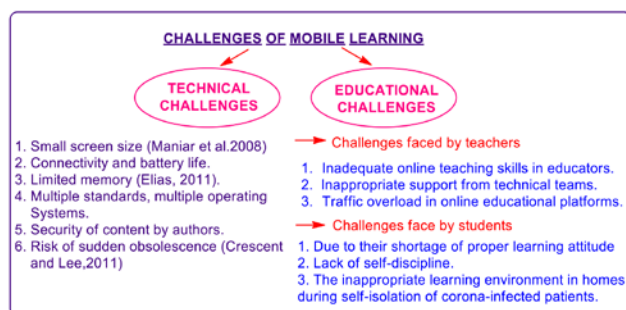
Although the penetration of mobile learning in the education system has been regarded as innovation and a new paradigm, the mobile learning platform still faces a number of challenges. The first and foremost challenge is the security issue to carry the equipment to access the

**Table 1: The various advantages of mobile learning have discussed below.**

Sl. No.	Advantages	Description
	Portability	Smartphones are light in weight as compared to books. It can transfer data/notes in various forms—in typed, handwritten, or audio-video formats.
	Collaborative learning	Learners/researchers can efficiently distribute, collect and share information within groups, resulting in more successful collaboration.
	Motivation	Ownership of handheld devices increases interest in using and learning from it. Mobile technology can make learning more interested and engaging.
	Accessibility	Mobile learning provides easy access to learning at any time and place, which is more convenient for learners.
	Promote self-paced learning	By using mobile technology, students can learn context at their own pace.
	Multiple learning styles	Unlike classroom learning, different styles of mobile learning such as pictures, video, lessons, quizzes, and mind maps increase the learner's learning engagement and retention power.
	Cost-effective	Less expensive /cheaper than PCs or laptops.
	Time-efficient	It utilizes spare time during travelling, in between the meetings, to learn a topic that you are interested in.

**Table 2: The demerits of mobile learning.**

SI. No	Disadvantages	Description
1.	Small screen	A small screen of mobile phones can be a significant disadvantage because reading documents on a small screen can cause eye strain.
2.	Distraction	It happens with many students; they put their mobile phones for learning purposes. But the social media messages and video games distract their path.
3.	Isolation	The mobile phone connects people all around the world. But their addictions isolate you from your family as well as society.
4.	Misuse	Some people have used phones only to fulfill their evil intentions or for their enjoyment purposes.
5.	Lack of internet connections	It can be a problem in a rural area where internet access is not yet prevalent when you have a device but don't have the internet to run the machine.

**Figure 1: The challenges of mobile learning at the technical or educational platform.**

learning material at its desired time and place. Some of the important technical and untechnical challenges for mobile learning has mentioned below and depicted in Figure 1

**Technical Challenges:** Bandwidth, Users support, digital distance (b) **Untechnical Challenges:** Lack of awareness, and motivation, negative understanding. The different researchers from different countries are starting their research study to find out the solution to avoid these technical and untechnical challenges. Moreover, the untechnical challenges are resolved by motivating the students, teachers, and parents by providing knowledge on using mobile technology to acquire information on any specific topic such as context-based awareness. The ubiquitous nature of mobile technologies can pose a problem if users are overloaded at any time. From anywhere, users may be at risk of being distracted and feeling instability of the mind or “24\*7 headaches”. The expensive equipment, lack of technical support; health-related issues due to over-use of mobile phones; inadequate investment are the major obstacles in the path of mobile learning. Furthermore, a lack of interest and a negative attitude towards a mobile phone such as deleterious devices that students use only for chatting and playing games with friends, cheating, and cyber-harassment.<sup>31-32</sup>

## Future Perspectives

The most popular mobile apps for pharmacy educators

have depicted below. These apps provide a lot of information relevant to the course. All are free accessible apps that can easily be downloaded from the play store. According to the subject, it provides study material in brief. Also, give free mock test services that inform us, to which extent you understand any topic. These mobile apps are also helpful for competitive examinations like GPAT, DI, etc.

1) **GDC classes: Pharma Aspirant -1st Choice** – It provides the e-notes to the pharmacy aspirants shortly and concisely. It is a free, best online learning platform that provides a weekly mock test to prepare for competitive pharmacy exams.

2) **Pharmacy India:** It is another online platform for pharmacy students to enhance their knowledge. It shares its valuable videos, pdfs on social websites via YouTube, Instagram, telegram, etc.

3) **Pharma Rocks:** It also shares the information regarding all the subject-oriented topics in pharmacy education.

Others less prevalent but not the least choice of students such as Med plus mart, Pharma Easy, Pharmacy study notes, Pharma Hub, Pharma Sapience, etc.

## Mobile Apps for the Pharmacy Technician Students

A Pharmacy technician is a health care provider who provides medications to patients. Provide relevant information to patients and other health care professionals as well. They are working with licensed pharmacists to collaborate. They are well-versed in drugs. The mobile apps designed for pharmacy technician students are shown below.

