Volume: 10 Issues: 59 Issue [March, 2025] pp. 230 - 242
International Journal of Accounting, Finance and Business (IJAFB)
eISSN: 0128-1844
Journal website: www.academicinspired.com/ijafb
DOI: 10.55573/IJAFB.105920

A DECADE OF SYSTEMATIC LITERATURE REVIEW ON STUDENT EXPERIENCE IN MOBILE LEARNING

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Article history
Received date : 15-2-2025
Revised date : 16-2-2025
Accepted date : 23-3-2025
Published date : 15-4-2025

To cite this document:
Radzali, H., Luqman, A. & Ismail, M. N. (2025). A decade of systematic literature review on student experience in mobile learning. *International Journal of Accounting, Finance and Business (IJAFB)*, 10 (59), 230-242.

Abstract: *Student experience encompasses pragmatic quality (usability and functionality) and hedonic quality (satisfaction and enjoyment) while using mobile devices for educational purposes. However, the student experience in mobile learning depends on technology and human quality. Therefore, this article focuses on a systematic literature review of factors contributing to student experience in mobile learning. For this study, articles were selected from two significant databases, Scopus and Web of Science, and a supporting database, Google Scholar, from 2015 until 2024. Consequently, 15 related studies were found concerning factors of student experience in mobile learning. Three major themes emerged from the thematic analysis of this review: technology and application quality, emotion quality and student experience quality. The results elaborate on the factors that can contribute to student experience. Factors influencing student experience in mobile learning should be explored in future research to support Sustainable Development Goal 4, which ensures quality education for all.*

Keywords: *Hedonic Quality, Mobile Learning, Pragmatic Quality, Student Experience, Systematic Literature Review review*

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Introduction

The phrase "mobile learning" refers to education on a mobile device. According to Crompton & Burke, (2018) mobile learning is learning through social and content interaction across multiple contexts using personal electronic devices. The term provides insight into the educational benefits of learning with mobile devices, as learning is not restricted and occurs across various settings, timeframes, subjects, individuals, and technologies. Mobile electronics, including smartphones and tablets, feature a convenient power button and are highly portable. Therefore, based on this criterion, laptops were not considered for mobile learning.

Mobile learning, or m-learning, is an innovative form of distance education that harnesses modern technology to provide instructors and learners with 24/7 access to learning materials and services, enabling maximum learning benefits (Al-Nawayseh et al., 2019). Though mobile learning has been believed to be paramount in education and learning in the higher education environment, it is still in the initial stages of implementation and practical implementation in university settings (Al-Nawayseh et al., 2019).

Mobile learning began to take shape as educational materials were adapted for early mobile devices, primarily focused on text and simple multimedia formats (Kukulska-Hulme & Shield, 2008). The fourth industrial revolution (IR4.0), or Industry 4.0, is marked by advanced connectivity, automation, and the integration of cyber-physical systems. The explosion of smartphone uses and advancements in mobile internet technologies such as 4G and 5G have significantly enhanced mobile learning capabilities. This period saw the development of sophisticated mobile learning applications that support interactive and personalized learning experiences, utilizing multimedia, gamification, and real-time collaboration (Dirin et al., 2020). Mobile learning platforms have become more ubiquitous, allowing learners to access education anytime and anywhere. The fifth industrial revolution (IR5.0) is the current and emerging phase, which envisions a collaborative environment where human intelligence and artificial intelligence (AI) work together harmoniously. This era is characterized by the integration of AI, machine learning, and immersive technologies such as augmented reality (AR) and virtual reality (VR) into mobile learning. These technologies enable highly personalized and adaptive learning experiences, catering to individual learners' needs and preferences. AI-driven analytics helps understand learner behaviour and tailor content, accordingly, thus enhancing the overall student experience.

