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### EXPLORING THE IMPACT OF AI-POWERED MOBILE LEARNING TECHNOLOGIES: A SYSTEMATIC REVIEW FROM THE EDUCATION PERSPECTIVE

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# EXPLORING THE IMPACT OF AI-POWERED MOBILE LEARNING TECHNOLOGIES: A SYSTEMATIC REVIEW FROM THE EDUCATION PERSPECTIVE

## Abstract

**Introduction:** The emergence of artificial intelligence-powered mobile learning systems has significantly affected how individuals teach, learn and conduct various educational practices. The rapid expansion of these systems has gained popularity and interest among various educational categories worldwide.

**Objective:** This study aims at exploring the impact of the artificial intelligence powered by mobile technologies.

**Methods:** The study has adopted the use of systematic literature review adopting the PRISMA guidelines to highlight the current composition of literature on Artificial intelligence integration with mobile learning in educational settings from 2019 to 2024. methods. It has been noted in the study that Asian geographical countries seem to be leading in the scholarly publication within the scope of this phenomenon. The review looked at different aspects such as keyword occurrence, authorship, publication countries, participants, types of mobile devices and educational practices, process delivery, and perceptions of end-users from using technology

**Results:** This study has discovered that from 67% of the 21 studies it was revealed that Artificial intelligence-powered mobile learning tools increased students' learning experience, developed higher levels of participation,

**Conclusion:** It has been found that artificial intelligence in has an opportunity to understand the current trends and how artificial intelligence integrated with mobile learning technology can be utilised in global education settings. Additionally, it is an opportunity to assist scholars in framing the direction of future research studies, especially in developing countries located on the African continent.

**Contribution:** This study will enhance understanding, knowledge acquisition, enhanced vocabulary skills for providing better students' academic performance and outcomes.

**Keywords:** Artificial intelligence, mobile learning, technology, education, students.

## 1. Introduction

Educational institutions' transformation from classroom-based to digital learning has rapidly grown in recent years. The development of transformative and innovative digital technologies has shifted various instructional categories around the globe, such as professional education, health, banking, and sports. Education has transformed from traditional classroom-based learning to digital learning methods, such as e-learning, mobile learning, virtual learning, and artificial intelligence (AI) context learning that has reshaped the physical and virtual techniques based on individual needs (1). Consequently, these innovative instructional techniques have become more and more important in professional education as the sector rapidly transforms due to the need for automation, AI, and digitisation (2). This digital transformation strategy aims to meet the demand for global quality education, enhance student abilities, and keep up with the need for the ever-changing digital environment.

The global educational landscape is shifting towards the need for innovative learning technologies that simplify and improve other digital learning systems and provide a solution to the student educators' need for a customised learning experience. Incorporating AI within the educational landscape helped accelerate the acceptance of personalised learning, providing adaptable solutions that could transform teaching and learning processes (3). The AI model is a type of software that examines data collection to find particular trends before predicting the outcomes (4). For example, some of the AI tools used were ChatGPT, OpenAI and the Massive language model (5). These AI tools were frequently used to support instruction, oversee classrooms, and assess student conduct (6), including assisting students to complete learning tasks. Similarly, students have gained the ability to learn according to individual demands and capacities (7). At the same time, the overall requirements for providing quality education cannot be met by AI alone; integrating AI with other digital learning applications to improve education quality and enhance learning experiences is necessary.

Mobile learning applications have emerged as one significant tool for enhancing education quality and learning experiences. According to (8), mobile learning is described as an educational process that considers the portable nature of technology, students, and the academic experience as a whole. The mobile learning application's portability allows for integration with other digital systems. As a result, one meaningful way to improve and elevate learning experiences was by incorporating AI technologies into mobile learning (9). The function of AI is understood to enable the automation of these applications (10). Identically, AI-powered learning applications fall under

the category of thinking intelligence, providing practical services and are used to enhance students' learning abilities (4). These are some of the motivations behind developing innovative mobile applications with the characteristics required for instruction and learning in education (11). Therefore, introducing AI-powered mobile learning in educational institutions improves the effectiveness of higher education in providing quality education, prepares students for a world dominated by technology, and provides more technological development tools to embrace the future.

### **The need for intelligent mobile devices used for AI-powered mobile learning**

There is a daily increase in the integration of AI-powered technologies and mobile learning applications in educational settings, possibly due to the extensive use of intelligent mobile devices. Both emerging and fully developed nations have seen an increase in mobile learning practices, primarily through the use of mobile phones (12), and other intelligent devices such as Smartphones, Laptops, and Tablets. Nowadays, educational institutions are forced to use these mobile computing devices for academic reasons because of the rapid development of digital technologies (13). The quick progression of AI and the extensive use of these mobile devices have generated considerable opportunities for educators and students to explore AI-powered mobile learning. Thus, by allowing students to access instructional materials across multiple devices and events easily, incorporating AI into mobile learning platforms encouraged a more student-focused and personalised approach to education and supported a meaningful and ubiquitous learning process (14). Moreover, the compatibility of intelligent mobile devices and the rise of AI-powered mobile learning created a chance for improved academic content flexibility and customisation while meeting students' various demands and interests.

Likewise, one of AI's top priorities was the development of intelligent mobile devices that can assess the surroundings and perform tasks just like people (15). This is because AI tools have the intelligence to go beyond physical human actions and replicate events in real human environments such as educational settings. These intelligent devices have improved very efficiently and fruitfully the use of the time and energy of educators as well as students (7). Furthermore, the emergence of these digital devices has led to the rise of effective personalised learning systems and data-driven analytics (3). However, the challenge was that these mobile devices were at the heart of the education economy, housing the different learning systems and applications that

always attract students' attention (16). Therefore, beyond the AI's major functional characteristics, such as customisation, AI-powered mobile learning offers several advantages that can address the difficulties educators and students encounter during the teaching and learning process in educational settings.