1) **R<sub>x</sub> Shortages** – This is an open-access, free-of-cost mobile application service. It gives detailed information related to drug prescription, the frequency of drug

administration. According to the FDA source, all the information related to the drug has been updated.

**2) Lexicomp** –It provides complete detailed information regarding the dose of a drug, route of administration, drug-drug interaction and its adverse effect. Also, provide information regarding contraindication in pregnant and lactating women. It provides answers to medication questions at exact moments.

**3) Pocket Pharmacist** – This application is generally employed to find the best drug for a given patient to cure their illness without side effects. You can easily verify the price and properties of a drug by putting their generic or brand names. All the information relevant to a drug (dose form, dose strength, precautions, and side effects) are mentioned here and updated every month.

**4) iPharmacy** – It tells us about drug dose, warnings, adverse reactions if not properly taken a medicine. The prices of drugs with their brand names have compared to find out a less expensive and more effective medication for a given patient according to their disease condition and other factors like age, sex, etc.

**5) Medscape-** In this, we can search for a specific drug with its brand name. It can give information related to diseases and the drugs to cure them. It also informed about recent policies that come in the market with their medical news.

### Mobile Learning Softwares

Various mobile learning software have depicted below-

**SAPLitmos:** Mobile and secure Learning Management System.

It is a cloud-based learning platform and is widely used for employee training, customer training, channel training, compliance training.

**Talent LMS:** - Fastest path to learn unique.

The designing of online courses on a cloud platform and then sharing it with their team members/remote team.

**Sky Prep:** - Smarter and faster training LMS.

It is a cloud-based, online learning platform designed for business purposes. It is easy to use. The information is provided to train, and test the ability of employees.

**Ed App:** - Free, mobile-first micro-learning-based LMS.

Ed is a superior mobile LMS designed for providing more effective micro-learning directly to the learner at anytime and anywhere.

**Talent Cards:** - It is Mobile training solution.

Learning cards are created on the web and delivered through the app to train people on any subject using a micro-learning approach. It supports simple assessments to enhance the learning experience and improve the acquisition of knowledge.

**GoToWebinar:** Video-conferencing and webinar hosting for significant events.

**UQualio:** Create video-based courses to promote your business.

**Lecturio:** It is a medical course and video lecture delivery platform.

**Digital Chalk:** Employed for building skills and instilling knowledge.

### CONCLUSION

In this review, M-learning and its impact on the education system have been discussed briefly. Mobile technology has both positive and negative impact on learning. The integration of mobile technology with pedagogical learning strategies enhances the process of mobile learning. The students who utilized mobile technology for learning had better academic results than students who don't use it. The incorporation of gamified simulation into pharmacy education also boosts confidence, competence and prepares pharmacy students for their future pharmacy practice. On another side, distraction, less concentration power, eye strains are negative impacts. There are various challenges and opportunities for digitalization of health that the pharmacy students need to be prepared. In this review article, we discussed various merits, demerits, and challenges of mobile learning in the education system especially pharmacy education. Students benefit from technologically integrated learning by improving their critical thinking and communication skills. The lessons learned during the coronavirus pandemic situation will be useful in enforcing new laws and regulations, which will help the country's development in terms of novel approaches in education.

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## CONFLICT OF INTEREST

The authors declare that there is no conflict of interest.

## ABBREVIATIONS

**COVID-19:** Coronavirus Disease 2019; **D-learning:** Digital learning; **M-learning:** Mobile learning; **IT:** Information Technology; **SCAS:** Smart Career Assistance System; **ADC:** Automated Dispensing Cabinet; **MTM:** Medication Therapy Management; **LMS:** Learning Management System; **PDA:** Personal digital assistant; **ICT:** Information and Communication Technology; **PC:** Personal computer; **CDC:** Centers for Disease Control and Prevention; **GPAT:** Graduate Pharmacy Aptitude Test; **ADME:** Absorption Distribution Metabolism Excretion; **FDA:** Food and Drug Administration; **DI:** Drug Inspector; **ADC:** Automated Dispensing Cabinet; **MTM:** Medication Therapy Management.

## SUMMARY

Mobile technology has an imperative role all over the world. However, its scope has been expanded at a rapid pace during the COVID-19 epidemic. In this article, we shed some light on the impact of mobile technology on pharmacy education during this pandemic. All educational institutions adopted online learning platforms, which were further facilitated by mobile devices. These modifications in learning strategies upgrade learning outcomes using various mobile apps. Mobile technology also plays a pivotal role in the advancement of research. Despite their wide applicability, it also has negative impact on the education system. In this article, we were succinctly discussed the merits, demerits and challenges of mobile learning. In conclusion, we can conclude that the positive and negative impacts on the education system can be controlled by the method of their use.

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