Mobile Learning in Higher Education: A Systematic Literature Review

Quadri Noorulhasan Naveed 1, Heena Choudhary 2, Naim Ahmad 1,*, Jarallah Alqahtani 3 and Adel Ibrahim Qahmash 4

Abstract: Mobile learning (M-Learning) has become a popular and effective method of education that leverages the ubiquity of mobile devices. M-Learning has digitally transformed the process of teaching and learning. It has tremendous potential to empower all sections of society through education and training. This study presents a systematic literature review of M-Learning. The articles were retrieved from Scopus and Web of Science databases. After applying inclusion and exclusion criteria, a final selection of 161 articles published between 2016 and 2022 was included in the review. To analyze the articles, the researchers employed the TCCM (Theory, Context, Characteristics, Methods) framework, which facilitated addressing the research questions. This review identified various theories, such as behaviorism, constructivism, cognitivism, situated learning, problem-based learning, context awareness learning, socio-cultural theory, collaborative learning, conversational learning, lifelong learning, informal learning, activity theory, navigation, and location-based learning, that are used to support and guide the implementation of M-Learning. In terms of context, developing countries contributed to 70.8% of the studies, while developed countries contributed to 29.1%. Further, a majority of the studies, 93%, involved students followed by faculty members and only two studies involved staff from higher education management. A total of 19 unique characteristic factors have been identified, such as personal, intention, attitude, usage, utility, ease of use, learnability, social, technological, pedagogical, anxiety, enjoyment, accessibility, knowledge, experience, trust, price, and habit. A quantitative research design was used in 90% of the studies, followed by mixed methods research design in 7% of the studies, and qualitative research design in only 3% of the studies. Further, this article synthesizes previous research findings and highlights gaps for future research. Overall, this review contributes to the understanding and advancement of M-Learning as a valuable educational platform.

Keywords: research gaps in mobile learning; PRISMA framework; TCCM (Theory, Context, Characteristics, Methods) framework; human computer interaction; technology enhanced learning transformation

1. Introduction

The reliance on mobile phones has become increasingly prevalent worldwide, with numerous individuals incorporating them into their daily routines. Projections suggest that the global number of mobile users is expected to reach 7.33 billion by 2023, a rise from 7.26 billion in the previous year [1]. Furthermore, Figure 1 illustrates that the total count of mobile users is estimated to reach 7.49 billion by 2025. The COVID-19 pandemic triggered nationwide lockdowns, resulting in approximately 1.5 billion children experiencing school closures, which UNICEF identifies as the most significant disruption in the history of...
education [2]. In this context, M-Learning stands out as a valuable solution due to its convenience and accessibility for learners. It enables individuals to learn from any location and at any time [3,4], eliminating the need to constantly carry physical learning materials [5].

Mobile learning can be defined as “a form of learning that enables individuals to acquire experiences through individual or collaborative learning with the activities of accessing, producing and managing information through portable devices” [6]. Similarly, Crompton [7] defines mobile learning as learning in multiple contexts through social contexts and interactions using personal electronic devices. This definition highlights that mobile learning encompasses the use of mobile devices, such as mobile phones and tablets, for learning in various contexts, involving diverse individuals and content. According to Keegan [8], mobile learning is defined as the use of pocket computers, PDAs, and mobile phones to conduct education. Thus, the advancement of mobile learning (M-Learning) in higher education has been remarkable, transforming the way students learn and engage with educational content [9,10].

M-Learning enables students to collaborate in real time through discussion boards, group projects, and shared documents [11]. This fosters peer-to-peer learning, teamwork, and knowledge exchange, regardless of physical location. Moreover, there is M-Learning microlearning, which involves the segmentation of educational content into compact, easily digestible modules or lessons [12]. Students access these modules on their mobile devices, enabling quick and targeted learning. Just-in-time learning allows students to access relevant information on-demand, addressing immediate learning needs [13].

From this perspective, higher education institutions (HEIs) have developed mobile apps and platforms specifically designed for learning purposes [14]. Augmented Reality (AR) and Virtual Reality (VR) technologies have been incorporated into M-Learning to provide realistic and immersive experiences [15]. HEIs leveraged these technologies to simulate real-world scenarios, conduct virtual laboratory experiments, and create virtual field trips, enhancing students’ understanding and practical skills. Moreover, M-Learning integrates gamification techniques, such as educational games, quizzes, and simulations, to create interactive and immersive learning experiences. This approach increases student motivation, participation, and knowledge retention by making the learning process enjoyable and engaging [16]. Furthermore, M-Learning platforms offer seamless assessment and feedback mechanisms. Students can take quizzes, submit assignments, and receive prompt feedback, enabling them to track their progress and identify areas for improvement.

The current trends in mobile learning (M-Learning) provide valuable insights for decision makers in formulating policies related to virtual learning environments [17]. Therefore, conducting a systematic literature review (SLR) would be a beneficial approach to comprehensively understand the current progress in the field of M-Learning and inform future studies. An SLR would systematically identify, analyze, and synthesize existing research to provide an overview of the state of knowledge, identify research gaps, and suggest directions for further investigation. This rigorous approach would enable decision makers to
make evidence-based policy decisions and ensure that future studies in M-Learning address the identified gaps and contribute to the advancement of virtual learning environments.

M-Learning is gaining traction, particularly in the post-COVID era. There are many studies in recent years that provide insight into the expansion of M-Learning knowledge. Through an SLR, Burden et al. [18] investigated on the usage of new mobile pedagogy for school-going students by considering that these approaches are different from regular going-to-school practices. They have reviewed 57 carefully selected research studies published between 2010 and 2017. Their findings are helpful to teachers and educators aiming to design innovative methods for effective M-Learning. However, they did not cover university-level higher education institutes.