### **The importance and benefits of using AI-powered mobile learning in educational settings**

Digital learning in an educational set-up is evolving, especially with the emergence of AI-powered mobile learning. These digital technologies and the accelerating growth of educational information have caused significant changes in the educational landscape (17). As a result, educational institutions are now integrating AI-powered tools with mobile learning as another alternative replacement for traditional classroom-based learning. The introduction of immersive technologies has gained prevalence globally, assisting educators in enhancing the quality of performance in education and improving overall educational success (18). These tools are essential for individuals and the education society overall, as well as for educational institutions, because of having features such as:

**Content Customisation** - One of the primary advantages of AI-powered mobile learning is the customisation of students' learning experiences (15). By leveraging adaptive digital learning technology, students can learn in a way that suits individual requirements. AI utilises student profiles and performance information to create or recommend learning resources that are customised to each individual's needs (14,19). This is done by mapping out each individual's learning patterns and preferences.

**Mobility in teaching and learning** - AI-powered mobile learning in education has become more accessible to a wide range of educators and student populations. Thus, it has caused learning to be done wherever and whenever individuals want (20,21), through different tools that meet diverse learning methods or accessibility needs.

**Providing real-time feedback** - AI-powered tools provide tailored assistance, instantaneous feedback, and flexible learning strategies, which improve student motivation, engagement, and academic performance (17). Thus, AI can give learning feedback right after students complete tests, quizzes and assignments, improving students' skills, enabling them to understand information effectively, and allowing teachers to determine which topic to concentrate on more.

For example, educators observed that the ability to use specialised software to record and assess students' activities significantly increased the efficacy of feedback and assisted students in realising individual errors (18).

**Increased accessibility and engagement** – Access to a range of digital resources has become more and more necessary to students due to digital technologies' transformed communication and engagement (18). AI systems can work with a large number of students at the same time, allowing educators to scale methods and keep quality in large classrooms or online courses. Furthermore, this particular approach has been noted by past studies to boost engagement and motivation as students experience a deeper connection to the content and a greater sense of ownership over the educational journey (3). Therefore, higher access and customisation of educational content can result in more effective use of the student's time, better learning results, and increased engagement.

**Extended Learning** – The flexibility and portability characteristics of mobile learning technologies helped bridge geographic gaps as these technologies can be brought anywhere (21). This means that mobile access allows students to interact with learning beyond the boundaries of classroom hours, fostering a sense of extended learning. Moreover, extended learning can be achieved by introducing digital tools such as chatbots and more gamified learning approaches; engagement can be elevated, resulting in a less boring learning process for students.

**Economic efficiency** – AI can allow educational institutions to reduce extensive physical requirements, limit extensive travel and operational costs, and provide the idea that digital content is often a more affordable and efficient learning technique. The emergence of AI helped close the educational gap in underprivileged or rural regions by providing online platforms and digital resources, expanding access to high-quality education in communities with a shortage of resources and educators (19).

**Provision of Data for Informed Best Practices** – AI can derive insights from performance data for educators to make informed decisions regarding curriculum development and instructional strategies that will ultimately boost the quality and performance of education. For example, The data drawn from a vast amount of information can assist teachers in expanding individual expertise and enhancing students' ability to earn high grades in the future (10).

Besides the significance and benefits of AI integration with mobile learning, it is a complex concept that may be useful if implemented and used correctly. However, it is crucial to remember that AI's replacement of human tasks probably does not answer most of the challenges

and problems within the education environment. According to (22), a challenge is any circumstance that makes it difficult to observe progress or accomplish an objective. Therefore, institutions must consider the effect of these challenges and problems before accepting the use of AI-powered mobile learning technologies in operations.

### **Challenges and considerations for using AI-powered mobile learning technologies**

The emergence of AI-powered mobile learning applications in the educational landscape has also been accompanied by enormous challenges not to be overlooked. Global demand for providing high-quality education and students' needs for learning that improves performance has brought many challenges and problems for many professional educational institutions. This is because the educational and learning needs of educators and students can no longer be satisfied by the traditional methods of instruction in professional education (23). These challenges cover a wide range of issues, including technological gaps, educators' adaptation to change, and the shifting of employment duties to AI-powered technologies (9). Moreover, the users' socio-economic and cultural backgrounds also bring additional challenges that may impact educational institutions' plans to adopt AI-powered mobile learning in a particular country. For example, inequitable allocation of educational resources has long existed in South Africa's educational system, with specific communities facing disadvantages because of socioeconomic status, race, or complexion (19). For this reason, educational institutions must ensure that the integration of AI-powered mobile learning technology is equitable and available to all students, irrespective of the preferred learning method or cultural background.

Educational institutions' requirements for a fitting technology with characteristics such as adaptability, mobility, flexibility, compatibility, intelligence, integration, privacy and security uncovered additional challenges. This includes technical issues with the software, insufficient support and training (18), the gathering and analysis of enormous amounts of student data and other obstacles to integrating AI into education (19). Furthermore, the potential posed by students to use AI to find answers to essay questions rapidly leads to cheating (5). Educators use AI detectors, which mostly catch students and cause failure or underachievement of the desired results. Therefore, educational institutions must address these challenges as a significant threat to user data's integrity, privacy and security.

