

## REVIEW

# Influence and scope of mobile learning in higher education: A systematic literature review

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**Abstract:** Due to the soaring progression in portable innovations and mobile technology, the popularity of mobile phones has expanded dramatically, which has led to the widespread adoption of mobile gadgets by almost every age group, especially the youth. The apparent consequence is embracing mobile phones in teaching-learning processes. Researchers have been inclined to study the potential and impact of incorporating mobile devices into the education system in recent years. Many studies have been conducted to explore the viability of integrating mobile gadgets into the higher education system. However, only a few works have addressed the realm from the perspective of the Indian higher education system. The present work employs the Preferred Reporting Items for Systematic Reviews and Meta-Analysis (PRISMA) framework and endeavours to contribute to the literature by exercising a systematic literature review of the open-access literary works carried out from the standpoint of India, especially the Uttarakhand province. The essential keywords, inclusion/exclusion criteria, and research questions addressing the cruxes of the desired investigation are contemplated and designed first. The articles are then populated from the leading academic databases, general web resources, and government reports. The PRISMA guidelines are followed to filter out articles satisfying the adopted criteria. The final shortlisted articles are then rigorously studied to develop insights and to answer the framed questions. The observations signalize the need to frame effective policies and address the hurdles to optimize the usage and impact of mobile learning in Indian higher education, including the education system of Uttarakhand.

**Keywords:** mobile learning, e-learning, higher education, Indian education system

## 1 Introduction

The massive progression in mobile technology and the easy affordability of mobile phones and handheld devices brought these gadgets within the reach of almost every individual. The accessibility to mobile devices and fast Internet connectivity enabled us to be connected to the world anywhere and anytime. Therefore, such handheld devices are used in everyday activities such as online browsing, instant messaging, social media activities, UPI payments, e-commerce trading, *etc.* Mobile devices are convenient nowadays for daily tasks. Mobile learning can be seen as a subset of mobile computing. The soaring popularity of mobile phones among the youth of higher education and the need of the hour compelled them to adapt mobile phones to their daily learning activities. Realizing the significant intrusion of mobile phones and the Internet in all facets of contemporary human lives, the stakeholders of the educational system have also started incorporating mobile phones and similar digital gadgets into the teaching-learning processes. Mobile learning has become the new constituent of modern pedagogy through which students can learn anywhere and any time at their convenience. Mobile learning can be considered an extension of e-learning, where mobile gadgets impart and acquire knowledge. The learning process across contexts and the use of mobile technology make it different from e-learning. E-learning is based on delivering educational content rich in multimedia, consisting of a bunch of hyperlinked texts and thus provides an interactive way of learning. In E-learning, learners can learn being away from the classroom or campus but are confined to a fixed position.

On the other hand, mobile learning is contextual, spontaneous, and personal and under its aegis, learning can take place on the go. E-learning can be seen as complementary to classroom learning, while mobile learning can be considered complementary to both classroom learning and e-learning (Vyas & Nirban, 2014). The paradigm shift from traditional to mobile learning occurred due to the massive advancement in mobile and wireless technologies (Mittal, 2019). Some scholars define mobile learning as delivering learning materials to students anywhere,

anytime, using mobile devices (( Al-Adwan, Al-Adwan, & Berger, 2018; Wang, Wu, & Wang, 2009). The significance of mobile learning in the domain of education can be characterized by a few crucial factors like convenience and accessibility, collaborative learning, personalized learning experience, interactive and multimedia-integrated learning, microlearning, experiential learning, etc. Undoubtedly, mobile learning has significantly impacted the education system by leveraging the features and functionalities of mobile devices.

Mobile learning is not only the method of delivering educational content to the learner but also imparts the new concept of disseminating knowledge through mobile technology. Mobile technology enables students to collaborate with peer groups and connect with experts, thus allowing them to acquire knowledge from them and share it with the outside world (Mittal, 2019). The success of integrating mobile learning with higher education may depend on the various facets and roles of mobile learning and its healthy adoption by various higher education stakeholders, like mentors and students. Kumar and Chand (2019) found that the difficult task of adopting mobile learning in higher education could be influenced by several significant aspects that might also act as barriers.

### 1.1 Status of mobile learning in the world

Today, there are more than 6.6 billion smartphone subscriptions globally, and in the next five years, this figure is expected to increase by 7.8 billion. The nations with the highest number of smartphone users are China, India, and the US, respectively (Taylor, 2023). Such a mammoth figure supports the obvious inclination towards the paradigm of mobile learning and associated businesses. The *International Association for Mobile Learning (IAMLearn)* has been organizing the prime international conference series, popular as mLearn since 2002 and in the continuity, the 22<sup>nd</sup> world conference on mobile, blended, and seamless learning (*mLearn-iTLT 2023* <https://www.iamlearn.org/mlearn/>) will take place in South Africa in the present year. The IEEE organized similar events known as *Wireless, Mobile and Ubiquitous Technologies in Education (WMUTE)* (formerly *Wireless and Mobile Technologies in Education*) to encourage the role of contemporary mobile technologies in education. A lot of other ventures, like the *International Association for Development of the Information Society (IADIS)*, Association for Learning Technology Conference (ALT-C), etc., have also been organizing similar conferences which bring professionals of higher education from all over the globe to enhance and enlarge the promising notion of the mobile-learning.