Kumar et al. [5] have performed an SLR to evaluate usability features in the application of M-Learning. Usability testing is a significant area of M-Learning application. They found that usability is also an important critical success factor in M-Learning, which faces several challenges, such as small screens and input capabilities. Twenty-three relevant studies were selected to give an insight into its contribution. Different opportunities for future researchers are also discussed by showing the research gap. However, they did not explore other critical success factors for practical M-Learning usage.

Krull et al. [17] studied different trends available in M-Learning in the field of higher education. Their study aims to assist educators and researchers in finding the trends and issues in using M-Learning in university education. They reviewed and analyzed 233 articles from 2011 to 2015. They found different trends, methods, applications, and systems for practical M-Learning usage. However, they did not investigate the essential factors of M-Learning.

These studies show the growing trends in the field of M-Learning. The advancement of technology, its high availability, and better internet infrastructure increased the use of mobile technology. This area is worth studying due to fast changes and increased usage, specifically in university-level higher education. Many studies are available on using M-Learning in higher education, but systematic review studies related to M-Learning in university education are very few.

Some SLR studies, such as Kumar and Sharma [19], reviewed M-Learning application development, while others, such as Yomeldi et al. [18], studied serious gaming on M-Learning; this is out of the scope of our review. Earlier studies showed the broader use of M-Learning application development but have not explicitly examined its use in university education. The objective of this review is to identify the theories applied in the m-learning area, the contexts of existing studies, the list of characteristic factors explored, and the research methodologies applied.

Further, the article is organized into sections, including prior literature reviews on M-learning, research epistemology, results, discussions, research gaps and future directions, study implications, and a conclusion.

2. Prior Literature Reviews on M-Learning

M-Learning has experienced a resurgence in prominence, particularly in the post-COVID era. There are many studies in recent years that have provided insight into the expanding M-Learning knowledge base (see Table 1). Through an SLR, Burden et al. [18] investigated the usage of new mobile pedagogy for school-going students by considering that these approaches are different from regular going-to-school practices. They have reviewed 57 carefully selected research studies published between 2010 and 2017. Their findings are helpful to those teachers and educators aiming to design innovative methods for effective M-Learning. However, they did not cover university-level higher education institutes.

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Table 1. Preview literature reviews.

<table>
<thead>
<tr>
<th>Article</th>
<th>Year</th>
<th>Review Type</th>
<th>Coverage</th>
<th>Studies Reviewed</th>
<th>Database Referred</th>
</tr>
</thead>
<tbody>
<tr>
<td>[21]</td>
<td>2017</td>
<td>SLR</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>[17]</td>
<td>2017</td>
<td>SLR</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>[22]</td>
<td>2020</td>
<td>Review</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>[23]</td>
<td>2020</td>
<td>SLR</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>[24]</td>
<td>2020</td>
<td>SLR</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>[25]</td>
<td>2018</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>[27]</td>
<td>2021</td>
<td>SLR</td>
<td></td>
<td>74 studies</td>
<td></td>
</tr>
<tr>
<td>[29]</td>
<td>2022</td>
<td>SLR</td>
<td></td>
<td>35 studies</td>
<td>Scopus</td>
</tr>
<tr>
<td>[27]</td>
<td>2021</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>[31]</td>
<td>2020</td>
<td>Content analysis and bibliometric mapping</td>
<td>2009–2019</td>
<td>310 studies</td>
<td>Scopus, Web of Science</td>
</tr>
</tbody>
</table>

2.1. Justification of New SLR

While there has been significant growth in scholarly research on M-Learning, the quantification and evolution of this research have received limited attention. Few studies have attempted to define M-Learning. Furthermore, the literature on M-Learning is fragmented in terms of theories, concepts, and constructs. Inconsistent definitions and terminology usage further contribute to the lack of coherence in the field. This review aims to synthesize and assimilate the fragmented knowledge on M-Learning through a systematic literature review. By logically synthesizing prior research, this review not only advances the understanding of M-Learning but also provides researchers with up-to-date insights and identifies research gaps. The adoption of an SLR approach facilitates a more robust understanding of M-Learning research and enables the development of future research agendas.

This study focuses on using smartphones or mobile devices for teaching and learning in the field of university higher education. Our research is different from existing reviews of literature in the following aspects:
i. Unlike existing SLRs that are primarily focused on summarizing and synthesizing existing research on M-learning, this study specifically aims to address the gaps in the geographical distribution and evolution of the research in this area. By analyzing the growth and evolution of scholarly research in M-Learning, this study provides a unique perspective that has not been extensively explored before.

ii. While existing SLRs have provided valuable insights into various aspects of M-Learning, this study specifically aims to synthesize and assimilate the fragmented knowledge on M-Learning. This comprehensive synthesis helps bridge the gaps and create a more holistic understanding of the topic, contributing to the development of a more cohesive body of knowledge.

iii. The study employed evidence-based guidelines for the inclusion of various research studies, drawing upon established methodologies and best practices outlined in the works of Budgen and Brereton [32] and Dwan et al. [33]. This ensured a systematic and rigorous approach to the selection and inclusion of relevant studies and hence the credibility and reliability of its findings, as well as ensured transparency and replicability in the review process.

iv. By utilizing the TCCM (Theory, Context, Characteristics, Methods) framework, this study provides a comprehensive analysis of the existing literature on mobile learning, identifying gaps across the theoretical, contextual, characteristics, and methodological dimensions. This identification of research gaps paves the way for future research endeavors and highlights areas where further investigation is needed to enhance our understanding of mobile learning in diverse educational contexts.

2.2. Research Questions (RQs)

The study attempts to address following RQs:

RQ1: Which major theories are explored in the M-Learning literature?
RQ2: What are the commonly used contexts in the M-Learning literature?
RQ3: What characteristic factors affect the usage of M-Learning in higher education?
RQ4: What are the commonly used research methodologies in the M-Learning literature?

