Jurnal
Guru Komputer
Journal homepage: https://ejournal.upi.edu/index.php/JGrKom

Systematic Analysis of Mobile Learning Implementation in Education

Erlangga[1], Almira Rahma Fadhila[2], Cynthia Hasna Mazaya[3], Fathanah Hamidah Tsaqib[4], Rizka Nabila Khairani[5]*

Universitas Pendidikan Indonesia, Indonesia
*Correspondence: E-mail: erlangga@upi.edu

ABSTRACT

The development of digital technology has driven the transformation of learning towards a more flexible, interactive, and learner-centered approach. One innovation that is increasingly being implemented is mobile learning (m-learning), particularly in the context of higher education and other formal education. This study aims to systematically analyze the implementation of mobile learning in education, focusing on the level of implementation, learning models and strategies, success factors, impacts, challenges, and development opportunities. The research method used is a Systematic Literature Review (SLR) based on the PRISMA protocol. The data sources were obtained from reputable scientific databases published between 2021 and 2025. The results of the analysis show that mobile learning has a positive impact on learning flexibility, student engagement, improved learning outcomes, and the strengthening of digital skills and independent learning. However, the implementation of mobile learning still faces various challenges, such as infrastructure limitations, the digital divide, low digital pedagogical competence of educators, and a lack of long-term evaluation. The findings of this study confirm that the success of mobile learning is highly dependent on the integration of technical, pedagogical, psychological, and institutional aspects.

ARTICLE INFO

Article History:
Submitted/Received 10 Jul 2025
First Revised 12 Aug 2025
Accepted 21 Aug 2025
First Available Online 01 Sep 2025
Publication Date 01 Sep 2025

Keyword:
Digital Education,
Education,
Mobile Learning,
Systematic Literature Review.

1. INTRODUCTION

The development of digital technology has brought major changes to various aspects of human life, including education. Currently, the world of education is required to adapt to rapid technological developments and optimize the ease of access to information and communication technology as a supporting tool in improving the effectiveness of the learning process (Fitrianti et al., 2024). Learning, which was previously conducted conventionally in classrooms through face-to-face interaction, has now begun to evolve towards technology-based learning that is more interactive, flexible, and innovative (Purwanto et al., 2025). This development has also encouraged a shift in the learning approach from one that was initially teacher-centered to one that is student-centered. In this approach, students become the center of the learning process, while teachers act as facilitators who guide and support independent learning (Silfiya & Siagian, 2024).

This paradigm shift further emphasizes the importance of educational transformation in the 21st century, which demands the emergence of a generation with critical thinking skills, adaptability to change, and the ability to face various challenges at the global level (Ridwan, 2024). In addition, advances in digital technology have had a major impact on learning methods. These range from more interactive and varied presentations of material and increased access to learning resources to the application of more adaptive approaches (Sakti, 2023). One form of innovation that has emerged from these developments is mobile learning as an alternative form of modern learning that utilizes digital devices.

Mobile learning, or m-learning, is a form of learning that utilizes digital technology, particularly mobile devices such as smartphones, to support the learning process without the constraints of time and space (Syahputra et al., 2024). The main characteristics of mobile learning are high flexibility and portability, allowing students to access learning materials, guides, and information anytime and anywhere, either online or through local storage (Syahputra et al., 2024; Ghafara et al., 2022). With its ability to support interaction and collaboration through various digital media, mobile learning has become one of the relevant learning strategies to be implemented in facing the demands of 21st-century education, which emphasizes independence and digital collaboration.

The implementation of mobile learning is currently an urgent need in the digital age due to the high penetration of mobile devices and advances in communication technology that are increasingly affordable and accessible. Mobile-based learning allows flexibility in accessing materials anytime and anywhere and supports independent and collaborative learning (Sophonhiranrak et al., 2021). By utilizing mobile applications and platforms, students can interact more actively through quizzes, discussions, and digital reflections that enrich the learning experience. In addition, various meta-analyses show that mobile learning significantly improves student learning outcomes, with large effect sizes in many empirical studies (Garzón et al., 2025). However, despite its increasing urgency, the implementation of mobile learning in education still faces various obstacles that need to be addressed.

Many educational institutions are not yet fully prepared to implement mobile learning effectively due to various technical and pedagogical obstacles that still exist. Unequal access to devices and unstable internet connections are the main obstacles to the equitable use of technology in educational settings. In addition, some educators are not yet fully capable of optimally integrating mobile devices into their learning strategies due to limited training and a lack of understanding of interactive and contextual mobile-based learning design (Tarhini et al., 2024). On the other hand, recent research shows that there is still a lack of studies assessing the long-term effectiveness and consistency of mobile learning implementation in supporting student learning outcomes, resulting in a research gap regarding the sustainability

DOI: http://dx.doi.org/10.17509/xxxx.xxx
p- ISSN xxxx-xxxx e- ISSN 2774-7891

and real impact of mobile learning implementation in the learning process (Sareen, 2024). Based on these conditions, it is important to conduct a more systematic study to understand how mobile learning is implemented and the factors that influence its success in various educational contexts.

Against this background, this study aims to systematically analyze the implementation of mobile learning in education, with a primary focus on the sustainability of its use and its contribution to the quality of learning. The analytical approach will include identifying factors that support and hinder the practice of mobile learning in academic institutions (Hameed et al., 2024). In addition, this study also aims to examine how mobile learning practices contribute to broader educational goals, including increasing access to and equity in education (Maketo et al., 2023). The results of the analysis are expected to produce findings on trends, challenges, and opportunities in the implementation of mobile learning, which will ultimately form the basis for the development of future educational policies and practices.

2. METHODS

This study uses the Systematic Literature Review (SLR) method as its main approach, because SLR is a relevant research method through a systematic and replicable process (Carrera-Rivera et al., 2022). This method was chosen so that the study has a strong foundation and the results obtained are objective and traceable. This approach allows researchers to obtain a comprehensive overview of various previous research results regarding the implementation of mobile learning in education. Based on the SLR guidelines written by Carrera-Rivera et al. (2022), this method is used not only to identify but also to evaluate and analyze all relevant research transparently so that the results obtained are reliable and easy to replicate in subsequent studies. There are three main stages in SLR: planning, conducting, and reporting (Kitchenham, 2004).

2.1 *Planning*

The planning stage focuses on formulating research questions that are in line with the objectives of this study. The research questions include:

a. RQ-1: How do the concepts, characteristics, and differences between mobile learning and conventional e-learning?
b. RQ-2: How is mobile learning implemented in the world of education?
c. RQ-3: What are the factors that influence the success of mobile learning implementation in education?
d. RQ-4: What are the impacts and contributions of mobile learning in education?
e. RQ-5: What are the challenges and issues faced in implementing mobile learning?
f. RQ-6: What are the opportunities for developing mobile learning?