### 1.2 Status of mobile learning in India

With 993 state and central universities, 39,931 affiliated colleges, and 10,725 autonomous institutions educating 27.5 million undergraduate students and 4.0 million postgraduate students, India stands among the largest higher education systems in the world (Human Resource Development, 2021). According to TRAI (2021), a phenomenal increase of 228% has been observed in rural Internet subscribers, from 175.21 million in 2014 to 474.11 million in 2020. While the number of urban internet subscribers expanded by 171% in the above tenure. By 2025, there ought to be around 900 million active Internet users in India, and this figure has been increased primarily due to the easy availability and affordability of mobile phones. Every active Internet user uses mobile devices to access the web and allied services. 11% of frequent Internet users were engaged in online learning activities. In urban India, 13% of active Internet users utilize online learning services, compared to 9% in rural India (Kantar, 2021). The Indian government has also taken distinguished initiatives to strengthen E-education and mobile education in the urban and rural areas through a multitude of online platforms, like DIKSHA, SWAYAM, NPTEL, e-PGPathshala, INFLIBNET, E-ShodhSindhu, e-Shodhganga and NDLI etc. In this direction, the government of India established the *National Digital Educational Architecture (NDEAR)* through the union budget 2021-22 to provide support for digital infrastructure and activities about education planning (GOI, 2023). Private sector ventures are also providing mobile learning apps in India, like Byju's, Unacademy, Udemy, Vedantu, etc., to support the vivacity of mobile learning. According to a report by UNESCO, India had been planning to join a pool of eight other nations to encash the global digital initiatives in education (IBEF, 2021). Many Indian provincial governments distributed laptops, tablets, and e-gadgets to students of higher secondary, graduate, and postgraduate levels in recent years to aid online and mobile learning. The *National Education Policy 2020 (NEP 2020)* also envisages strengthening the infrastructure for online education and the use of digital technologies in education. Towards this, the NEP 2020 opined to set up the *National Educational Technology Forum (NETF)*, an autonomous body to facilitate the exchange of ideas for using technology in education planning and administration.

Implementing mobile learning in the higher education system of developing countries like India may have a broader scope in the modern teaching-learning paradigm. It would be of great

interest to investigate the realm from the perspective of the Indian higher education system. A few scholars mentioned that teaching-learning apps appeared beneficial in higher education (Ansari & Tripathi, 2017; Awadhiya & Miglani, 2016; Goundar & Kumar, 2022). The present work sincerely endeavours to study the status of the role and impact of mobile learning in the Indian higher education environment. As observed in the literature survey, only some researchers contributed to studies targeting developing countries like India. Thus, the present work may prove to be a distinguished attempt to conduct a systematic literature review of the available literary works on the status of mobile learning in India's higher education system.

The remaining article is organized as follows: Section 2 summarizes a brief literature review; Section 3 presents the adopted methodology; Section 4 throws light on some observed results; Section 5 discusses the answers to the framed research questions; Section 6 summarizes the key findings of the reviewed literary works; the final section concludes the observations of the present work.

## 2 A brief literature review

Researchers' inclination towards studying the role and impact of mobile learning in higher education has rapidly increased since 2010, especially after the inception of affordable smartphones in the market. Many studies report that higher education institutes have started endeavouring to incorporate mobile devices in the teaching-learning processes.

Dağdeler (2023) exercised bibliometric analysis and reported that mobile learning, language learning, and vocabulary learning were the most frequent keywords used in recent studies. He further commented that a shift in keyword usage over the years had been noticed, and keywords like augmented reality, machine learning and gamification had acquired significant places in research works. İpek et al. (2023) studied the impact and applications of OpenAI's ChatGPT system in academia and education. The authors presented a systematic review and explored the pros and cons of integrating this artificial intelligence (AI) model into the education system. The authors felt the adverse impacts of the ChatGPT program in education and mentioned that it may bring a new paradigm into existence. Jurayev (2023) exploited an extended cloud computing setup powered by many smart gadgets and proposed a novel mobile learning pedagogical paradigm for higher education. He indicated that promising technology could overcome the hurdles in exercising mobile learning in higher education institutes.

The author also highlighted the need for appropriate course design and system solutions to fulfil the requirements of learners employing different gadgets. Qamar et al. (2023) investigated the effectiveness of mobile learning in Indian universities. The authors reported that quality issues related to the system and services needed specific attention from university management and instructors. They commented that institutions or teachers must ensure that the designed content meets the teaching-learning requirements and must be compatible with mobile and similar handheld devices. They further suggested that the instructors must make sure that all the necessary software and tools are latest, user-friendly, and trustworthy to achieve a flawless teaching-learning environment in the university through the mobile learning approach. Uzir et al. (2023) investigated the level of perceptions and associated barriers experienced by students and teachers in mobile learning. The authors stated that identifying the barriers to mobile learning could be the first step in improving mobile learning as the new teaching-learning pedagogy. They mentioned that the COVID-19 pandemic had shifted the primary paradigms of the education sector, and the sound and smooth implementation of mobile learning could be the current pressing need. Alathur (2023) studied the perceptions and emotions of users for general and education-related mobile learning services through Tweets. They found that perceptions of the higher education stakeholders in India towards mobile learning were less outlined and reported. The authors suggested enhancing the quality and frequency of Indian mobile learning applications and services.