3. Research Epistemology

To achieve the objective of answering the research questions, we conducted a comprehensive SLR study following the SLR methodology presented by Kitchenham [34]. The primary goal of the current SLR research is to critically examine the use of M-Learning in higher education at the university level, and to classify and thoroughly synthesize any new evidence based on information derived from identified published papers. Our methods are based on a predefined auditable and repeatable protocol that aims to be free of bias.

3.1. Keyword Search

To conduct a comprehensive search, the researchers created a keyword search query in December 2022 that included relevant terms related to M-Learning in university-level higher education. The goal was to cover a broad range of articles while keeping the search manageable in size [35]. The search string was designed based on the research questions of the study, ensuring that all relevant articles on the adoption of M-Learning in higher education were captured. Scopus and Web of Science databases were searched using the following keyword combination of search string:

(“M-learning” OR “M-Learning” OR “M-learning”) AND (“factors” OR “adoption facto*” OR “Critical Success Factors” OR “CSF” OR “Influencing Factors”) AND (“Higher Education” OR “University Education” OR “University”).

To ensure we were not missing anything, we reran the search with new synonym search terms until no new documents meeting the inclusion criteria were found.
3.2. Inclusion and Exclusion Criteria

Table 2 outlines the inclusion and exclusion criteria, respectively, to ensure that irrelevant information is not included in the analysis. By having separate lists for exclusion criteria, the researchers aimed to maintain a focused and accurate selection of studies that align with the research objectives. This approach helps to filter out studies that do not meet the specific criteria, ensuring that only the most relevant and applicable studies are considered for further analysis.

Table 2. Inclusion and exclusion criteria.

<table>
<thead>
<tr>
<th>Inclusion Criteria</th>
<th>Exclusion Criteria</th>
</tr>
</thead>
<tbody>
<tr>
<td>IC1: The paper should be focused on mobile phones as target devices, including</td>
<td>EC1: The paper is written in a language other than English and published at the</td>
</tr>
<tr>
<td>smartphones and tablet devices and their use in the education sector;</td>
<td>conference or as a book chapter;</td>
</tr>
<tr>
<td>IC2: The paper provides information about mobile usage in university higher</td>
<td>EC2: The study examines the internal features of a mobile phone but is not</td>
</tr>
<tr>
<td>education;</td>
<td>connected with higher education;</td>
</tr>
<tr>
<td>IC3: The paper reports on success factors of M-Learning adoption in university</td>
<td>EC3: The paper discusses mobile engineering.</td>
</tr>
<tr>
<td>higher education;</td>
<td></td>
</tr>
<tr>
<td>IC4: The paper is well-researched, scientifically sound and published as a peer-</td>
<td></td>
</tr>
<tr>
<td>reviewed journal article from 2016 to 2022.</td>
<td></td>
</tr>
</tbody>
</table>

3.3. Study Selection

After applying the inclusion/exclusion criteria, the references were stored in bibliography files. The following steps were considered during the selection process:

i. Identified papers were screened with titles and keywords;
ii. In the next phase, the team reread the abstracts;
iii. The full text was examined in detail in those papers and selected final papers.

By following these steps, the research team helped measure the credibility and validity of each entry and ensured a comprehensive and rigorous selection process for the literature review.

3.4. Selection Results

The PRISMA flow diagram in Figure 2 shows that 161 studies were identified and selected for review. The initial keyword search identified 394 studies on different databases, out of which 102 were removed for irrelevance. Further, after removing 68 duplicate studies, 224 studies were left for consideration. After checking the studies against the inclusion/exclusion criteria, 161 studies were left to read.

3.5. Quality Assessment

The quality of selected articles was assessed using a checklist to determine the credibility and validity of the study. The checklist focused on clarity over the following:

QA1: Are the research goals clearly stated?
QA2: Has the study been cited by other authors?
QA3: Does the study report credible results with supporting data?

3.6. Data Extraction Process

After the final selection of studies, the authors developed a thorough data extraction form (DEF) to ensure that the data extraction process was unbiased and that the results of the SLR were reliable. The DEF comprised a spreadsheet, including columns for information such as paper title, abstract, country in which study was conducted, study participants, variables into consideration, research design, analysis method, sample size, etc. The DEF
allows for the collection and storage of data from each included study in a consistent and systematic way.

![PRISMA framework](image-url)

**Figure 2.** PRISMA framework.

### 4. Results

This section aims to identify research gaps and propose new research directions in the field of M-Learning in higher education. The studies included in this study were categorized using the TCCM framework, as proposed by Paul and Rosado-Serrano [36]. The TCCM framework provides a systematic approach to identify research gaps and guide new research directions by focusing on four key dimensions: theory, context, characteristics, and methodology. According to Paul and Rosado-Serrano [36], theme-based evaluations and framework-based reviews, such as the TCCM framework, are more effective in identifying research gaps compared to other types of reviews, such as bibliometric or narrative reviews. Applying the TCCM framework enhances the value of this study, as it enables a structured analysis of the research literature. The TCCM framework has been widely employed in various disciplines, including gamification and e-learning, as evidenced by studies conducted by Behl et al. [37] and Silva, Rodrigues, and Leal [38]. Its versatile application in different domains highlights its effectiveness in guiding research analyses and identifying research gaps. In the following paragraphs, each dimension of the TCCM framework will be elaborated upon, shedding light on the objectives and elements of each dimension. By delving into these dimensions, researchers can gain a deeper understanding of the areas that require further research and exploration in the field of M-Learning in higher education.

**RQ1:** What are the significant theories explored in the M-Learning literature?

The literature on M-Learning reveals widely applied theories related to behaviorism, constructivism, cognitivism, situated learning, problem-based learning, context awareness learning, socio-cultural theory, collaborative learning, conversational learning, lifelong learning, informal learning, activity theory, connectivism, navigation, and location-based
learning that are used to support and guide the implementation of m-learning [39]. Table 3 lists the major theories that have been used to study M-Learning.

RQ2: What are the commonly used contexts in the M-Learning literature?