The digital revolution transforms education using information and communication technologies (ICT) to improve student learning outcomes. Reflecting the industrial revolution changes can be seen in every area, particularly education. Although there is evidence of the harmful impact Internet access, social networks, and the use of mobile devices could have on current education, the use of mobile technologies is gaining ground in education. Due to the characteristics of mobile devices and the inexperience of teachers and educational institutions, students may experience distractions in their learning and be involved in inefficient educational methodologies (Criollo-C et al., 2021). Mobile devices allow students to improve the way they acquire knowledge. Education is there to ensure all students can benefit from a learning experience. Therefore, educators and educational institutions should embrace technology as an innovative new methodology to enable students to achieve their goals.

A systematic literature review (SLR) is the process of identifying, selecting, and critically evaluating research to address a formulated query. SLR process employs a comprehensive search strategy encompassing multiple databases, and the protocol or plan is established before

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the commencement of the review process to facilitate replication by future research (Yunus & Ismail, 2024). SLR is essential for guiding and synthesizing available topics, identifying biases or voids, and directing future researchers in the appropriate direction for additional research. Even though there is quite a lot of existing past research on the factors influencing student experience in mobile learning, there has not been enough done to review the findings thoroughly. This review study aims to identify the patterns and trends from earlier research on student experience in mobile learning. This paper comprehensively covered the entire process of Systematic Literature Review (SLR) to gain a more profound comprehension of the subject. The process involved identifying the reference sources for SLR, formulating the research question, utilizing systematic searching techniques, identifying, screening, and qualifying the articles, abstracting the work, and analyzing the results. The study was strengthened by using existing material as supporting evidence.

Research Methodology

The ROSES (RepOrting standards for Systematic Evidence Syntheses) review protocol served as the study's guide, seeking to increase transparency and set higher standards for conducting systematic reviews and maps. The protocol starts with formulating the research question and then implements systematic search strategies, including identification, screening, eligibility, quality appraisal, and database extraction and analysis.

Research Question Formulation

This study aims to identify the factors influencing student experience in mobile learning. Thus, the researcher applied the PICO (Population OR Problem; Intervention OR Interest; Comparison and Outcome) method as the Research Question Development Tool (RQDT). The population comprises college matriculation students, and the context is mobile learning.

The SLR RQ is: What factors influence the student experience and use of mobile learning?

Systematic Searching Strategies

Okoli (2015), emphasizes that researchers should choose the criteria for SLR. There are five stages: identification, screening, eligibility, quality appraisal, and data extraction and analysis.

1. **Identification:**

The identification process begins by identifying basic keywords and synonyms. The keywords are derived from the research questions, while synonyms are used to broaden the search result.

Table 1: Result of Identification Process

Research Question	Keywords	Synonyms
What factors influence the student experience and use of mobile learning?	mobile learning experience	m-learning user experience, u-x

The identification process was conducted through two leading databases, Scopus and Web of Science, and Google Scholar, a supporting database. The question of when to cease searching is valid, researcher can stop when several searches with the same keywords across other databases provides no additional result (Ellis & Levy, 2009). A total of 434 articles were retrieved by searching the three databases: Scopus, Web of Science and Google Scholar. Table 2 simplifies the search strings, such as Boolean operators, phrase searching, and truncations

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used in each advanced search throughout all three databases. The documented result of an initial search is the identification process.

Table 2: Full Search String Used in Leading Databases

Section	Database	Initial Search
Research Question	What factors influence student experience and use mobile learning	
Scopus	TITLE-ABS-KEY ((“mobile learning” OR “m-learning”) AND (“user experience” OR “u-x”))	229 articles
Web of Science (WoS)	TS= ((“mobile learning” OR “m-learning”) AND (“user experience” OR “u-x”))	105 articles
Google Scholar	mobile learning” OR “m-learning” AND “user experience” OR “student experience”	100 articles