2.2 *Conducting*

The conducting stage is the process of searching for and selecting literature. At this stage, the PRISMA (Preferred Reporting Items for Systematic Reviews and Meta-Analyses) guidelines are used as a reference for selecting articles in a transparent and standardized manner.

2.2.1 Literature Search Strategy

This study uses secondary data sources obtained from various reputable scientific databases, namely Scopus, ScienceDirect, Garuda, and Google Scholar. The use of these various databases is important so that the results of the study cover both international and national perspectives, while ensuring that the literature is taken from credible sources. The

DOI: http://dx.doi.org/10.17509/xxxx.xxx
p- ISSN xxxx-xxxx e- ISSN 2774-7891

literature reviewed includes scientific articles, conference proceedings, and books discussing the application of mobile learning technology in the context of formal education. Thus, the scope of the study is broad and able to represent the development of mobile learning implementation at various levels of education.

The literature search process was conducted using a combination of keywords and Boolean operators (AND, OR) to obtain comprehensive yet relevant search results. The keywords used included: ("mobile learning" OR "m-learning") AND ("education" OR "learning environment" OR "classroom") AND ("implementation" OR "integration" OR "effectiveness"). In addition, to broaden the scope in the local context, the study used a combination of keywords in Indonesian, such as "*pembelajaran* berbasis mobile" AND "*implementasi*" AND "*Pendidikan.*" The publication time range used was 2021-2025 so that the literature analyzed would describe the latest developments and be relevant to the current state of digital education.

2.2.2 Inclusion and Exclusion Criteria

To ensure that the selected literature is relevant and meets academic quality standards, this study established several selection criteria.

a. Inclusion Criteria
   1) Research articles that discuss the implementation, effectiveness, challenges, or impact of mobile learning in the context of education.
   2) Articles published in reputable journals or scientific proceedings.
   3) Research conducted at the formal education level.
   4) Published between 2021 and 2025.
   5) Sources are available in English or Indonesian and are fully accessible.

b. Exclusion criteria
   1) Articles in the form of opinions, editorials, or non-systematic reviews.
   2) Research that does not explicitly discuss mobile learning.
   3) Articles with unverifiable data or methodology.
   4) Duplicate publications of the same research.

The application of these criteria helps narrow the scope of the literature to include only sources that truly support the research objectives.

The selection process in this study was conducted using the PRISMA (Preferred Reporting Items for Systematic Reviews and Meta-Analyses) approach to ensure a systematic, clear, and traceable literature review by other parties (Surbakti et al., 2025). The PRISMA approach serves as a guide in filtering literature gradually and ensuring transparency in the source selection process. This approach is applied so that the selection of articles is truly relevant to the focus of the research, namely the implementation of mobile learning in the context of education. The diagram of the process is shown in **figure 1**.

DOI: http://dx.doi.org/10.17509/xxxx.xxx
p- ISSN xxxx-xxxx e- ISSN 2774-7891

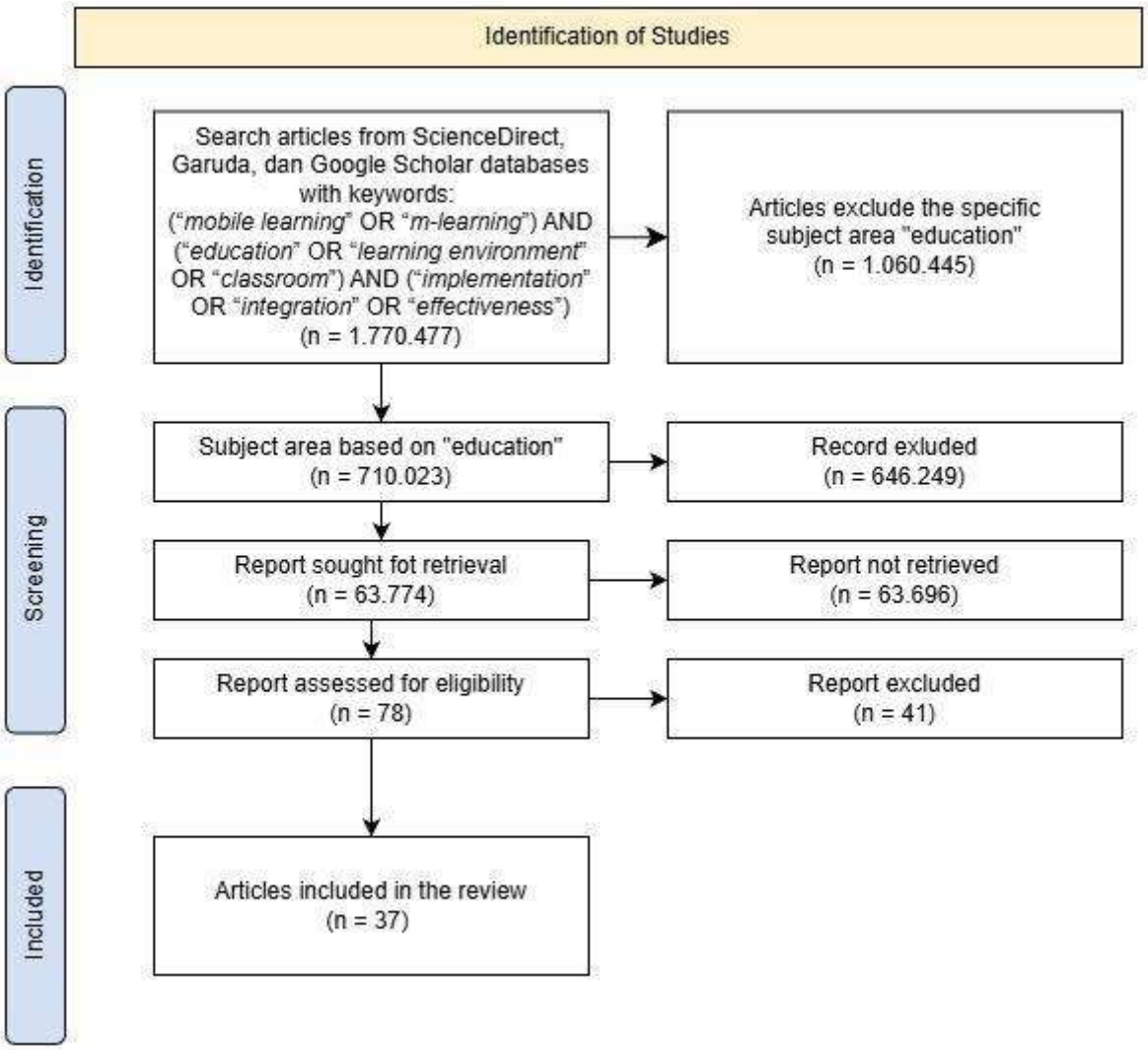

Figure 1. *Systematic Literature Review* Using PRISMA

3. RESULTS AND DISCUSSION

3.1. Concept and Characteristics of Mobile Learning

3.1.1. Definition Mobile Learning

Mobile learning, or m-learning, is a modern learning approach that utilizes the development of mobile device technology to overcome various limitations of conventional learning. Through mobile learning, the learning process becomes more interactive, flexible, and adaptable to individual needs (Sangur et al., 2025). Clark Quinn dalam (Faqih, 2020) explains that mobile learning arises from the intersection of mobile computing and online learning. This approach allows learners to easily access learning resources wherever they are, perform searches for information with speed, interact more richly, and receive performance-based learning support and assessment without being constrained by location or time.