## **Level of research studies on AI-powered mobile learning technologies**

Despite benefits and the availability of challenges in and out of the educational settings, educational institutions' interest in introducing AI integration with mobile learning technologies into the educational landscape has increased. However, there was still not enough research examining the successful integration of AI into mobile learning in educational settings despite the technology's increasing significantly in a variety of academic situations (9). The integration of AI into mobile learning is still in the early stages of research and development, with interest and awareness of its possibilities expanding. Therefore, research is needed to identify practical and affordable solutions appropriate for this field (24). As a result, a knowledge gap about the collaborative affordances offered by integrating AI into mobile learning in education has been identified. Thus, this study aims to give a current, systematic evaluation of the application of AI-powered mobile learning in education by looking at existing research from 2019 to 2024.

Furthermore, this study aims to answer the formulated research question and evaluate other quality factors of the synthesis to visualise the practical sustainability of AI-powered mobile learning applications. This includes the evaluation of mapped trends, authorship, citations, countries of study, and content similarities of the specified keywords.

Research question:

- *How does AI-powered mobile learning affect educational settings?*

## **Methods and materials**

To properly gain a deeper understanding of the integration of AI into the mobile learning phenomenon, a Systematic Literature Review (SLR) was conducted to satisfy the aim and objectives of our study. According to (25), the literature review is a rigorous procedure that serves as the basis for carrying out any study or research effort. As such, the study followed a formal SLR process.

### *Search strategies and sources of data*

The sources of data selected from journal articles were collected using the Scopus database as the primary source database for article selection. The articles' text keywords were used to retrieve the

included and excluded articles based on the set criteria. The keywords used for inclusion were: (“Artificial Intelligence” OR “AI” OR “Mobile learning” OR “Mobile technology” OR “Technology” OR “Students” OR “Students”). The primary database search resulted in 90 journal articles determined using the study-developed inclusion and exclusion criteria. Since AI integration into mobile learning technology is developing quickly, the search was created to find the most recent findings and developments regarding AI-powered mobile learning journal articles. These journals were published from 2019 to 2024 and were written in English.

### ***Inclusion and exclusion criteria***

To ensure that the appropriate research publications would be the only work included in the systematic review procedure, the study employed the inclusion and exclusion criteria as reflected in Table 1. Likewise, to be included in the analysis and boost the quality of assessment, each critically examined publication journal must satisfy the inclusion and exclusion criteria listed below.

<b>Inclusion Criteria</b>	<b>Exclusion Criteria</b>
The academic work should have been published in a journal article.	The academic work was not published in a journal article.
The journal article should have been published between 2019 and 2024.	The Journal article was not published between the years 2019 and 2024.
The journal article should have been written in English.	The journal article was not written in English.
The academic work should fall under the computer science, business management, and accounting categories.	The academic work does not fall under the computer science, business management and accounting category.
The full version of the publication is available and not an abstract-only journal article.	The full version of the publication is not available or is an abstract-only journal article.

**Table 1:** A summary of the inclusion and exclusion criteria.

### *Data extraction technique*

Data extraction is a process of gathering and arranging data from sources for analysis, synthesis and storage. This process ensures that the SLR process is organised, straightforward, and standardised, permitting for the improvement and validity of results. The data retrieved for this SLR from the Scopus database was exported to a Microsoft Excel database and Zotero referencing manager as the organisation and standardisation computing tools. The Microsoft Excel database enables scholars to organise, perform calculations, and statistically analyse data for an informed reporting process. Zotero will also assist in managing source referencing, citations, and data sharing. These computing tools were significant in ensuring smooth data collection and organisation process, meeting the inclusion and exclusion criteria and ensuring that the procedure used for identification, screening and eligibility was performed to meet the quality standards of the SLR.

### *Reporting, Quality analysis and framework development*

The analysis of articles in terms of the quality guidelines for this systematic review concentrated on the following:

- Study explanation of the AI, technology and mobile learning concepts,
- study unit of analysis, responses to questions observed in the study,
- study findings and conclusions,
- study limitations,
- and study suggestions for further developments in AI-integrated mobile learning.