2. Screening

The screening stage is where articles are included or excluded based on various criteria pertinent to the research objective, such as source type, language, and year of publication. According to Mengist et al., (2020) screening aims to select pertinent literature and identify relevant papers for review. For this study, Table 3 explained the eligibility, inclusion, and exclusion criteria were defined during the screening process to identify relevant papers for inclusion in the systematic review process. Source types were selected as the first inclusion criteria: journal. Other forms of documents, such as conference proceedings, conference reviews, reviews, book chapters, and book series, were excluded. The second criterion for inclusion was language. English language documents were included, and all non-English language documents were excluded to avoid misunderstanding and confusion. After the screening process, a total of 377 articles were removed from the 434 articles identified for this study. In a more general context, researchers can choose any criteria necessary for their SLR as long as they can justify all the selected criteria (Okoli, 2015). Okoli (2015), states that different situations will stimulate different needs, and different situations will cause the researcher to use different criteria for the SLR. As further emphasized the need to make the article selection criteria more comprehensive to enable researcher to obtain more relevant articles for SLR (Xiao & Watson, 2019).

Table 3: Inclusion and Exclusion Criteria

Criteria	Inclusion	Exclusion
Source	Journal	Conference proceeding, conference reviews, reviews, book chapters, book series
Language	English written articles	Non-English articles
Year of Publication	Articles published between 2015-2024	Other than 2015-2024

3. Eligibility

The researcher proceeded with the eligibility process, which was done manually. Moher et al., (2009) agree that the researcher might include articles that do not conform to the criteria

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determined by the researcher after the screening process. This phase entails scrutinizing all the selected articles from the previous step to ensure they are relevant to the study. Articles found to be irrelevant and duplicated, with no guidance on literature review methodology and unsuccessful attempts to access the articles, were excluded. Figure 2 portrays the flow diagram to explain the article selection process from the review. The final record for review is 15 articles after proceeding with the stages of SLR from the initial 434 articles found in the early stage.

4. Quality Appraisal

The researcher utilizes the Mixed Methods Appraisal Tool (MMAT) for quality appraisal, creating a critical tool for the appraisal phase of systematic reviews encompassing qualitative, quantitative, and mixed-method research (Hong et al., 2018). The selected articles indicated that a mixture of methods was used, which is 80% (12 articles) of the quantitative studies and 20% (3 articles) of the qualitative studies (see Figure 1).

Figure 1: Articles Based on Methodology

Different researchers use different quality assessment tools in systematic reviews as they examine different quality criteria due to differences in research perspectives and needs for different systematic review settings (Ellis & Levy, 2009). Regarding this, the researcher proceeded with qualitative approaches to quality assessment using Mixed Methods Appraisal Tool (MMAT) to quality assessment. This study uses all the criteria categorized by the research method, that is, 5 criteria for qualitative and 5 criteria for quantitative. Plus, with two mandatory criteria of MMAT used to evaluate the selected articles. The criteria used are presented in Table 4 below.

Table 4: Criteria of Mixed Methods Appraisal Tool (MMAT)

Criteria	Methodological Quality Criteria	Responses
Screening Question	S1: Are there clear research questions? S2: Do the collected data allow to address the research questions?	Yes/No/Can't Tell/ Comment
Qualitative	1.1 Is the qualitative approach appropriate to answer the research questions? 1.2 Are the qualitative data collection methods adequate to address the research questions? 1.3 Is the finding adequately derived from the data? 1.4 Is the interpretation of results sufficiently substantiated by data? 1.5 Is there coherence between qualitative data sources, collection, analysis and interpretation?	Yes/No/Can't Tell/ Comment

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Quantitative	1.1 Is the sampling strategy relevant to address the research questions? 1.2 Is the sample representative of the target population? 1.3 Is the measurement appropriate? 1.4 Is the risk of nonresponse bias low? Is the statistical analysis appropriate to answer the research questions?	Yes/No/Can't Tell/ Comment

At this stage, at least two reviewers involved in the appraisal process (Hong et al., 2018). The articles assessed under this stage will be categorized as high, moderate, or low quality (Petticrew & Roberts, 2008). Reviewers should prioritize high-quality articles and then consider moderate-quality ones. At this stage, researchers must eliminate low-quality publications from consideration and utilize them solely as foundational literature. The reviewers must agree with each other and find solutions to disagreements. Figure 2 summarizes the process from research question formulation to data extraction and analysis.