Furthermore, Ulfah et al. (2025) emphasize that mobile learning is a form of transformation from conventional learning to more efficient digital learning because it can save time and costs and increase learning effectiveness. Digital technology, especially the internet, is the main foundation in supporting this learning model.

According to Syahputra et al. (2024), mobile learning allows teachers and students to access learning materials, guides, and applications anytime and anywhere through mobile devices such as cell phones, laptops, and PDAs. Its main advantages lie in its flexibility and ease of access to various learning resources. In addition, mobile-based learning media are

DOI: http://dx.doi.org/10.17509/xxxx.xxx
p- ISSN xxxx-xxxx e- ISSN 2774-7891

developed with the assumption that the communication process in learning will become more meaningful. Thus, teachers can play an effective role as facilitators who are able to utilize, develop, and apply various learning technologies to support the learning process of students (Prima et al., 2022).

Therefore, it can be concluded that mobile learning is a technology-based learning approach that provides a more flexible, efficient, interactive, and accessible learning process anytime and anywhere, while strengthening the role of teachers as facilitators in optimally utilizing learning technology.

3.1.2. Characteristics of Mobile Learning

According to Sophonhiranrak (2021), mobile learning has several characteristics, including*:*

a. Mobile learning is a combination of online learning and contextual learning in the real world that takes place outside the classroom.
b. It provides opportunities for students to learn anytime and anywhere (anytime and anywhere learning).
c. It consists of several main components, namely input, sensors, output, and connectivity. Input components can be touchscreens, sound, or keyboards; sensors include cameras, microphones, and GPS; output includes screens, speakers, and earphones; while connectivity can be done through the internet network or cloud storage.
d. It is flexible, encourages collaboration between students, and enables the application of various innovative and situated learning methods that emphasize the learning process in a real context through the direct involvement of students in authentic activities.
e. It can be used in informal learning, which is the learning process that occurs naturally in everyday life without a curriculum structure, formal institutions, or certificates. In addition, mobile learning can also be used in non-formal learning, which are organized and structured learning activities that take place outside the formal education system, such as schools or universities.
f. It supports personalized learning, allowing learners to set learning goals, choose materials, and determine the pace of learning according to their individual needs.
g. Its effectiveness depends on the readiness of learners and educators, motivation, attitudes toward technology, and adequate infrastructure support.
h. Common learning activities include discussions, collaboration, taking pictures or videos, reflection, and inquiry-based learning that links theory with real-world experiences.

3.1.3. Comparison of Mobile Learning and Conventional E-Learning

E-learning is a learning approach that utilizes digital technology and the internet to provide online learning resources and enable interaction and collaboration between educators and learners in a virtual environment. This concept combines elements of distance learning, online learning, and digital learning into one integrated system. Historically, e-learning has developed through several phases, starting from a correspondence-based distance learning system, the use of radio and television media, and the use of multimedia systems to the internet-based system that is currently widely used in educational institutions (Chat et al., 2025).

Meanwhile, mobile learning (m-learning) emerged as a further development of e-learning that emphasizes the mobility of devices and access to learning content. According to Chat et al. (2025), m-learning allows learners to access learning resources through mobile

DOI: http://dx.doi.org/10.17509/xxxx.xxx
p- ISSN xxxx-xxxx e- ISSN 2774-7891

devices such as smartphones, tablets, or laptops, both online and offline. This makes m-learning more flexible because it allows the learning process to be carried out anytime, anywhere, and using any device in accordance with the "ATAWAD" (Any Time, Anywhere, Any Device) concept. In addition, m-learning supports personalized learning and adjusts the learning time of each individual, known as the "In My Own Time" and "Just for Me" principles.

The results of research conducted by Akbar (2025) show that m-learning has a number of advantages over conventional e-learning, especially in terms of flexibility, accessibility, and user experience. M-learning allows for more freedom in learning without the constraints of time and space, whereas e-learning still depends on computers and a stable internet connection. In terms of approach, m-learning supports the concept of microlearning, which is short and repetitive learning that increases interaction and learning retention among students. In addition, the m-learning interface is simpler, more interactive, and easier to use than e-learning. Mobile applications are also considered faster and more stable for activities such as quizzes or short discussions, while e-learning tends to rely on LMS servers that require a stronger connection.

Akbar (2025) explains that both approaches have their limitations. M-learning is sometimes hampered by small screen sizes and potential interference from other applications on mobile devices. Meanwhile, e-learning tends to be less flexible and can feel monotonous if not designed interactively. Therefore, these two learning models should be combined synergistically in hybrid learning. M-learning can be used for quick learning activities, material repetition, and interactive communication between educators and students, while e-learning can be used for in-depth material delivery, large assignments, and formal evaluations. By integrating the two, the learning process will become more adaptive, efficient, and effective.

3.1.4. The Role of Mobile Learning in Supporting 21st Century Learning

Mobile learning (m-learning) plays an important role in supporting 21st-century learning, which emphasizes flexibility, collaboration, creativity, and mastery of digital technology. Mlearning enables the teaching and learning process to take place anytime and anywhere through mobile devices such as smartphones, tablets, or laptops, thereby eliminating the limitations of space and time in learning (Efriyanti & Annas, 2020; Solomovich & Ceobanu, 2021). The following are some of the roles of mobile learning in 21st-century learning:

a. As a Flexible Learning Tool

M-learning enables learning to take place without spatial and temporal boundaries. Students can access materials, discuss, and complete assignments anytime and anywhere, bridging formal and informal learning (Efriyanti & Annas, 2020; Solomovich & Ceobanu, 2021).

b. Supporting the Mastery of 21st Century Skills

According to Efriyanti & Annas (2020), based on the Partnership for 21st Century Learning (P21) framework, m-learning contributes to four key competencies:

1) Ways of Thinking: helping students think reflectively, critically, and independently through access to interactive materials
2) Ways of Working: facilitates collaboration and communication between students and with teachers through discussion forums, chats, and online conferences.
3) Tools for Learning: encourages the use of digital technology for projects, experiments, and creative presentations.
4) Living in the Global World: fostering students' readiness to face global challenges with adaptability, collaboration, and digital responsibility.

