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REVIEW

Comparative analysis of mobile learning in various countries: Literature study on five continents

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Abstract: Mobile learning (m-learning) has emerged as essential in reshaping global education by increasing accessibility, engagement, and readiness for the digital era. This study examines the implementation and impact of m-learning in various contexts, including Indonesia, the United States, Finland, Australia, and Africa. Findings show that m-learning initiatives have successfully reduced geographic and infrastructure barriers, particularly in remote and underserved areas. In Indonesia, m-learning has significantly improved educational access and digital literacy among students and educators. Likewise, m-learning has fostered personalised learning experiences and interactive educational environments in the United States and Finland, enriching student engagement and learning outcomes. Australia has leveraged M-learning to achieve educational equity by reaching remote communities, while in Africa, m-learning has driven innovative educational solutions despite challenges such as uneven technological infrastructure. However, there are still challenges to be faced, such as ensuring fair internet access and developing locally relevant educational content. This research underscores the need for strategic policy development and continued investment in technological infrastructure to maximise the potential of m-learning in promoting inclusive and quality education globally.

Keywords: mobile learning, Indonesia, United States, Finland, Australia, Africa

1 Introduction

Mobile learning has emerged as a transformative educational approach, fundamentally changing how students access information and educational resources (Papadakis & Kalogiannakis, 2019). This innovative paradigm takes advantage of the availability and integration of mobile devices such as smartphones, tablets and laptops in everyday life, making the learning experience more flexible and accessible than ever before (Fadli et al., 2024). By leveraging mobile technology, educators can deliver content that can not only be accessed at any time and from any location but also tailored to meet the diverse needs of each learner (Louka & Papadakis, 2023). This flexibility allows for a more personalised learning experience, where students can engage with educational material at their own pace and in an environment that suits their learning style (Papadakis, 2020; Xezonaki, 2022). Additionally, mobile learning facilitates the incorporation of multimedia elements, interactive applications, and real-time communication tools, which can significantly increase engagement and retention of information (Eliza et al., 2023). Therefore, m-learning is particularly beneficial in reaching underserved or remote communities, providing educational opportunities for those facing significant barriers to traditional classroom-based education. This transformation covers formal education and includes professional development, lifelong learning, and informal education, making it a versatile tool in modern education (Lampropoulos, 2023). The rise of mobile learning reflects a broader societal shift towards digitalisation and connectivity, highlighting technology's potential to bridge education gaps and promote more equitable access to knowledge.

Mobile learning offers many advantages, making it an attractive educational approach in the digital era. One of the most significant benefits is its unmatched flexibility, allowing students to access educational content anytime and anywhere, breaking the traditional classroom-based learning boundaries. This flexibility supports a variety of learning styles and speeds, allowing students to engage with the material when they are most focused and ready to learn (Hakiki et al., 2023). Additionally, mobile learning promotes personalised education, which can be customised

to meet individual needs and preferences through adaptive learning technology and customised learning paths (Kalogiannakis & Papadakis, 2023). Integrating multimedia elements—such as videos, interactive simulations, and gamified learning modules—increases engagement and retention by making learning more interactive and fun (Novaliendry et al., 2023).

Additionally, mobile learning encourages greater collaboration and communication between students and teachers through real-time messaging, forums, and collaborative projects, regardless of geographic barriers (Nazar et al., 2022). It also supports continuous learning and professional development by providing direct access to courses and training materials, which is especially beneficial for working professionals who want to improve their skills without disrupting their careers (Papadakis & Kalogiannakis, 2020). Additionally, mobile learning can be crucial in bridging educational gaps in underserved and remote areas, offering access to quality educational resources where traditional infrastructure may be lacking (Chatzopoulos et al., 2023). Another advantage of mobile learning is cost-effectiveness, as it reduces the need for physical materials and classroom space, making education more affordable and scalable (Razak et al., 2019). Lastly, tracking and analysing learning progress via mobile platforms provides educators valuable insight into student performance, enabling timely intervention and support to improve learning outcomes (Lavidas et al., 2023). Overall, mobile learning represents a dynamic and inclusive approach to education, harnessing the power of technology to create more engaging, accessible and compelling learning experiences.