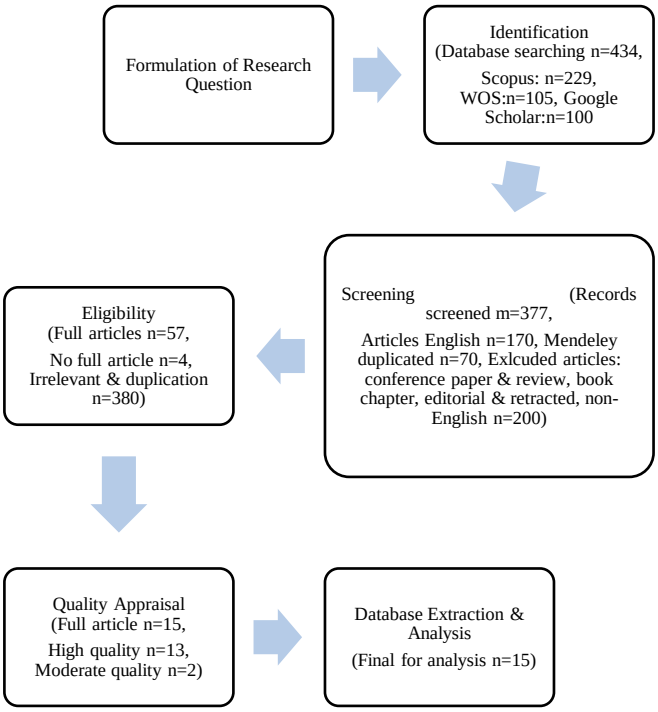

Figure 2: Systematic Literature Review Flow

Database Extraction and Analysis

At this stage, the researcher utilized a qualitative synthesis method known as thematic analysis. This approach is employed to identify patterns in prior studies, which can be classified based on similarities or correlations among the studies. The researcher examined abstracts followed by full articles, categorizing themes under the student experience in mobile learning (See Table 5). The researcher identified factors affecting student experience across three main categories:

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technology and application quality, emotional quality, and overall student experience (Criollo-C et al., 2021; Lee & Xiong, 2018; Relawati et al., 2022; Zahtila & Burghardt, 2022) (See Table 6).

Based on the SLR, there are 18 constructs influencing student experience in mobile learning, which are performance, ease of use, system quality, information quality, interface quality, interaction quality, emotion, service quality, instructor quality, course quality/content quality, computer anxiety, perceived usefulness, usability, motivation, engagement, satisfaction, user experience/student experience and intention to use (See Table 7)

Findings

In this SLR, the researcher finalized fifteen articles, highlighting three primary themes: technology and application quality, emotional quality, and experiential quality. The terminological factors employed to elucidate the themes are based on elements, dimensions, characteristics, and features. The researcher included articles from 2015-2024 to see student experience trends in mobile learning. Figure 3 below shows the number of publications on factors affecting the student experience in mobile learning, categorised by year (2015-2024). The researcher also categorised articles from the countries published (see Figure 4). From the findings, the researcher categorised 3 papers that used qualitative and mixed methods and 12 articles that used quantitative methods (see Figure 1).