Goundar & Kumar (2022) highlighted that nations with relatively better technological advancements are at the forefront of adopting mobile learning in higher education. In their study, Hinze et al. (2022) mentioned that academicians and students used mobile apps for educational and research purposes, particularly for communication and information (documents and data) exchange. They mentioned that mobile phones and similar gadgets could be used for in-class and research-oriented field activities. They also deduced that instructors and learners use mobile applications for personal reasons rather than resource support from their institutions. However, institutional encouragement and flexibility inspire more people to use mobile applications for learning and research. According to Kaur (2022), mobile learning had yet to be novel to India; learners had already received learning materials via mobile devices. She observed that the content's design remained compatible with various screen sizes. The author also highlighted different ways of creating study material and multimedia ingredients like employing images,

photographs, audio, and video that were both demanding and rich in information. [Okai-Ugbaje et al. \(2022\)](#) proposed a sociocultural and socioeconomic contextual framework for mobile learning. They observed that applying social constructivism and flow principles could shift conventional instructional methods to other learner-centred pedagogical practices like mobile learning. The authors mentioned that social constructivism promoted active learning by encouraging dynamic interaction and feedback systems between teacher and student.

On the other hand, the flow principles encouraged teachers to set clear learning objectives so students were clear of expected learning outcomes. They argued that widely adopted mobile technology might offer an opportunity for mobile learning to be a viable alternative to web-based e-learning. They finally commented that higher education policymakers should leverage mobile technology to design effective mobile learning pedagogies. [Zhang \(2022\)](#) conducted an interesting study by exploiting *artificial neural networks (ANNs)* to examine the effects of mobile learning in higher education. The author found that the ongoing development in the field of science and technology had gradually developed the dependence of college students on mobile devices. He also felt that the traditional teaching-learning methods might not satisfy the contemporary needs of modern learners. The author concluded that although mobile learning is a new and developing paradigm, it might effectively increase students' enthusiasm for their studies. He further commented that mobile devices also assist students in enhancing their classroom involvement and communicating with their teachers after college hours.

[Navaneetha & Mony \(2021\)](#) conducted a study at a nursing college in Puducherry and reported that students appreciated communicating and sending/receiving course materials on mobile devices. However, they have yet to discover any advantages over traditional classroom lectures. They concluded that mobile learning might be a supportive teaching and learning tool, but more is needed for live classroom teaching and teachers with it. The authors commented that the role of teachers in the teaching-learning process is crucial. [Sophonhiranrak \(2021\)](#) studied various attributes, hurdles, and determining aspects of mobile learning in higher education in his review article. The author mentioned that mobile devices can be utilized as learning tools for activities, including assignments, recapitulation on recent learning, and exchanging ideas. He found that the readiness of students and teachers, learning management, and supporting systems were the three key factors that instructors needed to consider while implementing mobile learning in higher education. [Voshaar et al. \(2021\)](#) studied the benefits of employing mobile learning apps to enhance students' learning experience and improve their academic performance. The authors found that an enhanced gamified environment of mobile learning apps and significant time spent on them might lead to noticeable improvements in student academic performance. This study intensely focused on the usefulness of gamification elements in mobile learning systems for students of higher education and highlighted the acquired motivation for them. [Ansari and Tripathi \(2017\)](#) studied mobile learning apps' role on students and investigated their scope and impact on the Indian higher education system. [Awadhiya & Miglani](#) shed light on the hurdles and challenges of mobile learning in India's open and distance learning (ODL) universities.

It has been observed that although there is a good amount of literary work on the role and impact of mobile learning in higher education, only a few scholars have studied the realm from the perspectives of the Indian higher education system. It seems reasonable to investigate the scope, effectiveness, challenges, and remedies associated with the integration of mobile learning in the higher education institutions of India. Therefore, the present work has made a sincere effort to contribute something novel to the literature by developing a corpus of knowledge targeting the realm of mobile learning in the Indian context. This study also aims to identify the prospects for adopting mobile learning in the higher education institutes of the Uttarakhand province of India. This study may be beneficial for the policymakers to frame and implement effective policies for the better future of the youth of Uttarakhand by exploiting the calibres of mobile learning in the most optimum way.

### 3 Materials and methods

To exercise a systematic investigation for the present study, the latest *Preferred Reporting Items for Systematic Reviews and Meta-Analysis (PRISMA)* guidelines are followed ([Page et al., 2021](#)). For the identification process, a few keywords have been designed to develop search strings for searching some popular international databases, namely ResearchGate, ACADEMIA, Google Scholar, Shodhganga, and CiteSeer<sup>X</sup>. The selected keywords are as follows: mobile learning, adoption, readiness, India, Uttarakhand, mobile adoption, and higher education, etc. The above-mentioned keyword-based search on the academic databases yielded 123 articles. The reference lists of these articles are then explored, and 18 more relevant literary works have also been identified. Finally, the general web is searched, and 06 relevant works in reports

have also been selected. Thus, 147 literary works have been identified, of which 30 were not open-access. A total of 117 studies, including journal articles (85), theses (12), book and book chapters (05), reports (06), web articles (01), and conference papers (08) have been selected. Six articles were identified as duplicates. The reader can refer to the accompanying spreadsheet's first sheet, 'All\_Articles' (see appendix).