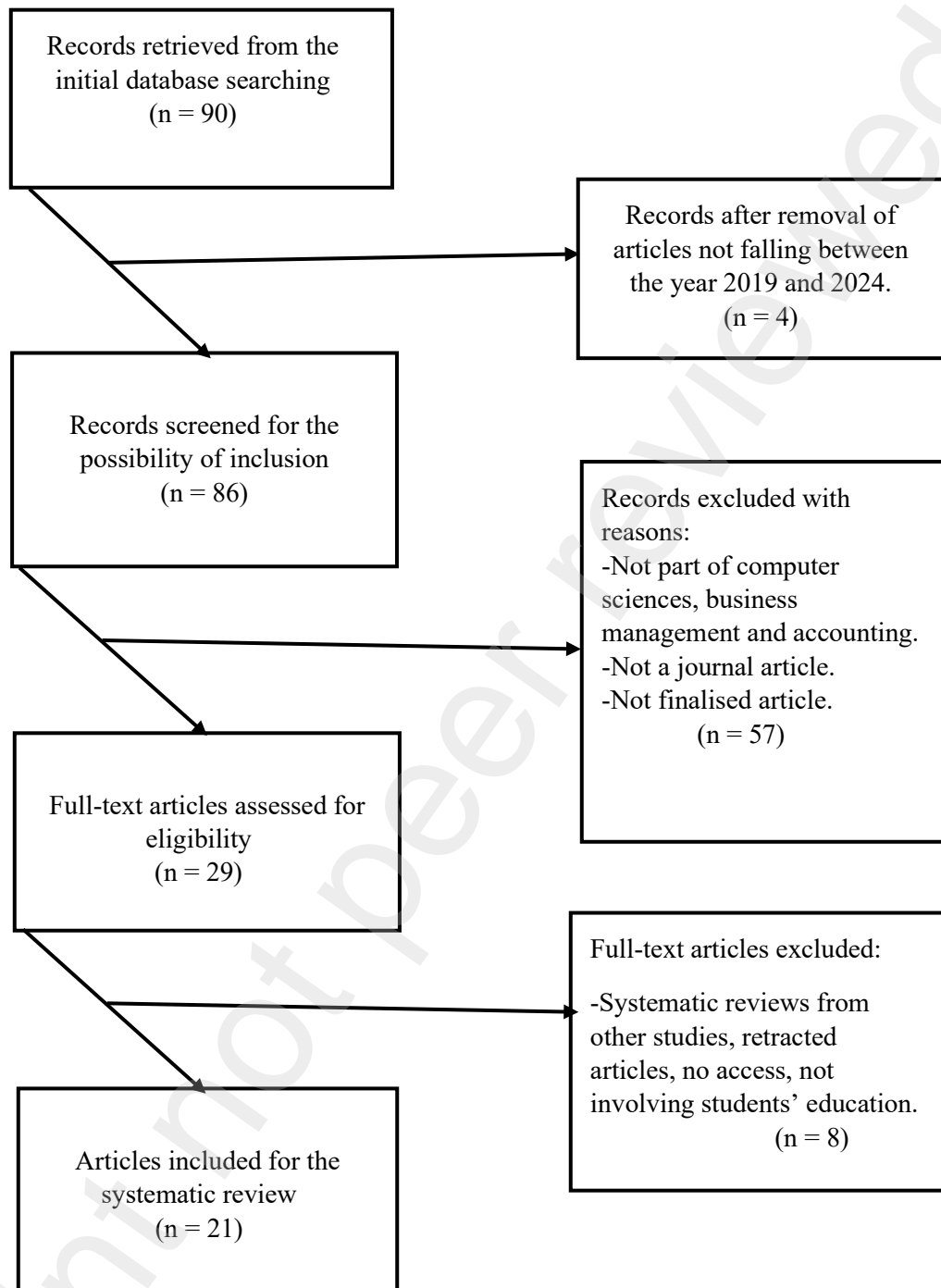
The SLR selection framework was developed according to the recommended reporting items for systematic reviews and meta-analysis (PRISMA) (25,26). The procedure is to identify, screen, consider eligibility, and recommend inclusion for the number of articles searched in the preferred database. The search was conducted to include final journal articles from the year 2019 to 2024. Furthermore, the search was narrowed down and focused on mapping existing literature on AI-powered mobile learning in the fields of computer science, business management, and accounting. At this stage, a total of 61 articles were excluded. These were full journal articles that had already been finalised and written in English. Likewise, at the final stage, 69 articles were removed as these did not meet the inclusion and exclusion criteria of this SLR.

This SLR is based on selecting full journal articles written only in English. No duplications were found during the screening process. The relevant keywords were checked in the article abstracts to ensure relevance and maintenance of the quality standards of the SLR. All articles were carefully evaluated, with a total of 8 journals excluded because of either systematic review from other studies or retracted articles, non-accessible and not involving students in education settings. Moreover, this study ensured that all journal articles that met the inclusion eligibility were selected based on meeting the inclusion and exclusion criteria. Therefore, at the end of the overall assessment, the study had only 21 full-text journal articles that passed the eligibility test for inclusion. Each activity was performed according to the steps shown in the illustrations in Figure 1.

NO	Authors	Publication Year	Analysed Unit	Country	Citations	Subject Area / Technique
1	Huang, Lin, Liu	2024	Students and Teachers in (Art Education).	China	02	Big data and AI in art teaching
2	Lin, Yang, Xu, Xue, Li	2024	Students (Classroom)	China	0	AI integrated into student classroom behaviour detection systems
3	Li, Cui, Jiang	2024	Test Data for Students	China	30	AI and metaverse empowered the internet environment
4	Wang	2024	educators (Dance Education)	China	0	AI integrated into dance education.
5	Eliza, Fadli, Hakiki, Trisnawati, Abdulah, Putra <i>et al.</i>	2024	Students (Electrical Engineering)	Indonesia	0	Integration of Mobile-based learning and project-based learning for teaching electric motor installation.
6	Wu	2024	Educators and students in higher education	China	0	Effective use of AI and 5G mobile networks for English teaching.
7	Sanchez	2024	Students	Japan	0	The effect of AI overuse in the education environment.
8	Baba, El-Faddouli, Cheimanoff	2024	Students	Morocco	02	AI-powered personalised mobile learning environment.
09	Synekop, Lytovchenko, Lavrysh, Lukianenko	2024	Teachers and Students	Ukraine	05	The Use of Chart GPT in English for Engineering Classes.

10	Boltsi, Kalovrektis, Xenakis, Chatzimisios, Chaikalis	2024	Experts and students	Greece	05	The use of digital learning tools such as AI and robotics under the 4IR education environment.
11	Kingchang, Chatwattana, Wannapiroon	2024	Students	Thailand	05	The use of AI Chatbot platform for educational Recommendations.
12	Lin, Wang, Zhou, Luo, Hwang, Zhou, <i>et al.</i>	2023	Students	China	14	Ethics of AI in augmented reality learning system bases contextualisation.
13	Naya-Varela, Guerreiro-Santalla, Baamonde, Bellas	2023	Students	Spain	11	Introduction of computer intelligence using educational robotics and AI to students for learning using the autonomous driving model.
14	Talib, Housni, Radid	2023	Students, career counsellors	Morocco	1	The use of AI-powered mobile learning technologies in career guidance.
15	Liao	2023	Educators and students	China	0	The use of AI in English vocabulary learning assisted by virtual reality.
16	Chang, Lee, Wong, Jeong	2022	Students	China	33	The use of AI-powered learning applications and gratification model in education.
17	Liu, Faisal, Alharbi	2022	Educators and students	China	13	The role of 5G networks and AI for decision support systems in situational teaching.
18	Hang, Khan, Alharbi, Nazir	2022	Students (English department)	Malaysia	17	Effective use of AI in English Teaching and Learning.
19	Khairy, Abougalala, Areed, Aatwy, Alkhalaf, Amash	2020	Educators and Students	Egypt and Saudi Arabia	06	AI in Educational Robotics
20	Hussain, Sidhu	2019	Students	Malaysia	01	Mobile AI analytics systems
21	Joy, Balakrishnan	2019	Students	India	10	Mobile AI in sign language Vocabulary.