DOI: http://dx.doi.org/10.17509/xxxx.xxx
p- ISSN xxxx-xxxx e- ISSN 2774-7891

c. Encouraging Teacher Innovation in Digital Learning

Teachers are required to integrate technology into the learning process. Through m-learning, teachers can develop interactive content, conduct application-based evaluations, and compile multimedia materials that are interesting and contextual to students' needs (Dahri et al., 2023).

d. Improving Higher Order Thinking Skills (HOTS) and Communication

The integration of m-learning has been proven to improve Higher Order Thinking Skills (HOTS) such as analysis, evaluation, and creativity, as well as students' scientific communication skills. M-learning enables real-time data collection, sharing results via the cloud, and guided reflection that reinforces inquiry-based and collaborative learning (Galimova et al., 2025).

e. Promoting Active, Meaningful, and Collaborative Learning

M-learning increases student engagement through cooperative learning and experiential learning. By giving students autonomy and control, m-learning supports internal motivation and active participation in line with self-determination theory (Solomovich & Ceobanu, 2021).

f. Changing the Roles of Teachers and Students

In the implementation of m-learning, students act as active and independent learners, while teachers become facilitators who help students explore knowledge and guide the learning process (Solomovich & Ceobanu, 2021).

3.2. Implementation of *Mobile Learning* in Education

3.2.1. Level of Implementation

Mobile learning is one of the strategies that is beginning to dominate various levels of education, from secondary school to university and professional training (Kurnia et al., 2024). This study reviewed 16 scientific articles on the implementation of mobile learning in education, as shown in **Table 1**.

Table 1. Application of *Mobile Learning* at the Secondary, Higher Education, and Professional Training Levels

No	Author	Level of Implementation	Results
1	Hutabarat, 2024	Intermediate Level (Junior High School)	The use of mobile learning as a learning medium is effective in increasing junior high school students' interest in learning mathematics, with an increase of 74.68%.
2	Prima et al., 2022	Secondary Level (Junior High School)	Students responded that the use of mobile learning in soccer material made the material more interesting and easier to understand. This was also proven by a 69.5% increase in students' minimum competency scores after using mobile learning.
3	Sasmito et al., 2021	High School Level	Learning using mobile learning media received positive responses from students, namely that mobile learning can facilitate understanding of the material, self-

DOI: http://dx.doi.org/10.17509/xxxx.xxx
p- ISSN xxxx-xxxx e- ISSN 2774-7891

No	Author	Level of Implementation	Results
			development, and independent learning.
4	Husaen & Yuliani, 2023	Secondary Level	The results of the study indicate that the use of mobile learning is feasible to implement. In science education in Indonesia because it can improve access, flexibility, interactivity, and student engagement. This medium also offers a number of advantages, such as encouraging learning motivation, providing a more interactive learning experience, and facilitating the monitoring of student learning progress.
5	Tristanti et al., 2025	Higher Education	Mobile learning provides flexibility in learning and can improve student learning outcomes in local history courses.
6	Nuswantoro, 2023	Higher Education	Learning using mobile learning can facilitate access to materials, increase participation, and support the development of communication skills in advocacy activities. Mobile learning has received positive responses and offers flexibility in terms of learning time and location. Overall, mobile learning provides tangible benefits that exceed the limitations of conventional learning.

Based on the results of a systematic analysis of various studies at various levels of education, it appears that mobile learning consistently has a positive impact on the learning process. At the secondary level (junior high and high school), mobile learning has been proven to increase interest in learning, facilitate understanding of material, and encourage independent and interactive learning. Meanwhile, at the university level, this technology provides learning flexibility and contributes to improved learning outcomes and student participation. Overall, mobile learning is worth implementing at various levels of education because it can increase motivation, accessibility, interactivity, and learning effectiveness.

3.2.2. Learning Models and Strategies

Mobile learning is increasingly being integrated into various modern learning models such as Project-Based Learning (PjBL), Blended Learning, and Gamification. In the Project-Based Learning (PjBL) model, the use of mobile devices helps students access information, document fieldwork, and collaborate digitally so that projects can be completed in a more structured and independent manner. The integration of mobile learning in PjBL increases students' independence in learning and collaboration skills, as they can upload reports,

DOI: http://dx.doi.org/10.17509/xxxx.xxx
p- ISSN xxxx-xxxx e- ISSN 2774-7891

monitor progress, and discuss through mobile-based learning applications (Febriyanti & Hidayat, 2024).

Mobile learning also contributes to the implementation of the blended learning model, especially in providing flexible asynchronous learning. Access to materials via mobile devices allows students to learn anytime, so that face-to-face time can be focused on problem-solving and discussion activities. Mobile-based blended learning can increase learning effectiveness because students can review material through easily accessible digital learning applications (Rani et al., 2025). This flexibility makes mobile learning an important element in the design of adaptive blended learning systems.

In the flipped classroom model, mobile learning serves as the primary medium for providing pre-class materials such as instructional videos, digital texts, and comprehension quizzes. Accessing materials before class via mobile devices can increase student motivation and readiness to learn because they come to class with a more solid foundation of understanding, making the learning process more effective and centered on discussion or problem-solving activities (Hao & Lan, 2023). In addition, the provision of materials through mobile devices allows students to adjust their learning time flexibly so that they are better prepared to participate in classroom learning activities. Thus, mobile learning encourages a shift from teacher-centered to student-centered learning.

The effectiveness of mobile learning is also influenced by the design of the learning activities provided. Interactive quizzes are one feature that can provide automatic feedback and allow students to review the material independently. The use of interactive quizzes based on mobile learning can increase motivation and understanding of concepts through the presentation of short questions and direct feedback from the system, thereby helping students learn at a pace that suits their abilities (Fadlan et al., 2024). These quizzes, which can be accessed at any time, also help students strengthen their memory through repeated practice in shorter durations.

The mobile-based microlearning approach is increasingly popular because the material is presented in small, concise units that help students understand concepts gradually and in a more structured manner. Microlearning is effective in improving student focus and reducing cognitive load during the learning process, especially when the material is delivered in a modular format that is easily accessible via mobile devices (Jannah et al., 2025). In addition, presenting the material in small chunks makes it easier for students to relearn without feeling overwhelmed by long material.

Overall, mobile learning plays an important role in optimizing the application of modern learning models such as PjBL, blended learning, and flipped classroom, while providing interactive, flexible, and adaptive digital learning activities. The implementation of features such as interactive quizzes and microlearning allows students to learn independently, gradually, and adjust their own learning pace. Proper integration of mobile learning makes the learning process more effective, responsive, and relevant to educational needs in the digital age.