Now, the following inclusion and exclusion criteria are framed and implemented for the first round of the screening.

### 3.1 Inclusion criteria

- (1) The article should be in English;
- (2) Focused devices should be smartphones, tablets, and similar handheld gadgets;
- (3) Only studies concerning the higher education level are to be considered;
- (4) Only the studies conducted in India's context of higher education are to be included;
- (5) Due to the limited availability of literary works in the selected context, the window has been taken as published articles between 2010 and 2022.

### 3.2 Exclusion criteria

- (1) Article in other than the English language;
- (2) Unpublished articles;
- (3) Focused devices are other than mobile phones or handheld devices;
- (4) They were published before 2010;
- (5) Only concept (coding, etc.) or framework is given in the article.

The following research questions are framed to study the impact and scope of integrating mobile learning in the teaching-learning processes under the aegis of the Indian higher education system.

RQ1: What purposes does mobile learning fulfil in higher education in India?

RQ2: What instructional techniques are used to incorporate mobile phones in teaching higher education students?

RQ3: What are the outcomes concerning the students' behaviour after integrating mobile phones into teaching and learning?

RQ4: What are the concerns in implementing mobile learning in higher education? (Parmar, 2015).

After dropping the duplicate articles, 111 distinct articles were screened against the above criteria for eligibility. Out of these 111 articles, 79 were rejected based on the above inclusion/exclusion criteria. The remaining 32 articles were screened for credibility and relevancy against the study's objectives. One article was found to be irrelevant to the study and therefore rejected. The remaining 31 full-text articles have been filtered out and selected for the proposed study. These 31 articles fully satisfy the criteria set. Figure 1 presents the current study's PRISMA 2020 compliant flow diagram (Page et al., 2021).

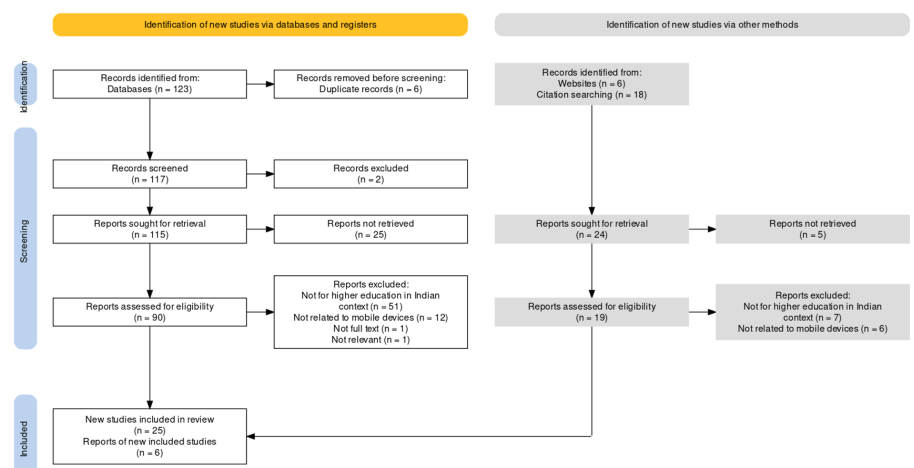


Figure 1 Flow diagram<sup>2</sup> for identification and selection of literary works

### 3.3 Data extraction

Since 31 articles have been finally shortlisted for further study and analysis, these selected articles need to be investigated thoroughly, and various data need to be extracted from them. The

critical data items to be extracted are title, name of the author(s), year of publication, literature type, country, device(s) focused, language, design, methodology, respondents, key findings, and conclusions. The data items are extracted as a table and exported to a spreadsheet, which is designed according to the objectives and criteria set for the study. The reader can refer to the fifth sheet, 'Extracted.Data' of the accompanying spreadsheet (see appendix). It has been observed that most of the studies have qualitative type of findings or knowledge.

## 4 Results and analysis

The shortlisted articles are then analyzed against a few parameters and study interests. In the following subsections, these observations are discussed.

### 4.1 Frequency of publications

Most literary works found to be published in the years 2018, 2019 and 2021. Figure 2 depicts the frequency of published articles from 2010 to 2022. It has been observed that only one literary work has been carried out in the context of higher education in Uttarakhand (Pande, 2018).

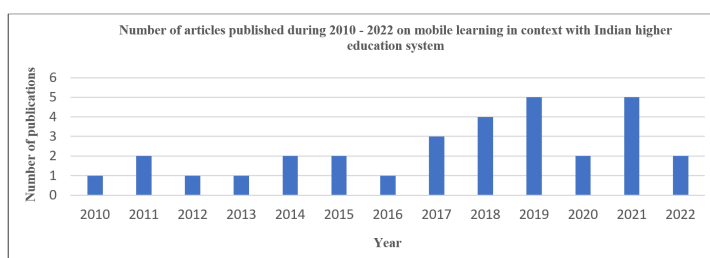


Figure 2 Frequency of research publications over the past years

### 4.2 Employed research methodologies

As mentioned above, the shortlisted literary articles are miscellaneous, from journal articles and book chapters to theses and web posts. It would be interesting to categorize these articles based on the research methodologies employed. Figure 3 summarizes the research methodologies employed in the articles and observes that most scholars employed quantitative-type research methodologies.