Previous research has strengthened the advantages of mobile learning in various countries. Studies in Indonesia show that mobile learning can increase educational accessibility in remote areas, helping students who previously found it challenging to reach conventional educational facilities (Darmaji et al., 2019; Fitriyana et al., 2020). In Finland, research shows that mobile learning increases student engagement through interactive and multimedia applications that facilitate active learning (Lumor et al., 2020; Samarina et al., 2022; Zainudin et al., 2019). In the United States, various studies have highlighted the effectiveness of mobile learning in supporting independent learning and personalised education, with results showing increased academic achievement and student satisfaction (Alturki & Aldraiweesh, 2022; Du, 2022; Odabasi et al., 2019). In Australia, mobile learning has been used to support education in remote communities, positively improving literacy and digital skills (Burden & Naylor, 2020; Kaliisa et al., 2019; Nursey-Bray, 2019). Research in several countries in Africa also shows that mobile learning can overcome the problem of limited educational infrastructure, providing access to quality educational resources in underserved areas (Kaliisa & Picard, 2019; Kelebeng et al., 2020; Kizilcec et al., 2021). Although many studies highlight the advantages and potential of mobile learning, there needs to be more cross-country comparative studies that holistically analyse the factors that influence the successful implementation of mobile learning in various contexts. This gap shows the need for in-depth comparative studies to understand how social, economic, and cultural factors influence the effectiveness of mobile learning in various regions.

This research proposes a comprehensive comparative analysis of mobile learning on five continents. The results will provide a holistic understanding of how mobile learning is implemented and experienced in various regions. The results will contribute to the global discourse on mobile learning by providing insights that can help bridge the gap between theory and practice, ultimately improving the quality and accessibility of education worldwide. The research questions are: What are the critical challenges faced in implementing mobile learning across regions, and how can these challenges be overcome?

2 Methods

This research uses a Systematic Review method to explore and analyse the implementation and effectiveness of mobile learning in Indonesia, Finland, the United States, Australia, and Africa as samples from five different continents. The literature study method was chosen because it allows researchers to collect and analyse data from various existing sources, providing a comprehensive and in-depth perspective on the topic under study. Desk studies also enable the identification of trends, challenges, and best practices revealed by previous research and save time and costs compared to direct field research. The Scopus database was chosen as the primary data source to ensure that the sources used in this research are high quality and relevant. Scopus is one of the largest and most trusted databases covering various scientific journals, conferences, and books from various scientific disciplines. The use of Scopus guarantees that the literature accessed has a high-quality standard and has gone through a peer-review process so that the validity and reliability of the data used in this research is guaranteed. The research procedures used include several main stages, namely data collection, literature analysis, summary, and synthesis. The

research procedure to be carried out can be seen in Figure 1.

Figure 1 Research procedure

2.1 Data collection

This research collected data by searching relevant articles, journals, and reports from the Scopus database. Scopus was chosen because of its reputation as one of the largest and most trusted databases covering various scientific journals, conferences, and books from various scientific disciplines. Searches were conducted using keywords such as "mobile learning", "Indonesia", "Finland", "United States", "Australia", and "South Africa" to ensure that the data collected included all countries that were the focus of the research. The search results are then filtered to ensure relevance and quality, only including literature that has gone through a peer-review process to maintain the validity and reliability of the research. The search criteria and strategies used are presented in Table 1.

Table 1 Search criteria and strategies

No.	Criteria	Detail
1	Database	Scopus
2	Publication Date	Only articles published between 2020 and 2024.
3	Language	English
4	Keyword Identification	Keywords include "mobile learning," "mobile education," "m-learning," and "digital learning."
5	Screening	Research conducted with Target countries ("Indonesia", "Finland", "United States", "Australia", and "South Africa") were used.