**Table 2:** Summary of reviewed synthesised studies.



**Figure 1:** A schematic illustration of the procedure for searching and reviewing literature.

#### 4. Discussion of results and findings

This section will present the results and findings of SLR and a discussion to answer the proposed research question. The analysis of data was done using VOSviewer, which allows us to map and

tabulate the data that have been extracted. Table 2 and Figure 1 gave a clear direction on how the results and findings were archived, giving an advantage to further elaborate on the topic and answer the research question. Moreover, this section will explore the trends within AI and mobile learning concepts in existing research papers including authors, countries of study, and most studied key terms. Furthermore, the study aims to explore the existing threats and opportunities that can guide future research.

## **The trends in existing research within the AI and Mobile learning concepts in education**

### *The Countries*

Since AI-powered mobile learning is a relatively developing concept, some countries have seen a significant rise in publications and authors showing interest in these innovations. However, what is still not clear is the number of educational institutions leading in the academic output of this concept. According to Figure 2, several countries have shown interest in AI-integrated technologies, leading academic research output and bracing society for the incoming technological changes. China has proved to be the leader in producing academic work related to AI-powered mobile learning, with 43% (9 publications) of the academic work output. Hence, as of January 2021, the largest global database of educational data was located in China (27). Morocco and Malaysia are second with 10% (2 Publications each) of the academic work output. The rest of the countries, such as Japan, Ukraine, Greece, Thailand, Egypt & Saudi Arabia, Spain, India, and Indonesia, all share the same academic work output of 5% each (1 Publication each). In summary, the number of academic work publications grew in the year 2024 (Eleven) compared to 2023 (Four), 2022 (Three), 2020 (One) and 2019 (Two). As a result, research studies on AI-powered mobile learning are expected to rise in the coming years.

### *The Author's Contribution and Citations.*

Several authors have shown interest in the academic scholarly review of integrating AI with other technology platforms. According to Table 2, authors attached to Chinese institutions were the most significant contributors to academic scholarly output between 2022 and 2024 (Nine Contributions), followed by Morocco and Malaysia with two contributions each. However, these scholarly output contributions are spread among Chinese educational institutions such as Qingdao University, Xi University of Science and Technology, Central South University of China,

Zhangzhou University of Technology, Jiangxi University of Technology and other categories of education institutes with a single output each. Thus, the rest of the publication countries' institutional contributions have been categorised by a single contribution of published journal articles.

Similarly, the results from the Scopus data extraction indicated that the top six most cited journal articles in this SLR were studies published by (28) Thirty-three citations, (29) 30 citations, (7) seventeen citations, (30) Fourteen citations, (10) Thirteen citations and (31) Eleven citations. Thus, as previously illustrated in Table 2, four of these top five studies were published in China, with one in Malaysia and one in Spain. In addition, nine published and selected studies for this SLR had less than ten citations each, with six studies still to be cited (zero citations). Therefore, this is a new and developing concept under investigation, and the relatively low contribution level of output and citation was expected. Moreover, the 2024 academic year is not yet complete, and more papers under this concept might be released, published and receive more citations by the current and new scholars.