The context has been identified from two perspectives: the geographic distribution of the literature, and the type of users that participated in the study, such as student, faculty, and higher education management staff. Figure 3 shows the cataloguing of studies based on the country type in which the study was conducted. It can be observed that the majority of the studies on M-Learning is conducted in developing countries (70.8%, 114 studies) compared to developed countries (29.1%, 47 studies). Further, Figure 4 highlights the country-wise distribution of the studies reviewed in the study. It demonstrates that studies conducted in Malaysia, Jordan, Taiwan, and China account for most of the published research on M-Learning, followed by studies that did not specify a geographic location. However, forming a firm conclusion regarding them is challenging due to the fragmented and diversified literature base. Existing research in M-Learning has predominantly focused on distance education within specific economies [40–42]; this leaves room for exploring a broader range of topics and regions, presenting opportunities for studies across diverse areas and countries.

Figure 3. Country type.

Figure 4. Country spread of M-Learning research.
Participants in the chosen studies fall into the categories of students, faculty, and higher education management staff. Figure 5 depicts the number of studies based on population type. It has been discovered that there are more studies involving students (93.8%, 151 studies) than those involving faculty members (5.0%, eight studies) or higher education management staff (1.2%, two studies). This is a result of the strong influence of M-Learning on student learning and the accomplishment of outcomes. Additionally, students frequently use smartphones and are more experienced with using mobile apps for educational purposes. Furthermore, many students are forced to study online from home using mobile devices since they cannot attend colleges or universities because of COVID-19 restrictions.

![Figure 5. Population type.](image)

RQ3: What characteristic factors affect the usage of M-Learning in higher education?

Several variables were found to be indicators of the adoption of M-Learning. Based on analysis of these studies, these factors have been divided into 19 major categories: personal, intention, attitude, usage, utility, ease of use, learnability, social, technological, pedagogical, anxiety, enjoyment, accessibility, knowledge, experience, trust, price, habit, and others. Efforts have been made to capture unique constructs, for example, usage refers to actual use of services, utility refers to academic relevance of the services, and ease of use refers to the users’ perceived comfort in using the service. The list of factors and how the elements with similar phrases were grouped are shown in Table 4. As a result of this evaluation effort, we can recommend areas for future research that would

### Table 3. Major theories used in M-Learning studies.

<table>
<thead>
<tr>
<th>Theory</th>
<th>References</th>
</tr>
</thead>
<tbody>
<tr>
<td>Technology Acceptance Model (TAM)</td>
<td>[43–61]</td>
</tr>
<tr>
<td>Theory of Planned Behavior (TPB)</td>
<td>[62–70]</td>
</tr>
<tr>
<td>Unified Theory of Acceptance and Use of Technology (UTAUT)</td>
<td>[63,71–94]</td>
</tr>
<tr>
<td>Constructivist Theory</td>
<td>[95,96]</td>
</tr>
<tr>
<td>Innovation Diffusion Theory (IDT)</td>
<td>[44,49,50,97]</td>
</tr>
<tr>
<td>Self-determination Theory (SDT)</td>
<td>[98–101]</td>
</tr>
<tr>
<td>Task-technology Fit Theory (TTF)</td>
<td>[102–104]</td>
</tr>
<tr>
<td>Use and Gratification Theory (U &amp; G)</td>
<td>[43,104,105]</td>
</tr>
<tr>
<td>Theory of Reasoned Action (TRA or ToRA)</td>
<td>[53]</td>
</tr>
<tr>
<td>Information System Success Model (ISS)</td>
<td>[47,48,51]</td>
</tr>
<tr>
<td>Social Cognitive Theory</td>
<td>[97]</td>
</tr>
<tr>
<td>Motivational Theory</td>
<td>[106]</td>
</tr>
<tr>
<td>Theory of Consumption and Altruistic Values</td>
<td>[107]</td>
</tr>
<tr>
<td>DeLone and McLean’s Model (DL &amp; ML)</td>
<td>[108]</td>
</tr>
<tr>
<td>Expectation Confirmation Theory</td>
<td>[109]</td>
</tr>
</tbody>
</table>

RQ3: What characteristic factors affect the usage of M-Learning in higher education?
analyze the effects of m-learning on the outcomes in terms of the structure and tactics of those organizations, including entry mode transition. Over the years, many articles have attempted to identify the precursors or facilitators of the adoption of M-Learning. Research in M-Learning has advanced in our understanding by identifying crucial elements such as antecedents and outcomes. Inconclusive information about the relationship between M-Learning and academic performance presents a difficulty for this sector.