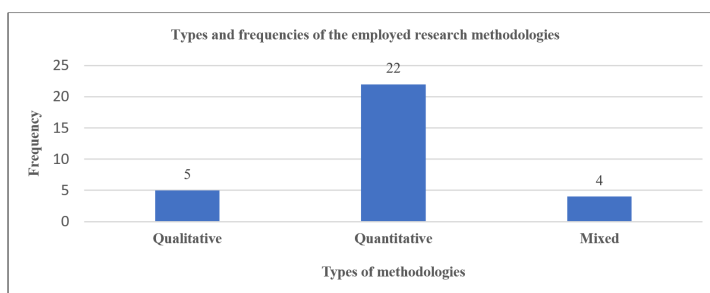


Figure 3 Types of research methodologies and their adoption

### 4.3 Data collection methods

Literary works differ in various data collection methods employed to conduct the research studies. The data collection methods exercised by the authors of the shortlisted articles are then explored. Figure 4 presents the comparative statistics of the same. Notice that most authors exploited self-constructed questionnaires as the prime data collection method. The second popular data collection method was found to be the survey method.

It has also been observed that out of these 31 studies, 25 studies reported the stakeholders of the regular mode programmes. While six studies reported that of the distance learning programmes.



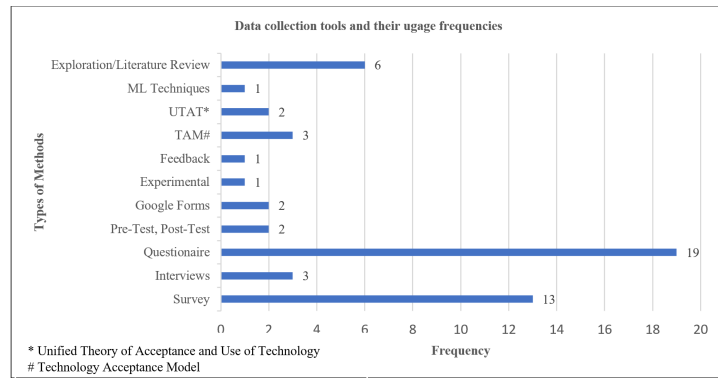


Figure 4 Various tools of data collection and their popularity

## 5 Discussions

In section 3, four research questions have been formulated. The answers to these questions are explored in the present section by thoroughly studying the shortlisted articles. These articles are investigated against the cruxes of the present research questions. The objectives of the current study are addressed below.

### (1) First objective: “What purposes does mobile learning fulfil in India’s higher education?”

The rigorous study of the shortlisted literary works revealed that smartphones and similar handheld devices have been getting attention and preference for the teaching-learning processes. It has been observed that mobile learning serves many vital purposes in the Indian higher education system, and it seems to be amalgamating an innovative and reforming teaching-learning experience for both stakeholders. Such facts should be explored in detail under the first objective of the present study. Table 1 below summarizes the critical observations of such various studies where the findings fall under the realm of the first objective of the present study. Readers can refer to the third sheet, named ‘Links\_To\_Articles’, of the accompanying spreadsheet (see appendix).

### (2) Second objective: “What instructional techniques are used to incorporate mobile phones in teaching higher education students?”

To explore this objective, 18 instructional techniques have been identified by thoroughly reviewing selected studies. These techniques are currently being employed in higher educational institutes in India. Figure 5 depicts the employed instructional techniques and their usage as reported by the author(s) of the shortlisted literary works.

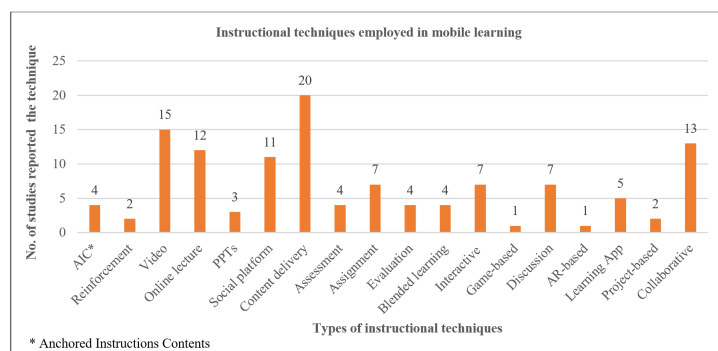


Figure 5 Instructional techniques employed in mobile learning and their usage frequency

Observe that online content delivery is the most widely adopted technique. Video lectures and collaborative learning secure the second and third positions, respectively. In the latter, mobile learning ensures that students are consistently engaged in learning activities which require continuous interaction with the peer group and teachers. Also, most students prefer mobile phones, tablets, and similar handheld gadgets for attending online lectures. Scholars have also reported that the stakeholders of the Indian education realm do not appear to leverage