2.2 Literature analysis

After the data is collected, the next stage is literature analysis. At this stage, every article, journal, and report is reviewed in depth to identify essential findings, methods used, and conclusions from previous authors. This analysis aims to understand how mobile learning is implemented in each country, what challenges are faced, and what results are achieved. Any relevant findings are recorded and organised by key themes such as accessibility, student engagement, learning outcomes, and technology infrastructure.

2.3 Summary

The summary stage involves summarising the results of the literature analysis in a more structured format. At this stage, the main findings from each source are organised and summarised to provide a clear and comprehensive picture of the implementation and impact of mobile learning in various countries. This summary includes the main points of each study and groups the information by theme and country to make comparisons easier.

2.4 Synthesis

The final stage of the research procedure is synthesis, where all findings from the literature analysis are integrated to provide a holistic and comparative picture. At this stage, the summarised data is analysed critically to identify patterns, trends and differences that emerge from implementing mobile learning in various countries. This synthesis also identifies existing research gaps and proposes recommendations for further research. By integrating all these findings, this research can make a meaningful contribution to the global understanding of mobile learning and how various social, economic, and cultural factors influence its effectiveness in various contexts.

3 Results

3.1 Indonesia

Research on mobile learning in Indonesia (Kusumastuti et al., 2021; Oliver et al., 2023; Sidik & Syafar, 2020) shows that this technology has played an essential role in expanding access to

education, especially in remote areas and isolated. Mobile learning programs have succeeded in overcoming geographic barriers and limited infrastructure by providing access to educational materials that were previously difficult to reach. This is crucial, considering that Indonesia has many islands and inland areas that are difficult for conventional educational facilities to reach. Mobile learning has also helped increase digital literacy among students and teachers, preparing them to face the challenges of today's digital era. However, challenges still being faced include the availability of equitable internet access throughout the region, the development of content relevant to local needs and the national curriculum, and sufficient funding to ensure the long-term sustainability of these programs.

On the other hand, the implementation of mobile learning in Indonesia also shows variations in approach and success depending on each local context. For example, some successful initiatives focus on training teachers to use new technologies and developing curricula that integrate mobile learning well. However, challenges are related to varying levels of digital literacy among students and teachers and the expansion of sufficient technological infrastructure to support the widespread use of mobile learning. In this context, developing supportive policies, investing in technological infrastructure, and providing ongoing training for educators is crucial to optimising the benefits of mobile learning in Indonesia.

3.2 America

Mobile learning in the United States has experienced rapid development and has become an integral part of the education system at various levels, from elementary to higher education. Previous studies (Bothe et al., 2022; Kuo et al., 2023; Zhang et al., 2021) show that using mobile devices, online learning applications, and other educational platforms has opened the door to more inclusive education and technology-oriented. The flexibility of time and place offered by mobile learning allows students to access educational resources whenever and wherever they are, supporting independent learning and personalisation of education. Mobile learning has also opened access to students with special needs or those in remote areas who previously might have needed help accessing conventional education.

Mobile learning has expanded traditional teaching methods at the high school and college levels by integrating more interactive and collaborative technology. For example, using apps to facilitate class discussions, collaborative projects, and app-based exams has increased student engagement and facilitated deeper learning. However, despite the many advantages, challenges include secure data management and privacy, practical learning in distance learning settings, and ensuring all students have equal access to necessary technology.

3.3 Finland

With an internationally recognised education system, Finland has successfully integrated mobile learning to enrich students' learning experience. Research that has been conducted (Lumor et al., 2020; Samarina et al., 2022; Zainudin et al., 2019) shows that mobile learning has positively contributed to student engagement and learning outcomes. The application of this technology not only increases accessibility to educational materials but also stimulates students' interest in learning through multimedia and interactive applications. The student-centred approach to teaching has been strengthened by mobile learning, allowing students to learn in a style that suits their learning preferences and rhythm.