### Table 4. Characteristic factors.

<table>
<thead>
<tr>
<th>Main Factors</th>
<th>Factors</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Personal</strong></td>
<td>Gender, age, marital status, family size, occupation, education level,</td>
</tr>
<tr>
<td></td>
<td>language background, income level, possessions or things, nationality,</td>
</tr>
<tr>
<td></td>
<td>ethnicity, race, religion, geography, and other</td>
</tr>
<tr>
<td></td>
<td>Personal innovativeness, awareness, subjective norm, self-efficacy,</td>
</tr>
<tr>
<td></td>
<td>confidence, subjective norm, motivation, learning autonomy, self-</td>
</tr>
<tr>
<td></td>
<td>management learning, locus of control</td>
</tr>
<tr>
<td><strong>Intention</strong></td>
<td>Behavioral intention, continuous intention, intention to adopt,</td>
</tr>
<tr>
<td></td>
<td>continuous use intention, perceived behavioral control</td>
</tr>
<tr>
<td><strong>Attitude</strong></td>
<td>Attitude, attitude towards learning, attitude towards use, willingness</td>
</tr>
<tr>
<td></td>
<td>to adopt M-Learning</td>
</tr>
<tr>
<td><strong>Usage</strong></td>
<td>Use behavior, actual use, frequency of use, perceived use</td>
</tr>
<tr>
<td><strong>Utility</strong></td>
<td>Satisfaction, perceived usefulness, learning expectancy, academic</td>
</tr>
<tr>
<td></td>
<td>relevance (AR), relevance, expectation confirmation, perceived values</td>
</tr>
<tr>
<td><strong>Ease of Use</strong></td>
<td>Ease of use, effort expectancy, performance expectations, perceived</td>
</tr>
<tr>
<td></td>
<td>ease of use, comfortability, perceived convenience, self-control</td>
</tr>
<tr>
<td><strong>Learnability</strong></td>
<td>Facilitating condition, context, perceived mobility value,</td>
</tr>
<tr>
<td></td>
<td>organizational support, perceived collaborative learning, suitability,</td>
</tr>
<tr>
<td></td>
<td>support, task-technology fit, top management support, top management</td>
</tr>
<tr>
<td><strong>Social</strong></td>
<td>Support institutional policy, organizational structure, change</td>
</tr>
<tr>
<td></td>
<td>management, vicarious learning, ubiquitous learning, information</td>
</tr>
<tr>
<td></td>
<td>availability, psychological comfort, mobile collaborative</td>
</tr>
<tr>
<td></td>
<td>experiential learning (MCEL), multiple sources, perceived mobility</td>
</tr>
<tr>
<td><strong>Technological</strong></td>
<td>Social influence, conformity, persuasion, social facilitation, peer</td>
</tr>
<tr>
<td></td>
<td>pressure, facilitating conditions, peer-group influence, peer learning,</td>
</tr>
<tr>
<td></td>
<td>sense of community</td>
</tr>
<tr>
<td><strong>Pedagogical</strong></td>
<td>System functionality, user interface, technology characteristics,</td>
</tr>
<tr>
<td></td>
<td>interactivity, mobile device limitations, service quality, security,</td>
</tr>
<tr>
<td></td>
<td>privacy, compatibility, relative advantage, trust, compatibility,</td>
</tr>
<tr>
<td></td>
<td>complexity, information quality, system quality, learning interaction,</td>
</tr>
<tr>
<td></td>
<td>reliability, dynamic learning space (DLS), programming practice</td>
</tr>
<tr>
<td><strong>Anxiety</strong></td>
<td>Content quality, M-Learning content quality, information quality,</td>
</tr>
<tr>
<td></td>
<td>teacher’s feedback, pedagogy, interactivity, instructor readiness,</td>
</tr>
<tr>
<td></td>
<td>class hour, student readiness, timely guidance</td>
</tr>
<tr>
<td><strong>Enjoyment</strong></td>
<td>Anxiety, mobile anxiety, resistance to change</td>
</tr>
<tr>
<td><strong>Accessibility</strong></td>
<td>Hedonic motivation, perceived enjoyment, perceived gratification,</td>
</tr>
<tr>
<td></td>
<td>perceived playfulness, timely guidance, inquiry learning</td>
</tr>
<tr>
<td><strong>Knowledge</strong></td>
<td>Device access, connectivity, internet speed</td>
</tr>
<tr>
<td><strong>Experience</strong></td>
<td>Phone competence, perceived awareness, digital readiness, technical</td>
</tr>
<tr>
<td><strong>Price</strong></td>
<td>Experience</td>
</tr>
<tr>
<td><strong>Habit</strong></td>
<td>Price</td>
</tr>
<tr>
<td><strong>Others</strong></td>
<td>Task characteristics, discomfort, learning impact, affection,</td>
</tr>
<tr>
<td></td>
<td>appearance quality, conscientiousness, habit, image, price, quality of</td>
</tr>
<tr>
<td></td>
<td>life, cost-effective, time, need for uniqueness, perceived conflict,</td>
</tr>
<tr>
<td></td>
<td>performance accomplishment, verbal encouragement, recommendation</td>
</tr>
</tbody>
</table>

Additionally, as per the existing literature, the research conducted in M-Learning is mainly concerned with student learning outcomes and the teaching profession in educational contexts. The results show that there are both internal and external antecedents to M-Learning, with organizational structure as an example of an internal antecedent and environmental dynamism as an example of an external antecedent. Previous studies have found that the adoption of M-Learning has a variety of internal precursors or enablers, including behavioral, psychological, cultural, and contextual factors. Contrary to contextual variables, which depend on socioeconomic context elements like procedures, systems, and cultures that serve as the main enablers of adoption, the behavioral approach stresses the necessity to realize the utility, ease of use, learnability, technological and pedagogical aspects of the
technology. Nevertheless, there is a gap in the literature regarding empirical evidence of the performance implications of technology adoption at the organizational level.

The M-readiness assessment model is a valid and reliable tool for measuring an organization’s readiness for implementing mobile technologies. Bakhsh et al. [110] presents the development and validation of an assessment model for measuring an organization’s readiness for implementing mobile technologies (M-readiness). The study investigates the readiness index and factors that affect an organization’s readiness to implement mobile technologies, such as the level of IT support, management support, and staff support. Therefore, we anticipate that subsequent research will reveal more enablers that could significantly impact M-Learning.

RQ4: What are the commonly used research methodologies in the M-Learning literature? In the field of M-Learning, various research methods and tools have been used, such as case analysis, empirical analysis, systematic literature review, structural equation modeling, and regression analysis, as listed in Table 5. Analysis reveals that survey-based primary data collection was the most popular methodology, followed by qualitative interviews and secondary data.

The research design is the fundamental element in conducting academic research and what makes a study strong. Figure 6 reveals that quantitative research design (n = 145; 90%) is the most adopted research design, followed by mixed methods research design (n = 12; 7%) and qualitative research design (n = 4; 3%). In the quantitative methods research design, surveys, descriptive analysis, correlation, and regression analyses are the most widely used research method in M-Learning. The questionnaire was discovered to be the most popular tool utilized by researchers in the literature to understand users’ motivation to use online learning as a learning medium [111]; the use of mobile technology and means of internet access [112]; the awareness of using mobile devices towards m-learning [113]; students’ perceptions related to the educational use of mobile phones [114–116]; students’ behavioral intentions [117]; and knowledge transfer among students.