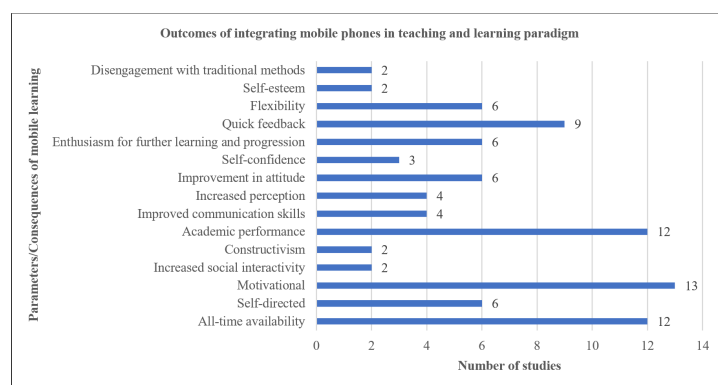
**Table 1** Purposes of mobile learning in higher education in India

S. No.	Observation(s)	Author(s) and year(s)	S. no(s). in the Excel sheet
1	Most researchers describe the role of the mobile phone in higher education learning as a novel tool for learning at one’s own pace and convenience, irrespective of gender, age, space, time, and location constraints. Moreover, students can select resources relevant to their interests and convenience. It brings high mobility.	Banerjee & Bose, (2011); Boity (2015); Ansari & Tripathi, (2017); Fouzdar & Behera (2017); and Kalaiarasi & Poonguzhali (2019)	35, 19, 10, 90, 43
2	Mobile phones can be an effective tool for creating interest towards learning among students.	Sharma (2019)	84
3	Mobile learning may be more beneficial to students enrolled in distance learning programmes. Some scholars believe that those students who study course materials or subjects through mobile tend to gain inclination towards it.	Chandran (2010); and Banerjee & Bose, (2011)	21, 35
4	Mobile learning is an important tool for self-directed learning, which is constructive for the student.	Rajasingham (2011); Hemabala & Suresh (2013); Ghosh & Chakraborty (2018); and Mittal (2019)	49, 107, 101, and 74
5	Mobile learning improves portability by substituting heavy books and note papers with handheld devices with customized learning content.	Gupta et al. (2021)	81
6	Being a more affordable and flexible learning option, mobile learning can replace traditional classroom learning.	Toteja & Kumar (2012)	85
7	Through mobile learning, learners get exciting and innovative experiences.	Ghosh & Chakraborty (2018); and Kirubakaran et al., (2018)	101, 45
7	Universities and institutions have made significant efforts to provide educational content on the institute’s website compatible with mobile phones.	Pande (2018)	37
8	Disabled students can participate in the learning process easily through mobile learning since mobile devices provide a variety of features which can be very effective for disabled students.	Madhusudan (2019)	42
9	By promoting student-centred learning, mobile learning can aid in achieving educational objectives. Mobile learning can bring ease for students and teachers to communicate effectively and cooperatively.	Kalaiarasi & Poonguzhali (2019); and Habib et al. (2022)	43, 30

the vast potential of mobile learning fully.

**(3) Third objective: “What are the outcomes of integrating mobile phones in the teaching and learning paradigm?”**

Integrating mobile devices into the teaching-learning paradigm may have many beneficial and/or detrimental consequences. The third objective of the present study has been framed to investigate such consequences (if any) in greater detail. To achieve this, full texts of the selected studies have been studied thoroughly to understand and analyze the outcomes of integrating mobile learning in higher education. It is a matter of interest that scholars have reported fifteen different parameters to assess the consequences of mobile learning. Figure 6 depicts the reported parameters and the number of studies in which they are observed.



**Figure 6** Observed outcomes or consequences of mobile learning

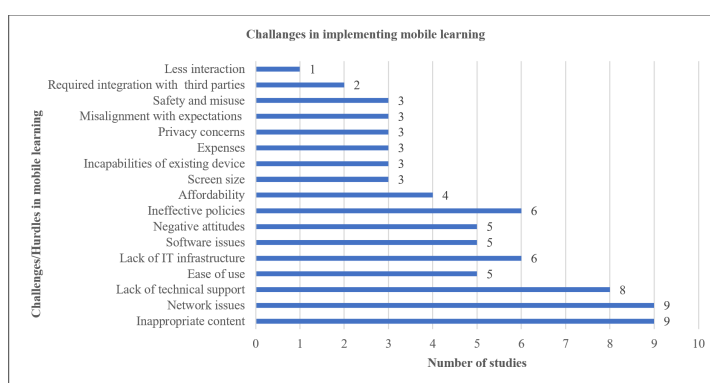
The motivation to learn and explore knowledge more effectively has been the most widely reported outcome of mobile learning. All-time availability of the education content and significant improvement in academic performances have secured second place in the list of outcomes. Moreover, a rich number of studies reported that quick feedback on the assessment of students is a significant outcome of mobile learning. Moreover, flexibility and self-paced learning are



also reported as favourable outcomes of mobile learning. A few studies reported improvements in attitude and enthusiasm for learning, a constructive impact or consequence of integrating mobile learning in higher education. However, a few authors reported that the overuse of mobile phones negatively affected the students’ academic performance. It hampered the students’ academic progress and imposed health issues on the students who had become dependent on mobile phones. Notice that among the fifteen parameters depicted in the above figure, there is also a negative outcome reported by some studies, viz. disengagement from the traditional teaching-learning method.