3.2.3. The Role of Teachers and Students

Mobile learning shifts the traditional role of the learning process, transforming teachers from a single source of knowledge into facilitators, learning experience designers, and managers of digital learning resources. Meanwhile, students are required to become independent learners who actively utilize mobile devices for access, collaboration, and practice. Various literature findings confirm that the success of mobile learning

DOI: http://dx.doi.org/10.17509/xxxx.xxx
p- ISSN xxxx-xxxx e- ISSN 2774-7891

implementation is largely determined by teacher capacity (digital and pedagogical competence) and student readiness (digital literacy and motivation) (Naveed et al., 2023).

Teachers in the implementation of mobile learning act as learning facilitators who design activities that take advantage of the advantages of mobile devices, such as flexibility, real-world context, and micro-learning, and guide students to use devices as meaningful learning tools, not just sources of information (Sinaga et al., 2024). In addition, teachers also act as content developers or curators by selecting, adapting, or creating materials that are suitable for the characteristics of mobile platforms, such as short modules, interactive quizzes, and short videos, so that learning remains effective on small screens and in short learning durations (Naveed et al., 2023). Teachers also play a role as managers and monitors of interactions, namely monitoring activity logs, student responses, and forum or chat interactions, providing quick feedback, and establishing device usage policies. Studies show that in low-resource contexts, this role remains central, requiring ongoing training support and adequate infrastructure availability (Prajuli et al., 2024). Not only that, teachers serve as digital literacy coaches who shape students' understanding of information literacy, digital security, and device usage ethics, such as plagiarism and privacy, so that students can utilize mobile learning more productively and safely (Sinaga et al., 2024).

In the implementation of mobile learning, students act as active and autonomous learners who are able to manage their own learning time and utilize mobile-based learning resources for exploration, practice, and reflection. This level of independence has been proven to improve learning outcomes when supported by strong motivation and adequate digital skills (Sayidaturrahmah et al., 2024). In addition, students act as digital collaborators who contribute to group work through chat, forums, or collaborative applications, including providing peer feedback and creating content together (Naveed et al., 2023). Students also play a role as device and content managers by selecting appropriate applications, maintaining account security, and applying digital ethics as taught by teachers, so that technical readiness and information literacy become key factors in ensuring the effectiveness of mobile learning (Sayidaturrahmah et al., 2024).

3.3. Factors Influencing Implementation Success

The success of mobile learning implementation is influenced by several interrelated factors, such as technical, pedagogical, psychological, and institutional factors. These factors need to be understood so that the application of mobile learning can be effective and sustainable in the world of education.

a. Technical Factors

   The availability of devices such as smartphones or tablets, the quality of the internet network, and the readiness of infrastructure are the main foundations for the implementation of mobile learning. When students' devices are inadequate or the internet connection is unstable, access to digital learning materials becomes very limited and reduces the effectiveness of mobile learning. This is demonstrated by findings that limitations in devices and ICT infrastructure have a direct impact on low participation and quality of digital learning (Husen et al., 2025).

b. Pedagogical Factors

   The success of mobile learning is greatly influenced by teachers' ability to design mobile-based learning, including the development of interactive contexts, digital activities, and application-based assessments. Curriculum support is also an important aspect for mobile learning to be formally integrated into the learning process. Improving teacher capacity

DOI: http://dx.doi.org/10.17509/xxxx.xxx
p- ISSN xxxx-xxxx e- ISSN 2774-7891

through TIL training has been proven to help teachers become more confident in utilizing mobile devices as teaching media (Riani et al., 2025).

c. Psychological Factors

Student motivation and readiness to accept technology have a major influence on the implementation of mobile learning. A positive attitude towards technology and confidence in using digital devices encourage students to be more active in utilizing mobile learning. Conversely, anxiety about technology or traditional learning habits can hinder mobile learning. These psychological factors also apply to teachers, especially in relation to self-efficacy in using digital devices (Peng et al., 2023).

d. Institutional Factors

At the general educational institution level, policy support, ICT budget provision, teacher training, and school management policies are determining factors for the success of mobile learning. Schools that have a policy of digitizing learning, provide adequate internet networks, and regularly hold technology training are usually better prepared to implement mobile learning on an ongoing basis. Lack of managerial support, budget constraints, and minimal strategic policies are the main obstacles to the development of mobile learning in many educational institutions (Oktarika et al., 2025).

Table 2. Supporting and Hindering Factors in Mobile Learning Implementation

Factor	Supporting	Barriers
Technical	Adequate, stable network, digital platform ready.	Limited devices, poor internet, minimal infrastructure
Pedagogical	Trained teachers, supportive curriculum, and interactive content design.	Low teacher competency, lack of curriculum integration.
Psychological	High motivation, positive attitude toward technology, and strong self-efficacy.	Anxiety technology, low self-confidence, and resistance to change.
Institutional	Policy, school, budget, ICT, teacher training, and management support.	Minimal policies, limited budget, lack of training.

3.4. The Impact and Contribution of *Mobile Learning*

The use of mobile learning continues to grow and has a variety of positive impacts on the learning process. This approach makes learning more flexible, increases student engagement, and supports the strengthening of digital skills and independent learning. In summary, these contributions can be explained through the following points:

a. Impact on Learning Outcomes and Student Engagement

Mobile learning provides a significant improvement in learning outcomes and student engagement through the flexibility of access and interactivity of digital learning features. By providing materials that can be accessed at any time, mobile learning helps students learn at their own pace, thereby increasing concept retention and learning independence (Naveed et

DOI: http://dx.doi.org/10.17509/xxxx.xxx
p- ISSN xxxx-xxxx e- ISSN 2774-7891

al., 2023). Additionally, features such as interactive quizzes, instructional videos, and digital discussion forums can increase student engagement in the learning process (Bülbül & Yılmaz, 2025). This interactivity makes the learning experience more engaging, thereby positively impacting academic performance.

b. Contribution to Equal Access to Education

Mobile learning also plays an important role in equalizing access to education, especially for students in remote areas or regions with limited educational facilities. The high penetration of mobile devices allows students in various regions to access digital learning without having to rely on physical school infrastructure (Naveed et al., 2023). Thus, mobile learning opens up opportunities for more inclusive information and learning opportunities for all students.

c. Improvement of Digital Skills and Independent Learning

The use of mobile learning requires students to engage in navigating digital applications, searching for materials, and managing their learning independently, thereby increasing their digital literacy (Bülbül & Yılmaz, 2025). Mobile learning also encourages students to develop independent learning habits because they have greater control in choosing materials, determining learning times, and accessing additional resources as needed. This process makes mobile learning one of the approaches that supports the strengthening of 21st-century skills.

d. Limitations: Duration of Effectiveness, Social Media Distractions, and Access Inequality

Despite its positive impact, mobile learning also has a number of limitations. One of them is its long-term effectiveness, which has not been fully tested because mobile-based learning is prone to causing digital fatigue if used too intensively (Alshamaila et al., 2023). In addition, distractions from social media and other app notifications can disrupt students' concentration during learning. Inequality in access to devices and the internet also remains a serious issue that makes it difficult for some students to participate optimally in learning (Naveed et al., 2023).