![Research design](image)

**Figure 6.** Research design.

In terms of data analysis technique, structural equation modelling (SEM) is the most used analysis technique in the M-Learning literature. Studies requiring a substantial amount of data from a large number of respondents have used this methodology. In contrast, in the qualitative methods research design, systematic literature reviews, interviews, and focus group discussions are some of the research methodologies in the selected papers. Qualitative approaches are utilized to assess the usability, acceptance, and adoption of M-Learning. Studies aimed at both students and instructors were conducted. Ref. [40] surveyed HEI (higher educational institution) management to evaluate the sustainability of M-Learning from many perceptions, such as organizational, financial, legal and ethical, pedagogical, assessment, psychological, as well as social factors. Almost all researchers have formally gathered participant demographic information, including gender, age, degree program, year of study, and race. Some studies call for the utilization of various research
techniques to address research concerns. Such studies have adopted the mixed methods research design. However, the number of such studies is relatively less.

Table 5. Research methodologies in the M-Learning literature.

<table>
<thead>
<tr>
<th>Research Design</th>
<th>Research Methods</th>
<th>Reference</th>
</tr>
</thead>
<tbody>
<tr>
<td>Quantitative</td>
<td>It is based on mathematical calculations performed utilizing a range of forms, such as closed-ended questions; correlation and regression methods; and mean, median, or mode metrics. It relates to non-quantifiable elements.</td>
<td>[41,44,51,54,61,67,81,83,85,88,100,107,109,118–137]</td>
</tr>
<tr>
<td>Qualitative</td>
<td>Participant observation, interview and focus group discussion are examples of ways to gather this information. There no mathematical computation involved.</td>
<td>[138–141]</td>
</tr>
<tr>
<td>Mixed method</td>
<td>Mixed methods research incorporates aspects of qualitative and quantitative analysis.</td>
<td>[40,45,84,93,142–146]</td>
</tr>
</tbody>
</table>

5. Discussion

This systematic review explores the extant literature on mobile learning (M-Learning) in higher education using an SLR approach. The review included 161 M-Learning studies and aimed to examine how online and offline learning are integrated through M-Learning. The research revealed that M-Learning encompasses more than just learning on a mobile phone. It extends to any device that can connect to the internet and facilitate communication with others. The concept of M-Learning expands the possibilities of learning beyond the confines of traditional mobile phones, emphasizing the flexibility and connectivity offered by various devices in the context of higher education [147].

Based on the review of existing literature, it has been observed that there is a lack of consistent definitions and frameworks for M-Learning behavior. The way M-Learning behavior is conceptualized and studied varies across different research studies. This inconsistency in defining M-Learning behavior hinders the development of a unified understanding of the concept. Furthermore, the literature on M-Learning is fragmented, scattered across various disciplines, which makes it challenging to integrate findings and develop a comprehensive understanding of M-learning. The scattered nature of the studies also hampers knowledge transfer and collaboration between different disciplinary perspectives. However, despite these challenges, previous studies (see [148–151]) have discussed the adoption of M-Learning in formal education and explored user viewpoints and perceptions. Findings suggest that using mobile devices has had a positive impact on learning outcomes in formal education settings. For example, M-Learning has been found to encourage student collaboration [70,95,152], facilitate skills development [57,77,98,102,153,154], and enable self-assessment opportunities for students [40,152]. These findings highlight the potential benefits of M-Learning in formal education, including enhanced collaboration, skill acquisition, and self-assessment opportunities, suggesting that mobile devices have positively impacted learning experiences when integrated into formal educational contexts.

The studies found that M-Learning was perceived as having a medium or poor value by users (see [126,155,156]). This suggests that users, including students and lecturers, did not view M-Learning as highly beneficial or effective for their educational needs. One of the concerns raised in these studies was related to the potential risks associated with using mobile technology for learning. This includes concerns about the confidentiality, integrity, and privacy of the data used in delivering mobile-based learning experiences. Users expressed apprehension about the security of their personal information, as well as the protection of sensitive educational data. These concerns were identified in studies conducted by Almaiah and colleagues [89,108,157–159] and further supported by other research [48,80,88,137,155]. Addressing these privacy and security concerns is crucial to ensure user acceptance and engagement in M-Learning initiatives. It requires implementing appropriate measures and safeguards to protect user data, ensuring compliance with data protection regulations, and promoting transparency in data handling practices. By addressing these concerns,
institutions can build trust and confidence among users, which may lead to a more positive perception of M-Learning and its value in the educational context.

Indeed, the literature suggests that M-Learning brings several objective and reasonable advantages, leading to its success in formal education. Studies by Gan et al. [103] indicate that M-Learning is viewed as more objective and reasonable compared to other learning approaches. This perception may stem from the interactive and engaging nature of mobile learning, which allows for personalized learning experiences and active participation. M-Learning also offers improved mobility and flexibility in educational settings, as highlighted by the studies conducted by [124,160]. The ability to access learning materials and resources anytime and anywhere through mobile technologies enhances the flexibility of learning, enabling students to engage in learning activities at their convenience and pace. Furthermore, the use of mobile technologies in M-Learning extends beyond the traditional classroom boundaries, allowing for learning experiences both inside and outside the classroom. This versatility and adaptability contribute to the success of M-Learning in formal education, as students can engage in learning activities beyond the confines of traditional classroom settings. These advantages of M-Learning, including its objectivity, reasonability, improved mobility, flexibility, and the utilization of mobile technologies inside and outside the classroom, have collectively contributed to its success in formal education. They have transformed the learning experience, making it more accessible, engaging, and personalized for students.