**(4) Fourth objective: “What are the major challenges in implementing mobile learning in higher education in India?”**

It is observed that the implementation of mobile learning in Indian higher education institutions has always been a very challenging task. A thorough literature review revealed that reasonable pieces of evidence had been reported by scholars, which highlights the fact that mobile learning in higher education institutions faces many hurdles. Figure 7 presents the seventeen major hurdles as highlighted by various authors and the number of corresponding studies in which they are reported.



**Figure 7** Challenges in implementing mobile learning in India

Network issues and inappropriate content are the most common challenges in implementing mobile learning. Lack of training and technical support for teachers and students and lack of IT infrastructure in the institutions are other dominating factors affecting mobile learning adoption. Also, only some studies mentioned inappropriate policies as a significant hurdle in successfully implementing mobile learning in higher education. Some studies underline that students have also experienced and reported privacy concerns in the learning process through mobile devices (Awadhiya & Miglani, 2016; Bansal & Joshi, 2014; Mittal, 2019). Intrusion in students’ privacy when learning through mobile or similar gadgets is a grave concern, and stakeholders should address it carefully.

## 6 Summary

This section summarizes the key findings observed from the shortlisted studies, discusses the weaknesses, and highlights the recommendations provided by the authors for future research in the realm of mobile learning in the Indian context. Mobile learning is not new to Indian students; they have used their mobile phones, tablets, and laptops for a decade to access educational content and course information and participate in discussion forums. Many scholars strongly recommend that mobile learning might be very beneficial for Indian students of higher education if it is implemented through proper planning and necessary infrastructure. Table 2 summarises the leading outcomes observed from the shortlisted articles. Readers can refer to the third sheet, named ‘Links\_To\_Articles’, of the accompanying spreadsheet (see appendix).

## 7 Conclusions

A thorough review of the available and shortlisted literary works brought many insights about the impact, role, state, and scope of mobile learning in the Indian higher system. Mobile learning has been familiar in India, but it might not commence with proper planning, roadmap, and policies. Many studies highlighted the promising consequences of implementing mobile learning in India, like 24×7 availability, self-directed and self-paced nature, increased motivation and performance, quick feedback, etc. All-time availability, flexibility and personalized nature of

**Table 2** Summary of the literary works in the realm of mobile learning

S. No.	Key Observation(s)	Author(s) and year(s)	S. no(s). in the Excel sheet
1	Many scholars focused on studying the impact of mobile learning on the academic performance of higher education students and reported significant improvements in it.	Chandran (2010); Toteja & Kumar (2012); Bansal & Joshi (2014); Boity (2015); Parmar (2015); Nagpal (2017); Ghosh & Chakraborty (2018); Kirubakaran et al. (2018); Sadotra & Sharma (2018); Kalaiarasi & Poonguzhali (2019); and Habib et al. (2022)	21, 85, 114, 19, 3, 63, 101, 45, 92, 43, and 30
2	Students exhibited a self-directed attitude by incorporating mobile learning into their studies.	Rajasingham (2011); and Hemabala & Suresh (2013)	49 and 107
3	Mobile learning escalated the motivation for learning, and students explored more in the concerned subjects.	Toteja & Kumar (2012); Hemabala & Suresh (2013); Parmar (2015); Boity (2015); Nagpal (2017); Kalaiarasi & Poonguzhali (2019); Sharma (2019); Habib et al. (2022); Fouzdar & Behera (2017); Navaneetha & Mony (2021); and Bharti and Kumar (2022)	85, 107, 3, 19, 63, 43, 84, 30, 90, 50, and 57
4	Improved constructivism has been observed in the students after integrating mobile learning into higher education.	Ghosh & Chakraborty (2018); and Mittal (2019)	101 and 74
5	Both students and teachers improved their communication skills after incorporating mobile learning into higher education.	Sharma (2019)	84
6	Improved perception while learning through mobile phones.	Habib et al. (2022); and Sripradha et al. (2022)	30, and 104
7	Many students believed that mobile learning had benefited them as it allowed them to get quick feedback from the teacher, and it had been an excellent tool to connect with their peers and teachers.	Chandran (2010); Rajasingham (2011); Toteja & Kumar (2012); Hemabala & Suresh (2013); Bansal & Joshi (2014); Parmar (2015); Nagpal (2017); Ghosh & Chakraborty (2018); and Sharma (2019)	21, 49, 85, 107, 114, 3, 63, 101, and 84
8	Some students reported that they felt stress-free while exploiting their mobile phones for accessing educational content and learning purposes.	Navaneetha & Mony (2021)	50
9	Some studies reported that students were proud of their achievements and personal success after incorporating mobile phones into their learning process.	Kirubakaran et al., (2018); Sharma (2019); and Habib et al. (2022)	45, 84, and 30
10	Most studies reported that mobile phones were used to deliver educational content to students.	Chandran (2010); Banerjee & Bose, (2011); Rajasingham (2011); Toteja & Kumar (2012); Hemabala & Suresh (2013); Bansal & Joshi (2014); Vyas & Nirban (2014); Boity (2015); Parmar (2015); Ansari & Tripathi (2017); Nagpal (2017); Sadotra & Sharma (2018); Ghosh & Chakraborty (2018); Kalaiarasi & Poonguzhali (2019); Madhusudan (2019); Mittal (2019); Alvi (2021); Kumar & Pande (2021); and Habib et al. (2022)	21, 35, 49, 85, 107, 114, 70, 19, 3, 10, 63, 92, 101, 43, 42, 74, 6, 47, and 30
11	Some authors reported the preferred usage of blended learning, project-based learning, problem-solving, and evaluation. This might imply a need for appropriate educational content specifically designed to harness the maximum benefits of mobile learning. A few studies reported the exploitation of social media platforms for educational purposes.	Bansal & Joshi (2014); Ansari & Tripathi (2017); Nagpal (2017); Ghosh & Chakraborty (2018); Madhusudan (2019); Sharma (2019); Basu et al. (2020); Sripradha et al. (2022); Alvi (2021); and Habib et al. (2022)	114, 10, 63, 101, 42, 84, 17, 104, 6, 30
12	Lack of proper infrastructure to implement mobile learning smoothly.	Parmar (2015); Awadhiya & Miglani (2016); Nagpal (2017); Mittal (2019); and Habib et al. (2022)	3, 12, 63, 74, and 30
13	Lack of technical support and training for teachers and students. Technical support is required as many students and teachers need more exposure to modern technologies. Technical training is required to develop mobile-compatible educational content.	Banerjee & Bose, (2011); Parmar (2015); Awadhiya & Miglani (2016); Nagpal (2017); Kirubakaran et al., (2018), Alvi (2021); Kumar & Pande (2021) and Habib et al. (2022)	35, 3, 12, 63, 45, 6, 47, and 30
14	Concerns related to privacy, safety, and misuse of mobile devices.	Bansal & Joshi (2014); Awadhiya & Miglani (2016); and Mittal (2019)	114, 12, and 74
15	A few studies reported that students exhibited negative attitudes and disinterest towards mobile learning.	Gupta et al. (2021); and Thaker & Vaghela (2021)	81, and 109