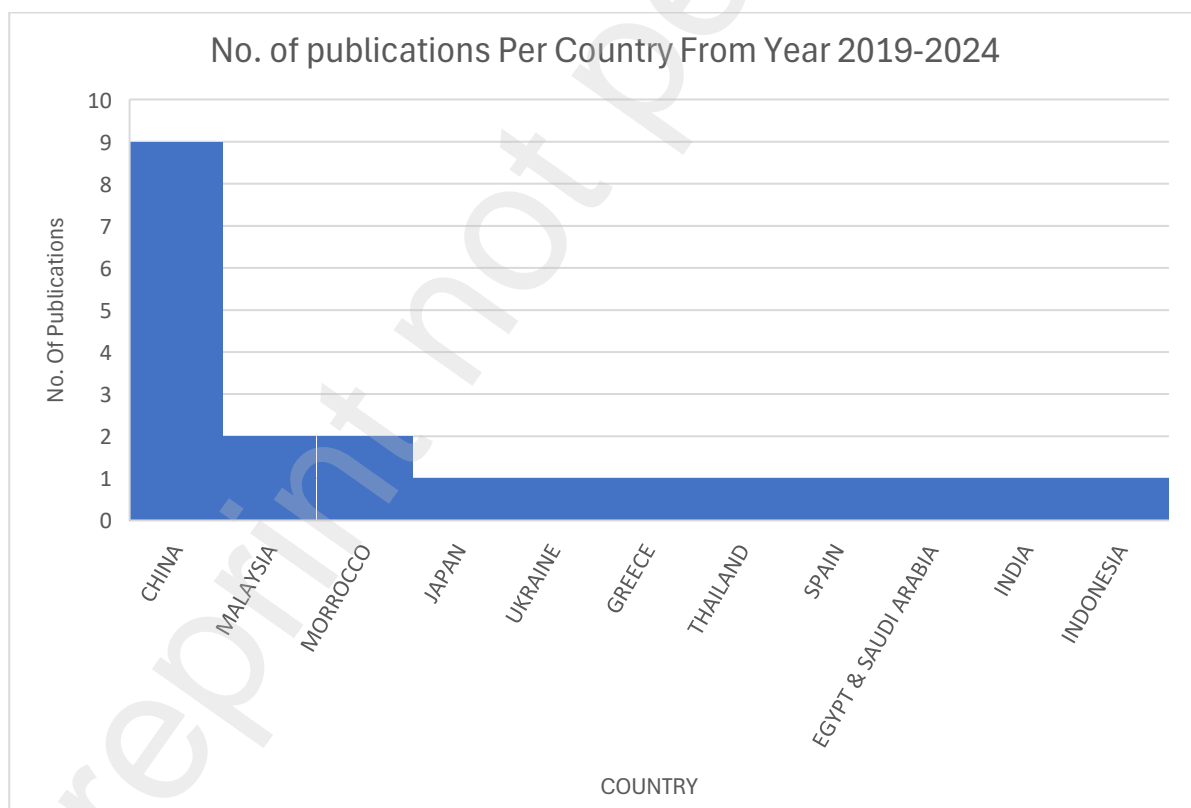


Figure 2: Summary of top countries based on publication output from 2019 -2024.

### *The most contributing key terms*

The role of AI and mobile technologies in various education categories is now in the spotlight regarding literature reviews, with a particular emphasis on the impact of integrating AI with mobile learning applications, even though this is a new and developing concept of interest and investigation. According to Table 3, the top 5 critical terms by relevance and occurrence are artificial intelligence, student, technology, development and integration. However, although mobile applications are second from the bottom, this SLR focuses on how its integration with AI unfolds in the education environment. Students are growing interested in using mobile devices in education and how mobile applications can transform how students are taught and learn. Educational institutions are developing strategies to ensure that the teaching and learning processes are digitally transformed by adopting innovative and immersive technologies. The SLR further discussed the significance of these critical terms under sub-research questions 1, 2 and 3.

Key terms	Occurrences	Relevance
Artificial intelligence	27	1.66
Student	25	1.52
Technology	26	1.50
Development	12	1.19
Integration	6	1.10
Paper	13	1.03
Field	9	0.95
Data	8	0.82
Analysis	9	0.79
System	16	0.79
Ability	7	0.75
Mobile application	6	0.58
user	7	0.34

**Table 3:** Summary of Key terms occurrence and relevance.

### **Research question**

*How does AI-powered mobile learning affect educational settings?*

The study created supplementary sub-questions to help examine each chosen study to address the research question. The results will assist the SLR in gaining critical knowledge that will help scholars understand the impact of AI mobile learning technologies in educational settings. These questions are based on the results of the selected studies with a focus on whether the technology delivers what is expected, changes the perception of end-users, and impacts different educational practices on which it was implemented. The supplementary sub-questions were highlighted as follows:

1. *Does the use of AI tools as a method of technology in an educational environment deliver an improvement?*
2. *What are the end users' perceptions of using AI tools in an educational environment?*
3. *What were the different educational practices investigated in the selected papers?*

This category of improvement referred to in the sub-questions includes process improvement, performance improvement, knowledge acquisition, skills improvement, quality improvement and enhancement of student performance or achievement. According to Table 2, the end-users refer to educators and students (participants), as referred by in most of the selected studies. These end-users' perspectives and characteristics include positive attitudes, responses, motivation, increased engagement, and interest in the continuous use of AI-powered technology.

First, investigating the method of technology used for improvement delivery was responded to by the majority of studies in this review. The results from 14 studies (67% ) found that the use of AI-powered tools improved the following: educator's awareness of students' knowledge (11), students' creative capacities and personalised learning settings (27), response time and quality of the process experiences (29), learning outcomes and personalised experience (1), motivation, involvement, and immersive, interactive learning opportunities for students (23), language spelling, acquisition and vocabulary development (32), dance education skills (18), vocabulary rate of learning and development (33), students inspirations (2), mobile learners' experience driven by AI mobile-tailored learning systems, higher levels of participation, enhanced understanding, and better academic performance (3), language learning skills, results, better teaching methods and personalised learning experiences (10), real-time performance and technological efficiency (6), positive effect on vocabulary (7), and learning results, performance and AI ethical considerations (30).

On the other hand, two studies (10%) suggested that AI tools were proven to be effective platforms and efficient methods for making educational suggestions (4) and have the potential to give students dynamic, customised assistance (34). Moreover, one study (5%) had mixed results between participants: students were more optimistic, while educators were more cautious about using AI tools. However, 10% of the studies were not clear about whether the use of AI tools provided an improvement or were effective during application and use. One study (5%) reported decreased learning motivation and students' absence of independent abilities and goals (16).

*What are the end users' perceptions of using AI tools in an educational environment?*

Secondly, investigating the end-user's perceptions of using AI tools in an educational environment was responded to by six of the studies, covering 29%. These perceptions among students were examined from several angles, such as investigating students' engagement levels and academic performance, outcomes or achievement, and other factors contributing to students continued use of AI-integrated tools. For example, it was highlighted that this method encouraged the growth of employable talents pertinent to the labour market and student engagement through efficient teamwork and communication (2). These AI-powered solutions enhanced student engagement and the educational process (7). Moreover, research shows that the AI-powered mobile-tailored learning system greatly enhanced the educational experience of mobile learners, resulting in higher levels of engagement, better comprehension, and better academic performance (3). Combining context-awareness technology with AI educational robotics created a customised, immersive learning environment that improved student engagement and knowledge acquisition (1). Thus, integrating modern network technological advances into tertiary education enhanced student engagement and inspiration and created a more engaging and immersive learning environment (23). Therefore, an evident increase in user engagement over time signified rising confidence in the usefulness and efficiency of these systems (34).