The study also identified several challenges associated with the implementation of M-Learning in formal education. One challenge is the restricted use of mobile devices in classrooms, as highlighted by the study conducted by Aamri and Suleiman [161]. Many educational institutions have policies that limit or prohibit the use of mobile devices during class time, which can hinder the integration of M-Learning into traditional classroom settings. Another challenge is the reluctance of teachers to promote student use of mobile devices due to concerns about potential distractions. Aamri and Suleiman [161] found that teachers expressed apprehension about students becoming easily distracted by their mobile devices, potentially disrupting the learning environment. Furthermore, the study highlights that there is limited understanding of the dynamic processes involved in distance learning education. Students face struggles in developing their learning abilities, becoming self-regulated learners, and ultimately acquiring the skills to become competent and lifelong learners. This suggests a need for further research and exploration of effective strategies to support students in distance learning environments. Despite these challenges, it is worth noting that the number of students engaging in online higher education is growing. This indicates a recognition of the potential benefits and opportunities offered by online learning, including flexibility and accessibility. The study draws attention to the importance of addressing the challenges and leveraging the growing interest in online higher education to enhance the learning experience and support students’ development as self-regulated and lifelong learners.

6. Research Gaps and Future Directions
6.1. Theoretical Gaps

Even though there have been substantial advancements in the theory’s application, we found a lack of application of advanced theories during the review. Future research into empirical analysis for M-Learning adoption should build on the latest theories. New theoretical lenses could be used to describe hitherto unexplored areas, such as how the participation of many stakeholders can offer feedback on essential areas of M-Learning adoption. Although the technology acceptance theory is a critical model in technology acceptance, and many studies are being used in M-Learning also. It is relatively old and does not cover specific aspects and internal/external motivation factors. New elements and areas that previous models and scales did not cover can be explored.

Modular learning offers a more intelligent and personalized approach to presenting information, catering to individual learners’ needs. In contrast, traditional course frame-
works often present information sequentially, leading to a sense of monotony for learners. Keegan’s classification of theories of distance education includes theories of independence and autonomy, theories of the industrialization of teaching, and theories of interaction and communication, as outlined in his work “The Foundations of Distance Education.” However, the relatively new learning theory of connectivism suggests that students should combine thoughts, theories, and general information in a meaningful way. It recognizes the importance of technology in the learning process and acknowledges our constant connectivity, providing opportunities for learners to make choices about their own learning. Additionally, the Complex Adaptive Blended Learning System (CABLS) framework offers a comprehensive analysis of learning as a complex and dynamic system. It identifies six interacting elements: the learner, teacher, technology, content, learner support, and institution. This framework can be further explored and applied in various educational settings.

6.2. Contextual Gaps

Although significant contributions have been made to explain the body of M-Learning research on outcomes focusing on students’ learning achievement and satisfaction, these contributions do not yet address other conventional versus unconventional strategies. It is also observed that not many studies explore the antecedents in distance education and learning context. Moreover, it is recommended that studies may focus on educational levels other than higher education, taking into consideration the characteristic variables presented in Table 4. There is a gap in examining HEI from countries that are not traditional clusters of technology expand internationally, particularly in less technology-intensive countries. Furthermore, the potential effect of newly emerging technologies, especially VR and AR technologies, which have been popular in recent years, can be examined at all educational levels. Mobile game application as an educational platform is better than traditional academic learning and is easy and understandable [162]. Mobile devices’ features also make it possible for special needs education students, such as students with autism or visual impairment [163]. Therefore, research on M-Learning adoption in higher education should consider students’ perspectives, such as non-traditional students, students from underrepresented groups, and students with disabilities.

6.3. Characteristics

A substantial body of literature has focused on identifying antecedents of M-Learning. Further this study identifies following gaps in this area

(i) Study the impact of M-Learning on student outcomes: Research should investigate how M-Learning affects student engagement, achievement, and retention;
(ii) Investigate the role of faculty: Research should examine how faculty attitudes and behaviors influence the adoption of M-Learning;
(iii) Investigate the role of technology: Research should investigate how different mobile technologies, such as smartphones, tablets, and laptops, are used for learning and how they impact student outcomes;
(iv) Study the effect of institutional policies: Research should investigate how institutional policies and support structures impact the adoption and effectiveness of m-learning;
(v) The effect of educational and technological tools on motivation can be explored in detail;
(vi) The effects of self-efficacy, digital literacy, and self-regulation on learning experiences and academic achievements can be analyzed in detail.

6.4. Methods

The analysis of research methods used in M-Learning studies reveals that conceptual and qualitative methods were not frequently employed, indicating a need for more attention and exploration in this area. Among the research methods, the least utilized was the case study method. However, incorporating survey-based studies alongside case studies can have a significant impact on developing new frameworks and insights in the field of M-Learning,
Longitudinal studies can also be valuable in tracking the adoption of M-Learning over time, capturing changes and identifying patterns and trends. This longitudinal approach can provide valuable insights that inform future research and contribute to a deeper understanding of M-Learning. To gain a more comprehensive understanding, researchers should consider employing mixed-methods research that combines both quantitative and qualitative data. This approach can provide a holistic view of M-Learning adoption, allowing for a more nuanced analysis of the topic. Furthermore, to enhance methodological rigor in M-Learning research, future studies could benefit from implementing analytical approaches such as meta-analysis and other econometric tools. These techniques can strengthen the statistical and analytical aspects of research, providing a more robust foundation for drawing conclusions and making evidence-based recommendations.

7. Study Implications
1. This study emphasizes the importance of purposeful and selective use of mobile technologies in M-Learning. It suggests that M-Learning is most effective when integrated into the curriculum with clearly stated learning goals and when guided by knowledgeable teachers who gradually reduce support as students become more independent. Research, such as the study conducted by Kondo et al. [164], supports the notion that teacher guidance and scaffolding play a crucial role in maximizing the benefits of M-Learning.