3.5. Challenges and Issues Faced

Despite offering many benefits, mobile learning still faces a number of challenges in its implementation. These obstacles include limitations in infrastructure and user readiness, as well as technical and ethical issues surrounding the use of personal devices. Some of the main challenges can be summarized as follows:

a. Infrastructure and Cost Limitations

The biggest challenge in implementing mobile learning is the availability of adequate infrastructure, such as stable internet connections, compatible devices, and adequate technical support. Students often face obstacles such as slow networks, limited device memory, or high internet quota costs, which hinder the learning process (Alshamaila et al., 2023).

b. Digital Divide Between Regions or Institutions

Differences in infrastructure quality between regions cause a digital divide that affects equal access to mobile learning. Urban areas tend to have better internet networks than rural areas, so students in remote areas have more limited learning opportunities (Naveed et al., 2023). This inequality means that the adoption of mobile learning is not evenly distributed.

c. Lack of Teacher Training

Teachers as learning facilitators often lack adequate digital competencies to effectively integrate mobile learning. The lack of training makes it difficult for many teachers to utilize learning applications, manage digital classrooms, or design mobile-based activities (Bülbül &

DOI: http://dx.doi.org/10.17509/xxxx.xxx
p- ISSN xxxx-xxxx e- ISSN 2774-7891

Yılmaz, 2025). This condition hinders the optimization of mobile learning in the educational process.

d. Lack of Long-Term Effectiveness Evaluation

Most research on mobile learning only focuses on short-term effects, thus failing to provide a comprehensive picture of its long-term effectiveness. The lack of longitudinal evaluation makes it difficult for educational institutions to determine whether mobile learning can be used as a sustainable learning strategy (Naveed et al., 2023).

e. Data Security and Ethics Issues in the Use of Personal Devices

The implementation of mobile learning also raises data security issues because many learning applications require access to users' personal information. If not managed properly, this data has the potential to be misused. In addition, the use of personal devices in the classroom raises ethical challenges, such as misuse of devices or access to irrelevant content during learning (Alshamaila et al., 2023).

3.6. Opportunities for Mobile Learning Development

In recent years, the development of mobile learning has increased, giving rise to a number of opportunities for mobile learning development that can be utilized in the future:

a. Increased Accessibility and Personalization

The use of mobile learning applications makes the learning process more flexible and accessible anytime and anywhere. In addition, mobile learning can be tailored to the needs and learning styles of each student (Ardiansyah, 2024; Ananda et al., 2024). The use of mobile learning is not only limited to higher education but also extends to teacher education, secondary schools, elementary schools, and vocational education (Ananda et al., 2024). Furthermore, technology also expands opportunities for personalized learning through features such as material recommendations, real-time feedback, and the use of chatbots or virtual assistants that can tailor interactions based on user preferences (Asadullah et al., 2023).

b. Development of 21st Century Skills

Mobile learning has great potential in supporting the development of 21st-century skills, such as critical thinking, collaboration, creativity, and digital citizenship (Ardiansyah, 2024). Through an active, interactive, and technology-based learning approach, students not only receive knowledge but are also trained to become self-regulated learners who are able to set their own learning strategies and goals (Ardiansyah, 2024; Widyakusuma & Sudibyo, 2024).

c. Innovations in Mobile Learning Systems and Platforms

Another opportunity lies in the innovation of mobile learning systems and platforms that are increasingly interactive, adaptive, and integrative with supporting technologies such as augmented reality (AR), virtual reality (VR), artificial intelligence (AI), and learning analytics (Ardiansyah, 2024; Ananda et al., 2024). In addition, AR and VR technologies provide a more immersive learning experience, allowing students to visualize abstract concepts and interact with three-dimensional objects through mobile devices (Ardiansyah, 2024). Mobile learning not only provides content that can be accessed through mobile devices but also brings about changes in learning design towards a more contextual, collaborative, inquiry-based, and real-life-oriented model (Ardiansyah, 2024). In addition, research results using theoretical models such as UTAUT (Unified Theory of Acceptance and Use of Technology) show that the focus of mobile learning development in the future is not only on technological aspects but also on user and pedagogical aspects, resulting in a more effective system oriented towards meaningful learning experiences (Ananda et al., 2024).

DOI: http://dx.doi.org/10.17509/xxxx.xxx
p- ISSN xxxx-xxxx e- ISSN 2774-7891

4. CONCLUSION

Mobile learning is a relevant and effective learning strategy in supporting educational transformation in the digital era. Mobile learning can increase learning flexibility, expand access to education, increase student engagement, and support the development of 21st-century skills such as independent learning, digital literacy, collaboration, and critical thinking.

Mobile learning implemented at various levels of education has a positive impact on learning interest, material comprehension, and learning outcomes. The integration of mobile learning into modern learning models such as project-based learning, blended learning, and flipped classroom has been proven to optimize the learner-centered learning process. In this context, the role of teachers has shifted to that of facilitators and designers of digital learning experiences, while students take on the role of active and independent learners.

However, the successful implementation of mobile learning is not without challenges. Technical factors such as device limitations and network quality, pedagogical factors such as low digital competence among teachers, psychological factors related to user motivation and readiness, and institutional factors such as policy and budget support remain major obstacles to the optimal and sustainable implementation of mobile learning. In addition, issues of digital distraction, data security, and the lack of long-term effectiveness evaluation are also important concerns in the future development of mobile learning.

Therefore, the implementation of mobile learning needs to be supported by strong institutional policies, increased educator competency through continuous training, the provision of adequate infrastructure, and pedagogical and contextual learning designs. This study provides a theoretical contribution by presenting a comprehensive overview of the current state of mobile learning, as well as a practical contribution as a basis for decision-making in the development of inclusive and sustainable digital learning. Further research is recommended to examine the long-term effectiveness of mobile learning and integrate it with advanced technologies such as AI, AR, and learning analytics.

5. ACKNOWLEDGMENT

The author would like to express his deepest gratitude to all those who have contributed to the preparation of this article entitled "Systematic Analysis of Mobile Learning Implementation in Education." Special thanks are extended to the lecturer in charge of the Mobile Learning course for his guidance, constructive input, and validation of the research framework. Finally, the author would like to thank colleagues who have always provided encouragement, motivation, and support, which have greatly helped in the completion of this research.