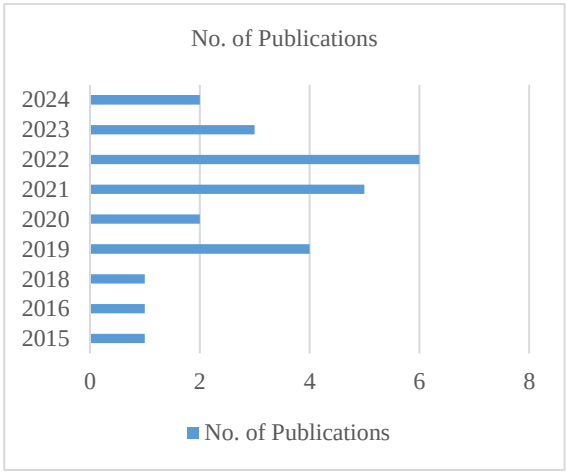

Figure 3: Distribution of Articles Based on Year

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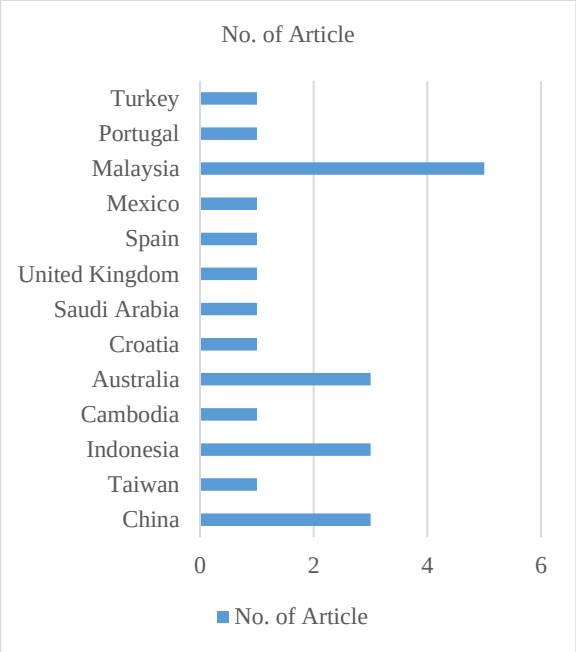

Figure 4: Distribution of Articles Based on Country

Table 5: Thematic Analysis (Data Extraction & Synthesis)

Studies	Year	Term that used			Student Experience			
		EL	DI	CH	FE	TAQ	EQ	EXQ
Lee et al.	2022	/		/		/		/
Relawati et al.	2022			/	/	/		/
Criollo-C et al.	2024				/	/		/
Brata & Brata	2020			/	/	/		/
Lok & Hamzah	2022	/		/		/		/
Jiang et al.	2022			/	/	/		/
Ferreira et al.	2020			/	/	/		/
Tang et al.	2022	/		/	/	/		/
Zahtila & Burghardt	2022			/	/	/		/
Marques & Pombo	2023			/	/	/		/
Ramli et al.	2024		/	/	/	/	/	/
Lee & Xiong	2022	/		/	/	/	/	/
Hsu & Chen	2023	/		/	/	/		/
Salehudin et al.	2023			/	/	/		/
Juric et al.	2021			/	/	/		/

Table 6: Thematic Analysis (Result Based on Themes)

Authors based on themes	Total
Technology and Application Quality	14
Emotion Quality	4
Student Experience Quality	29

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Table 7: Data Analysis on Attributes of Student Experience from 15 Articles

No.	Code	Frequency of Articles	Frequency of Repetition in Articles
1	System Quality	3	30
2	Information Quality	2	28
3	Interface Quality	4	74
4	Interaction Quality	1	2
5	Instructor Quality	3	156
6	Course/Content Quality	3	3
7	Service Quality	1	14
8	Perceived Ease of Use	6	41
9	Perceived Usefulness	3	24
10	Usability	6	64
11	Computer Anxiety	1	56
12	Emotion	3	13
13	Motivation	8	16
14	Performance	4	20
15	Engagement	4	44
16	Satisfaction	5	52
17	Student Experience	21	125
18	Intention	2	28

Discussion

As shown in the previous section, this study explored 15 relevant articles that relate to its objective and research question. Based on the analysis results obtained from the systematic literature review conducted, the studies were conducted in both developed and developing countries.

System quality refers to the technical performance and functionality of a mobile learning application. It encompasses aspects such as reliability, accessibility, response time, operational stability, and ease of navigation (Lee & Xiong, 2021). A high quality-system ensures consistent performance, which reduces frustration and enhances user satisfaction (Brata & Brata, 2020b). For example, in mobile learning, system quality directly impacts students' engagement by providing a stable and reliable platform for accessing educational content. Poor system quality potentially hinders their learning experience. Relawati et al., (2022) highlighted that the usability of an application significantly influences user satisfaction and ease of learning.