2. Privacy and digital safety concerns need to be taken into consideration when designing M-Learning environments. While these concerns were not extensively addressed in the reviewed research, they have the potential to significantly impact learners' experiences and their ability to self-regulate in the long term. Educators should pay attention to ensuring the privacy and safety of learners when implementing M-Learning initiatives.

3. Defining M-Learning in a comprehensive manner that considers the rapidly evolving mobile technology and pedagogies that prioritize learner-centered participatory activities is crucial. Such definitions should serve as the foundation for both m-learning research and practice. This ensures a clear understanding of the unique characteristics and potentials of M-Learning as an educational approach.

4. Policymakers and education developers should explore the potential of mobile exam platforms as a new assessment tool, particularly in the context of distance learning. Mixed-method research is needed to assess the effectiveness and suitability of using these platforms, especially for postgraduate levels in higher education. Studies, like the one conducted by Alshurideh et al. [134], can provide insights into the feasibility and advantages of utilizing mobile exam platforms in educational assessment practices.

Overall, this study highlights the importance of the purposeful implementation of M-Learning, considerations of privacy and digital safety, clear definitions of M-Learning, and the exploration of innovative assessment platforms in educational policies and practices. These considerations can contribute to the effective and meaningful integration of M-Learning in educational settings.

8. Conclusions
M-Learning is an excellent example of digital transformation in the teaching and learning process by adopting state of the art information technology tools and techniques. The present study conducted a thorough review of 161 M-Learning studies from 2016 to 2022 with the aim of identifying potential areas for future research. While previous research has explored the benefits and trends of M-Learning, this study offers new insights and directions for future investigations. The analysis revealed the need for comparative studies to determine the most effective M-Learning approaches and highlighted the importance of addressing less commonly discussed issues to bring fresh perspectives to the field. Notably, studies that combined qualitative and quantitative analysis garnered the highest citation counts, indicating the value of mixed-method approaches. Furthermore, there has been
a shift in M-Learning contexts from traditional classrooms to real-world settings, and an increased focus on junior and senior high school students. Based on these findings, the study provides suggestions for researchers, both new and experienced, to enhance their M-Learning studies. It encourages future research to focus on assessing the added value of M-Learning, explore disciplinary or topical educational issues that have received limited attention, and employ comprehensive analysis methods to examine learners’ performance from multiple perspectives. In essence, this study identifies specific research gaps in applied theories, context, characteristics, and research methods within the field of M-Learning. The findings contribute to a clearer understanding of the areas that require further exploration and provide valuable guidance for researchers interested in advancing the field of M-Learning.

Author Contributions: Conceptualization, Q.N.N., H.C., N.A., J.A. and A.I.Q.; methodology, Q.N.N. and H.C.; software, Q.N.N. and H.C.; validation, N.A., J.A. and A.I.Q.; formal analysis, Q.N.N. and H.C.; investigation, Q.N.N., H.C., N.A., J.A. and A.I.Q.; resources, J.A. and A.I.Q.; data curation, Q.N.N., H.C., N.A., J.A. and A.I.Q.; writing—original draft preparation, Q.N.N. and H.C.; writing—review and editing, N.A., J.A. and A.I.Q.; visualization, Q.N.N., H.C., N.A., J.A. and A.I.Q.; supervision, J.A. and A.I.Q.; project administration, N.A., J.A. and A.I.Q.; funding acquisition, J.A. All authors have read and agreed to the published version of the manuscript.

Funding: This work is supported by the Deputy for Research and Innovation, Ministry of Education, Kingdom of Saudi Arabia for this research through a grant (NU/IFC/2/SERC/-/9) under the Institutional Funding Committee at Najran University, Kingdom of Saudi Arabia.

Institutional Review Board Statement: Not applicable.

Informed Consent Statement: Not applicable.

Data Availability Statement: Not applicable.

Acknowledgments: The authors would like to acknowledge the support of the Deputy for Research and Innovation, Ministry of Education, Kingdom of Saudi Arabia for this research through a grant (NU/IFC/2/SERC/-/9) under the Institutional Funding Committee at Najran University, Kingdom of Saudi Arabia.

Conflicts of Interest: The authors declare no conflict of interest.

References
10. Ahmad, N.; Hoda, N.; Alahmari, F. Developing a Cloud-Based Mobile Learning Adoption Model to Promote Sustainable Education. *Sustainability* 2020, 12, 3126. [CrossRef]


40. Coskun-Setirek, A.; Tanrikulu, Z. M-Universities: Critical Sustainability Factors. SAGE Open 2021, 11, 2158244021999388. [CrossRef]

52. Han, I.; Shin, W.S. The Use of a Mobile Learning Management System and Academic Achievement of Online Students. *Comput. Educ.* 2016, 102, 79–89. [CrossRef]
Sustainability 2021, 13, 15366


91. Al-Bashayreh, M.; Almajali, D.; Altamimi, A.; Masa’deh, R.; Al-Okaily, M. An Empirical Investigation of Reasons Influencing Student Acceptance and Rejection of Mobile Learning Apps Usage. Sustainability 2022, 14, 4325. [CrossRef]


107. Hilal, M.P.; Wichadee, S. Gender Differences in Mobile Phone Usage for Language Learning, Attitude, and Performance. Turk. Online J. Distance Educ. 2017, 18, 68–79. [CrossRef]


134. Alshurideh, M.T.; Al Kurdi, B.; AlHamad, A.Q.; Salloum, S.A.; Alkurudi, S.; Dehghan, A.; Abuhashesh, M.; Masa’deh, R. Factors Affecting the Use of Smart Mobile Examination Platforms by Universities’ Postgraduate Students during the COVID-19 Pandemic: An Empirical Study. *Informatics* 2021, 8, 32. [CrossRef]


160. Mittal, N.; Chaudhary, M.; Alavi, S. Development and Validation of Teachers Mobile Learning Acceptance Scale for Higher Education Teachers. *Int. J. Cyber Behav. Psychol. Learn.* 2017, 7, 76–98. [CrossRef]


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