6. AUTHORS' NOTE

The authors declare that there is no conflict of interest regarding the publication of this article. The authors confirmed that the paper was free of plagiarism.

7. REFERENCES

Akbar, R. I. (2025). Comparison Between E-Learning and M-Learning Using Learning Outcome and IPA Matrix. Jurnal Pedagogi Dan Pembelajaran, 8(2), 226–236.

Alshamaila, Y., Papagiannidis, S., Alsawalqah, H., & Aljarah, I. (2023). Effective use of smart cities in crisis cases: A systematic review of the literature. International Journal of Disaster Risk Reduction, 85, 103521.

DOI: http://dx.doi.org/10.17509/xxxx.xxx
p- ISSN xxxx-xxxx e- ISSN 2774-7891

Ananda, Y. F., Usmeldi, Giatman, M., & Effendi, H. (2024). Emerging Trends and Impacts of Mobile Learning in Education: A Bibliometric Analysis. Jurnal Penelitian Pendidikan IPA, 10(11), 806–817.

Ardiansyah, T. (2024). The Role of Augmented Reality in Interactive Mobile Learning: Current Trends and Future Directions. Journal Mobile Technologies (JMS), 2(2), 79–86.

Asadullah, M., Yeasmin, M., Alam, A. F., Alsolami, A., Ahmad, N., & Atoum, I. (2023). Towards a Sustainable Future: A Systematic Review of Mobile Learning and Studies in Higher Education. Sustainability, 15(17), 1–17.

Carrera-Rivera, A., Larrinaga, F., & Lasa, G. (2022). Context-awareness for the design of Smart-product service systems: Literature review. Computers in Industry, 142(9). Chat, M., Zghida, N., Ouaali, A. A., Youlyouz, A., Amiri, E. M., & Janati-Idrissi, R. (2025). Towards a New Definition of E-Learning and M-Learning. Multidisciplinary Reviews, 8(9), 1–10.

Dahri, N. A., Al-Rahmi, W. M., Almogren, A. S., Yahaya, N., Vighio, M. S., Al-maatuok, Q., Al-Rahmi, A. M., & Al-Adwan, A. S. (2023). Acceptance of Mobile Learning Technology by Teachers: Influencing Mobile Self-Efficacy and 21st-Century Skills-Based Training. Sustainability, 15(11), 1–22.

Efriyanti, L., & Annas, F. (2020). Aplikasi Mobile Learning Sebagai Sarana Pembelajaran Abad 21 pada Era Revolusi Industri 4.0. Jurnal Educative: Journal of Educational Studies, 5(1), 28–40.

Fadlan, M., Hartati, T., Suarna, N., & Faqih, A. (2024). Mobile Learning Berbasis Android dalam Bentuk Media Interaktif Kuis Menggunakan Four-D Models. INTERNAL (Information System Journal, 7(1), 76–86.

Faqih, M. (2020). Efektivitas Penggunaan Media Pembelajaran Mobile Learning Berbasis Android. Konfiks: Jurnal Bahasa, Sastra Dan Pengajaran, 7(2), 27–34.

Febriyanti, K. N., & Hidayat, W. N. (2024). Pengembangan Media Pembelajaran Mobile Learning Berbasis Android Berbantuan Thunkable dengan Model Project Based Learning pada Materi CSS Kelas X Program Keahlian PPLG. Journal of Innovation and Teacher Professionalism, 2(2), 184–194.

Fitrianti, E., Annur, S., & Afriantoni. (2024). Revolusi Industri 4.0: Inovasi dan Tantangan dalam Pendidikan di Indonesia. Journal of Education and Culture, 4(1), 28–35.

Galimova, E. G., Sergeeva, O. V., Zheltukhina, M. R., Sokolova, N. L., Zakharova, V. L., & Drobysheva, N. N. (2025). Mobile Learning in Science Education to Improve Higher-Order Thinking Skills and Communication Skills: Scoping Review. Frontiers in Communication, 10, 1–17.

Garzón, J., Burgos, D., Kinshuk, & Tlili, A. (2025). Mobile learning significantly enhances student learning gains: A meta-analysis and research synthesis. Computers and Education, 238. https://doi.org/10.1016/j.compedu.2025.105415

Ghafara, S. T., Simatupang, W., Ambiyar, Muskhir, M., & Irfan, D. (2022). Pengembangan Media Pembelajaran Berbasis Android - Pembelajaran Inovatif untuk Meningkatkan Kompetensi Siswa SMK. ZONASI: Jurnal Sistem Informasi, 4, 1–17.

DOI: http://dx.doi.org/10.17509/xxxx.xxx
p- ISSN xxxx-xxxx e- ISSN 2774-7891

Hameed, A. R. A. G., & Sumari, P. Bin. (2024). Adoption and continued usage of mobile learning of virtual platforms in Iraqi higher education an unstable environment. International Journal of Information Management Data Insights, 4(2).

Hao, Y., & Lan, Y. (2023). Research and practice of flipped classroom based on mobile applications in local universities from the perspective of self-determination theory. Frontiers in Psychology, 1–12.

Husaen, M. M., & Yuliani, H. (n.d.). Sytematic Literature Review: Kelayakan Media Pembelajaran Mobile Learning Sebagai Penunjang Pembelajaran MIPA Di Indonesia. Lambda: Jurnal Ilmiah Pendidikan MIPA Dan Aplikasinya, 3(2), 78–86.

Husen, S., Hizbullah, & Mustari, M. (2025). Dampak Keterbatasan Infrastruktur TIK Terhadap Efektivitas Pembelajaran Digital (Studi Penerapan Model TPACK Di SDN 3 Jagaraga). Cermat: Jurnal Cendekiawan Dan Riset Multidisiplin Akademik Terintegrasi, 2(1), 171–176.

Hutabarat, M. L. O. N. (2024). Pengembangan Media Pembelajaran Mobile Learning Terhadap Minat Belajar Matematika Siswa SMP Negeri 18 Medan. Journal of Student Research, 2(1), 165–175.

Jannah, F. M., Wiryanto, Ekawati, R., & Mariana, N. (2025). Potensi Microlearning Game dalam Meningkatkan Motivasi Belajar Matematika Siswa Sekolah Dasar. Didaktika: Jurnal Kependidikan, 14(3), 4073–4080.

Kitchenham, B. (2004). Procedures for Performing Systematic Reviews.

Kurnia, U. I., Lathifa, A., Rizki, F., Larasati, B. S., Puspitasari, S., & Fatiha, A. S. (2024). Penerapan Media Pembelajaran Berbasis Mobile Learning di SMP Negeri 4 Abung Barat. Jurnal Pengabdian Kepada Masyarakat Ungu, 6(1).