Similarly, Lee and Xiong, (2021) emphasized the importance of enhancing system and interface quality to reduce students' anxiety in application-based learning environments. A well-designed interface facilities intuitive navigation and interaction, making it easier for students to engage with the content (Brata & Brata, 2020b; Lee & Xiong, 2021). The integration of gamification in educational content has also been shown to effectively enhance cybersecurity teaching by fostering user intention and maintaining a low mental workload.

Another significant factor that influences student experience in mobile learning is the instructor quality. Instructor quality pertains to the instructor's ability to effectively use mobile learning tools to support teaching. This includes their technical competence, responsiveness, teaching style, and ability to provide timely feedback (Lee & Xiong, 2021). High instructor quality

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positively influences students' attitudes toward mobile learning by reducing anxiety and fostering a supportive environment. Instructors play a crucial role in guiding students using mobile applications, addressing technical issues, and creating engaging learning experiences.

Another part of instructor quality involves the role of educators in facilitating effective use of mobile learning systems. Marques and Pombo, (2023) emphasized the importance of instructors understanding how to use mobile augmented reality games effectively to enhance educational outcomes. Whereas instructors' readiness to adopt mobile learning tools was highlighted as critical in fostering positive perceptions of usefulness and ease of use among students. Training programs for instructors were suggested to improve their ability to integrate such technologies into their pedagogy (Juric et al., 2021).

Perceived ease of use reflects how effortless it is for students to interact with a mobile learning application. This factor influenced by both system quality and interface quality (Tang et al., 2022). Applications that are easy to use encourage higher adoption rates and sustained engagement by minimizing barriers to entry. For example, if an application is intuitive and requires minimal effort to learn or navigate, student is more likely to perceived it as useful and integrate in into their learning routines. As students valued features that made task straightforward but noted challenges like (Marques & Pombo, 2023).

Research on mobile learning in higher education reveals pragmatic and hedonic factors influencing student acceptance and experience. Student perceived mobile devices as useful tools for knowledge construction, visualization of abstract concepts, and self-directed learning in science subjects (Lok & Hamzah, 2022). Fagan, (2019) has found that enjoyment and performance expectations are significant in mobile learning acceptance. This is confirmed by Tanja Merčun and Maja Žumer, (2017) that user experience is shaped by combining a system's pragmatic and hedonic qualities.

Furthermore, extensive research indicates that emotions play a crucial role in the learning process, with AR-based mobile learning materials designed to elicit specific emotions based on identified principles. Current literature strongly supports that a high-quality student experience is a key factor in achieving successful learning outcomes (Criollo-C, Guerrero-Arias, Buenano-Fernandez, et al., 2024). By adopting modern educational approaches, students are encouraged to engage in learning activities using mobile devices in both indoor and outdoor settings, contributing to an overall positive student experience (Zahtila & Burghardt, 2022).

Conclusion and Recommendations

In a nutshell, the SLR found that many factors influence student experience in a mobile learning context. Using mobile devices in learning has a broad impact on the learning process and teaching methods. Future studies may have different themes and comprehensive coverage of the group, explaining in detail the factors influencing student experience. Naveed et al., (2023) discovered the potential effect of newly emerging technologies, especially VR and AR, which can be examined at all educational levels. Therefore, future studies should counter the gap by investigating additional factors that may or may not affect the direct relationship. The 2030 Sustainable Development Agenda has been recognized as a global goal for all nations by the United Nations (2023). This allows future researchers to investigate the relationship between student experiences and sustainability.

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This study explored the factors influencing student experiences in the context of mobile learning. The researcher utilized the SLR method to analyse patterns in prior studies. Conducting an SLR also helped to identify research gaps and directed future inquiries (Petticrew & Roberts, 2008). On top of that, using SLR allowed the researcher to approach the current investigation systematically and methodically. The findings from the SLR are expected to aid the researcher and others in investigating student experiences from various perspectives or fields.

Acknowledgement
This research article was financially supported by Universiti Teknologi MARA and Institute of Postgraduate Studies UiTM.

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eISSN: 0128-1844
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Journal website: www.academicinspired.com/ijafb
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