mobile learning can empower students to take more control over their education, catering to diverse learning styles and needs. It also motivates students to learn extensively and improve their performances.

Moreover, quick assessment and feedback mechanisms may improve the efficiency of the teaching-learning process, allowing educators to focus on providing targeted support to students. Mobile learning may effectively meet the contemporary requirements of the students of this modern era. On the contrary, many significant hurdles and challenges have been reported, like Internet connectivity, inappropriate learning content, lack of proper infrastructure, technical support, training, and ineffective and improper policies.

The present circumstances in India may not be favourable for mobile learning compared to other nations worldwide. Though mobile learning in India is still in the early stages, there are solid prospects for its development and significant impact. Substantial efforts are needed by higher education institutions, policymakers, and governments for its survival, betterment, and long-term development. The central and/or state governments should design effective policies to sensitize the teaching professionals and all the stakeholders of the higher education sector to impart education to youth by exploiting mobile learning in the best possible way. The identified hurdles need serious attention to be mitigated or rectified.

Issues of Internet and network connectivity are significant concerns in implementing mobile learning. Uttarakhand province's geographical structure and mountain terrain bring significant network connectivity issues. The need to establish effective strategic plans and their ground-level implementation is felt to connect Uttarakhand's different districts, schools, colleges, and universities. Effective and fruitful implementation of mobile learning in Uttarakhand province may be possible by developing skilled faculties through arranging in-service training. Technical support for the teaching fraternity and students is also required. Taking into account the challenges associated with mobile learning in India, future research in the realm should focus on issues like strategies for improving Internet connectivity, exploring cost-effective infrastructure solutions to support mobile learning with limited resources, examining the privacy concerns of students, exploring ways to align mobile learning with the diverse cultural and linguistic needs of Indian learners, to assess the impact of government policies and initiatives in the realm, and to assess the effects of mobile learning on employability & career advancements in Indian environment. Athanassopoulos et al. (2023) recently mentioned that the ChatGPT program might benefit teaching-learning procedures. Therefore, one may also consider studying the status, scope, and impact of generative AI and associated mobile applications in the higher education environment.

It is also observed that limited studies have been conducted in this realm in the context of Uttarakhand. The Uttarakhand province possesses unique challenges and opportunities due to its typical topography and cultural landscape, and therefore, more extensive future research is needed to study the prospects and potential of mobile learning in Uttarakhand's higher education institutions. Endeavours could be exercised to investigate and develop suitable infrastructure, standard policies, training schedules, and standardization of developing e-content for mobile learning.

## Appendix

The reader can view or download the accompanying spreadsheet as the Microsoft Excel file from the web link:

<https://docs.google.com/spreadsheets/d/1s9lnqD5aAUZfoGDdlCzh4EXDIXHajxl/edit?usp=sharing&ouid=105378546561176283175&rtfpof=true&sd=true>

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