Another significant angle of investigation was to explore how these AI-powered tools enhance student performance, outcomes, or achievements. Three studies (14%) affirmed the significance of AI-powered tools in enhancing performance and learning outcomes. These studies highlighted that interactive digital learning offered students a more adaptable, individualised, and interactive learning environment, which enhanced learning outcomes and motivated students to work towards personal development (27). Another study concluded that AI improved students' performance and English language proficiency (7). Furthermore, students' positive attitudes greatly impacted learning performance and the intention to continue using these tools (28). However, two studies highlighted the potential and challenges of AI to monitor and enhance learning performance and personalise learning but suggested the need for further research (1,32). Students enjoy a better learning experience, better performance, and good learning outcomes due to the enhanced approach suggested by selected studies in this SLR.

*What were the different educational practices investigated in the selected papers?*

Thirdly, the next sub-question investigated the different types of educational practices explored by the selected papers. Ten studies (47%) responded with AI-based mobile learning or mobile applications used in different learning environments to achieve different goals and purposes. These mobile applications were integrated with AI to form practices such as Project-based language learning (2), Computer-assisted language learning (CALL), Mobile-assisted language learning (MALL) (7,33), Virtual Reality (VR) (32), Augmented Reality (AR) (18), AI Chatbots (34) and AI-powered mobile learning (11,28). The main goal was to discover how these technologies affect students' critical areas, such as attitudes, language learning skills, motivation, performance, and results. Most of these studies noted the potential of AI tools to enhance student performance, achievement and the quality of education. Seven studies (33%) focused more on the effectiveness of AI-powered technology in English language teaching and highlighted its potential to improve vocabulary skills (7,10,23,28,32,33,35). Suggestions or assistance offered by AI mechanisms such as Contemporary Science, Technology, Engineering and Mathematics (STEM), Chatbots, ChatGPT, and educational robotics were noted by six studies (28%), with students affirming that a decision was made based on educational recommendations made by these AI tools. These tools positively impacted students' engagement, participation, outcomes, and knowledge capacity.

Three studies (14%) noted the significance of big data integration with AI and mobile applications as a necessary educational practice in AI analytics, behavioural detection and different categories of teaching (6,11,27). This subsequently emphasised the significance of students understanding a particular educational topic and ensuring that information can be stored, processed and accessed in larger quantities. As a result, advanced, high-speed, faster connectivity was required and delivered through a 5G network. So, three studies (14%) noted the significance of AI and 5G networks in education (10,23,36). AI and 5G technologies have revolutionised teaching and learning methods by enabling quicker and easier access to educational materials. Thus, modern educational practices based on innovative technologies are built on high-speed network methods for effective voice and content display mechanisms.

### *Types of mobile devices used*

Although 14% of the studies highlighted the impact of the 5G network on educational processes, further scrutiny of the selected papers revealed that most studies focused on the term mobile devices but barely described the types of mobile devices educators and students use for effective AI-powered mobile learning in educational practices. This is an essential and concerning factor, considering that specific AI tools are uniquely designed for performance, compatibility and deployment on mobile devices or mobile technology. Similarly, some educators also raised concerns about whether these technologies will be available to all students, particularly those with less Internet access or high-tech mobile devices (18). The unique design, features, capabilities and performance of mobile devices also affect the end users' perception, which leads to determining whether the integrated technology is effective.

### *Types of educational practices and participants*

AI-powered mobile learning has revolutionised education, how teaching and learning methods are conducted, and how society perceives modern education. Most selected studies have highlighted several educational practices, such as Art Education, Dance Education, Sports Education, and classroom-based education. Seven studies (33%) have pointed out the educational practices related to using AI tools for language teaching, primarily focusing on English language vocabulary. These studies included suggestive tools such as Chatbots, ChatGPT, and mobile applications to improve students' vocabulary skills. Students enrolled in various educational institutions, from schools and colleges to universities, were the most concentrated and prevalent participants in the chosen subjects. Additionally, some of these studies used educators, while others used both.

### *Addressing the research question: How does AI-powered mobile learning affect educational settings?*

In order to answer the study question on the impact of AI-powered mobile learning on educational settings, the three sub-questions must first be addressed. This SLR combines results from Sub questions 1 through 3 to create a definitive response. The majority of the studies (up to 67%) supported the assertion that AI-powered mobile learning tools increased students' learning experience, developed higher levels of participation, enhanced understanding and knowledge acquisition, enhanced vocabulary skills, bettered students' academic performance and outcomes,

created an environment of quality teaching methods and customised learning environments. These improvements in an educational setting led to the effective delivery of quality education and allow institutions to meet strategic and transformation objectives.

The perception of educators and students is often changed by technology performance and experiences, which determine an individual's view of effectiveness. Hence, the increase in user engagement, motivation and the urge to continue using the AI-powered tools was driven by the positive attitude of the users. Students were more inspired to engage, communicate, and make decisions based on the AI tool's suggestions due to the positive attitude developed through improved skills such as language and vocabulary. The user believes that AI-powered tools can potentially enhance motivation, engagement, performance, achievement, personal experiences and the overall delivery of quality education. However, some users often view AI-powered tools on a different dimension and often approach the technology's use and effectiveness with caution.

The most exceptional characteristic of AI-powered mobile learning technology is the ability to be used differently in various educational practices. According to the selected studies, AI-powered potential improved and positively affected art education, dance education, sports education, language education, classroom-based education, analytics and system-based mobile education such as big data, robotics, MALL, CALL, and STEM. The accessibility and compatibility characteristic of AI-powered mobile learning allows for the effective use of modern mobile devices and high-speed connectivity, enabling quality voice and video display. These AI-powered technology tools were usable by users of different levels of education enrolled in schools, colleges, and universities, giving them the urge to transform different education settings effectively.