Maketo, L., Issa, T., Issa, T., & Nau, S. Z. (2023). M-Learning adoption in higher education towards SDG4. Future Generation Computer Systems, 147, 304–315.

Naveed, Q. N., Choudhary, H., Ahmad, N., Alqahtani, J., & Qahmash, A. I. (2023). Mobile Learning in Higher Education: A Systematic Literature Review. Sustainability, 15(18).

Nuswantoro, S. A. (2023). Laporan Penelitian" Mobile Learning Kreatif: Meretas Batasan Pembelajaran dalam Mata Kuliah Komunikasi dalam Advokasi".

Oktarika, D., Dharmayanti, W., & Puspitasari, H. (2025). Analisis Faktor Pendukung dan Penghambat Penggunaan Teknologi Informasi dalam Pembelajaran di MTs S Miftahussa'adah Pontianak. Jurnal Jurnal Pendidikan Teknologi Informasi Dan Komputer (JPTIK), 7(1), 21.

Peng, R., Razak, R. A., & Halili, S. H. (2023). Factors influencing in-service teachers' technology integration model: Innovative strategies for educational technology. Plos One, 1–19.

Prima, A. U., Herpratiwi, H., & Fitriawan, H. (2022). Pengembangan Pembelajaran Berbasis Aplikasi Mobile Learning Materi Sepak Bola di Sekolah menengah Pertama. Edukatif: Jurnal Ilmu Pendidikan, 4(4), 5311–5322.

PRISMA Executive. (2024). PRISMA flow diagram. https://www.prisma-statement.org/prisma-2020-flow-diagram

DOI: http://dx.doi.org/10.17509/xxxx.xxx
p- ISSN xxxx-xxxx e- ISSN 2774-7891

Purwanto, N. J. K., Lovinno, P. P., & Kurniawan, G. C. (2025). Inovasi Pembelajaran Berbasis Teknologi dalam Membangun Generasi Cerdas di Era Digital. Nusantara: Jurnal Pendidikan, Seni, Sains Dan Sosial Humaniora, 3(1), 1–25.

Rani, S., Koli, M. C. S., Rukmi, J. N. P., Maysyarah, S., & Kurniawan, C. (2025). Integrasi Aplikasi Berbasis Mobile pada Blended Learning: A Systematic Literature Review. Journal of Education Research, 6(3), 721–731.

Riani S, N. W. L., Dewi, M. P., & Mustari, M. (2025). Strategi Peningkatan Kompetensi Guru dalam Pemanfaatan Teknologi Informasi dan Komunikasi untuk Pembelajaran Interaktif di SDN 8 Buwun Mas. Jurnal Ilmiah Profesi Pendidikan, 10(1), 112–117.

Ridwan, W. (2024). Inovasi dalam Strategi Belajar Mengajar Abad 21. Tahta Media Group.

Sakti, A. (2023). Meningkatkan Pembelajaran Melalui Teknologi Digital. JUPRIT: Jurnal Penelitian Rumpun Ilmu Teknik, 2(2), 212–219.

Sangur, K., Zubaidah, S., & Sulisetijono. (2025). A Systematic Literature Review of Mobile Learning Trends in Biology Education Over Ten Years. Social Sciences and Humanities Open, 11, 1–25.

Sareen, S., & Mandal, S. (2024). Challenges of blended learning in higher education across global north-south: A systematic and integrative literature review. In Social Sciences and Humanities Open (Vol. 10). Elsevier Ltd.

Sasmito, D. A., Yusrotin, A., & Shaherani, N. (2021). Implementasi Mobile Learning Sebagai Solusi Pembelajaran Daring Untuk Peserta Didik Akibat Pandemi Covid-19 Di SMA Negeri 1 Singosari. Indonesian Journal of Sociology, Education, and Development, 3(1).

Sayidaturrahmah, S. S., Kenya, P. B. M., Salim, A. Y., Adicitadharma, T. N., Kurniawan, C., & Nordin, R. M. (2025). The Potential of Mobile Learning in Improving Students' Intention and Learning Readiness in Higher Education: A Systematic Literature Review Using PRISMA. Paedagogia, 27(3), 481.

Silfiya, & Siagian, I. (2024). Penggunaan Teknologi dalam Dunia Pendidikan Tanpa Menghilangkan Nilai-Nilai Sosial. Journal on Education, 7(1), 2554–2568.

Solomovich, S., & Ceobanu, C. (2021). The Effect of Mobile Learning on Students' Attitudes Using Mobile Devices. Educatia 21, 21(3), 23–37.

Sophonhiranrak, S. (2021). Features, Barriers, and Influencing Factors of Mobile Learning in Higher Education: A Systematic Review. Heliyon, 7(4), 1–10.

Surbakti, G. N. P., Hartati, B., & Susaningsih, C. (2025). ANALISIS FAKTOR PADA MEDIA SOSIAL DALAM PEMENUHAN KEBUTUHAN INFORMASI MENGGUNAKAN PENDEKATAN PRISMA. Journal of Information System Management (JOISM), 7(1), 94-101.

Syahputra, F., Sabrina, E., Elsadin, R. T., Asisah, F., Syahbila, A., & Pradana, R. S. (2024). Penggunaan Mobile Learning Sebagai Media Dalam Proses Belajar Mengajar. JCRD: Journal of Citizen Research and Development, 1(2), 789–793.

Tarhini, A., AlHinai, M., Al-Busaidi, A. S., Govindaluri, S. M., & Shaqsi, J. Al. (2024). What drives the adoption of mobile learning services among college students: An application of SEM-neural network modeling. International Journal of Information Management Data Insights, 4(1). https://doi.org/10.1016/j.jjimei.2024.100235

DOI: http://dx.doi.org/10.17509/xxxx.xxx
p- ISSN xxxx-xxxx e- ISSN 2774-7891

Tristanti, N., Fanani, G. P. I., Romadloni, N. T., Efendi, B., & Setiani, H. (2025). Cerdas digital dengan artificial intelligence: Solusi teknologi untuk pelayanan dan keamanan publik. Cahaya Pengabdian, 2(1), 98-103.

Ulfah, N. N., Habibi, B., & Mulyono, T. (2025). Pengembangan Mobile Learning (M-Learning) Berbasis Moodle Sebagai Alternatif Media Pembelajaran di Tingkat SMK. Pendas : Jurnal Ilmiah Pendidikan Dasar, 10(2), 798–809.

Widyakusuma, A., & Sudibyo, A. S. R. (2024). The Future of Education: How Mobile Learning, Microlearning, and Gamification are Revolutionizing Architecture Learning. Syntax Transformation, 5(11), 1284–1300.

DOI: http://dx.doi.org/10.17509/xxxx.xxx
p- ISSN xxxx-xxxx e- ISSN 2774-7891