#### *Recommendations for educational institutions exploring new opportunities and developments*

This SLR has also identified other areas of scholarly interest that may be explored for the future development of innovative and transformative technologies such as AI-powered mobile learning. These opportunities were identified from the developing trends in the global education society to meet the demands for quality education and promote a multi-diverse teaching and learning experience. More research may be required to determine if these applications have the same beneficial effects on every student because different students have different learning methods in terms of timing and behaviour during learning (37). Hence, educational institutions must explore some of the identified opportunities for a multi-diverse teaching and learning experience between educators and students. These opportunities include:

- New compatible software for smooth AI integration with mobile learning applications. These innovative developments will address the use of mobile applications and software and their services outside of the institution's teaching and learning settings (38). Undoubtedly, our viewpoint is that newly developed software and mobile applications in the market can increase interaction, participation and the chance for educational institutions to explore new ways of improving their teaching and learning practices anytime, anywhere. Likewise, these software and mobile applications offer intelligence and compatibility for the future, allowing them to be responsive and used with new and existing devices.
- It would be preferable if more extensive research could be started to examine the influence and usefulness of the User Generated Content process and be able to generalise their findings (39). This review recommends that institutions' research include all stakeholders, which will allow the determination of mobile learning level of competency and identification of areas where improvement is required. Competency improvement through official institution processes such as formal training is crucial in ensuring all stakeholders have the required knowledge to use these User Generated Contents. For instance, it will be helpful if all AI-powered mobile learning end-users in the institution have the competencies to engage, interact, and communicate and can use mobile learning practices at the same knowledge level.
- There is a need for scholars to research and design educational technology products that can attract the younger generation of students from the look and feel perspectives. These scholars must follow up actions to carry out a more detailed analysis of the features of User Interface (UI) / User Experience (UX) products that will be more effective and efficient and have been developed by designers for users, build for better and more detailed design models which can accommodate more broad student testing (40). The analysts of the UI and UX products must consider the composition elements to include an attractive look and feel, easy and official instructions, improved correspondence tools, communities for sharing information, and better accessibility and compatibility features, which must be able to increase student engagement and performance by creating user-friendly experiences.

## **Conclusions**

This systematic review was designed to offer the academic community up-to-date and developing trends based on a scholarly review of selected studies on AI and mobile learning integration in educational settings. This paper followed the PRISMA guidelines that led to the retrieval of 21 quality journals for developing a systematic paper on AI-powered mobile learning from an educational perspective. The summary of these studies revealed a growing trend in using AI and mobile devices in educational practices such as art, dance, sport, vocabulary, and classroom settings. Several authors from different countries led by China have suggested and recommended the significance and effectiveness of AI integration in educational settings. Hence, essential lessons have been learned about the changing trends involving AI integration into mobile devices, which has revolutionised the educational aspects of teaching and learning. The development of AI-powered mobile learning can improve the teaching and learning aspects through customisation, increased engagement, improved vocabulary skills, enhanced knowledge acquisition, better learning performance and outcomes, and delivery of quality education practices. These improvements are considered effective from an educational perspective to transform interactive teaching and learning experiences between educators and students.

This SLR has concluded that AI-powered mobile learning systems are an effective tool that can help educators better understand students' needs, training and areas of improvement, providing customised content, real-time suggestions and feedback leading to promoting a technology-centred learning environment. Student access to intelligent mobile devices and high-speed network connectivity allows for adequate quality education through smooth access to large amounts of educational content, as well as visualisation and display of educational videos. However, a broader view of the individual authors and country contributions to developing AI-powered mobile learning remains a significant factor in its effectiveness globally. Moreover, the outcomes from most of the reviewed studies show that opportunities exist for scholars to further conduct interesting research on AI integration with mobile learning and its constructs, especially in developing countries in other continents like Africa.

## **Study limitations, recommendations and direction for future research**

The concept of AI-powered mobile learning is developing quickly as an attractive area of research for most scholars in different institutions and locations. As a result, more quality papers on this

concept have been published and stored on various digital database sources. This study identified limitations based on the determination that more quality papers may have been missed due to the following reasons:

- The SLR inclusion criteria may have led to this study missing other quality papers due to [a] papers being published in other formats, such as conference papers and books; [b] papers being published in other languages except for English; [c] academic work falling outside of computer science, business management and accounting categories; [d] academic works being found on other sources and databases except for Scopus database; [e] academic work publications falling outside the year range of 2019 to 2024, [f] Other quality articles may have been missed due to inability to fit into the keywords criterion of this SLR. Hence, some studies might have relevant information needed for this study but irrelevant titles, subject descriptions, or lack of keywords on abstracts.
- In addition, 2024 is not yet complete, and trends in technology continue to grow with other elements such as access to new technology, acquisition of new knowledge, changes occurring in the technology sphere, and changes in regulations of developing concepts like AI, which may have resulted in missing other quality papers that should have been included in this SLR.

The integration of AI with mobile learning is still in the early stages of interest, and most studies were conducted in international countries such as China and Malaysia, with Egypt and Morocco being the only countries representing the African continent. More research is required to determine the effectiveness of AI-powered mobile learning in an African educational setting. Similarly, an opportunity exists for future research to include more members of the academic society, such as educators, faculty members, senior executives and policymakers, who can influence the implementation of AI-powered mobile learning in educational settings. So, it is also significant for future research to explore additional areas of scholar's concern, such as challenges encountered by end-users when using AI-powered mobile learning and how AI can enhance the performance of mobile devices and other compatible technologies.

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