In Finland, mobile learning is also used to support cooperation and collaboration between students and teachers. For example, using online platforms for discussions, group projects, and game-based learning has increased social interaction and student engagement in the learning process. However, the challenges faced include ensuring that the implementation of mobile learning does not just add new technology but also truly integrates Finnish educational values of student-centeredness and meaningful learning. The development of relevant educational content, ongoing training of educators, and continuous evaluation of the effectiveness of these new methods are crucial to optimising the potential of mobile learning in Finland.

3.4 Australia

Australia uses mobile learning to support education in regional and remote areas where access to conventional education facilities may be limited. Research conducted (Burden & Naylor, 2020; Trede et al., 2019; Zhang et al., 2019) shows that mobile learning has helped increase equal access to education for all students, regardless of their geographic location. These programs often focus on improving students' digital literacy and technology skills while harnessing the full potential of using technology for interactive and engaged learning. Mobile learning in Australia has also been

used to provide education tailored to student's specific needs and individual preferences, enabling a more personalised educational approach and responsiveness to each student's needs.

The implementation of mobile learning in Australia has also shown a positive impact in preparing students for an increasingly digital future. By leveraging online platforms, educational apps and other digital resources, education in Australia has moved towards a more flexible and relevant learning model. However, challenges that need to be overcome include addressing disparities in technology access among specific communities and ensuring that all schools and students have adequate infrastructure and resources to support the effective implementation of mobile learning. In this context, collaboration between government, schools, and the technology industry is critical to ensuring that mobile learning can benefit education in Australia.

3.5 South Africa

Studies in several South Africa (Joubert et al., 2020; Kaliisa & Picard, 2019; Kizilcec & Chen, 2020) highlight the critical role of mobile learning in improving the accessibility and quality of education in areas underserved by infrastructure. Mobile learning implementation in Africa often focuses on creating innovative and affordable educational solutions, using mobile platforms to provide educational content relevant to local needs. This approach has helped overcome geographic barriers and limited infrastructure, enabling more comprehensive access to education for previously difficult-to-reach communities with conventional education.

However, challenges faced in implementing mobile learning in Africa include uneven technological infrastructure and limited internet accessibility in some regions. While technology adoption is growing, sustainable strategies are also needed to support mobile learning across the continent. Targeted training for educators, development of educational content relevant to local contexts, and collaboration with the private sector to improve technology infrastructure are crucial to expanding the impact of mobile learning in Africa.

4 Discussion

Findings from mobile learning research in Indonesia, the United States, Finland, Australia, and Africa highlight significant progress and challenges in technology integration in education. In Indonesia, mobile learning has succeeded in increasing access to education in remote and underserved areas, overcoming geographic barriers and infrastructure limitations. For instance, initiatives such as the "Rumah Belajar" platform have allowed students in remote villages to access educational content through their mobile devices. Despite these successes, issues such as uneven internet access and the need for locally relevant content persist. Many rural areas still need more reliable internet connectivity, and the educational content often fails to address local cultural and linguistic contexts, making it less effective. Future efforts should focus on enhancing internet infrastructure and developing culturally and linguistically appropriate content for diverse student populations.

Mobile learning has become an integral part of the education system in the United States, offering flexibility and inclusivity at various levels. The widespread use of Learning Management Systems (LMS) like Canvas and Blackboard has facilitated personalised learning experiences and increased student engagement. However, concerns over data privacy and equitable access to technology remain significant challenges. For example, during the COVID-19 pandemic, disparities in access to devices and internet connectivity became starkly apparent, affecting students from low-income families disproportionately. Addressing these issues requires robust policies to ensure all students have access to necessary technological resources and personal data protection.

Research in Finland (Samarina et al., 2022) emphasises the role of mobile learning in promoting student-centred approaches and collaborative learning environments. Finnish schools have integrated multimedia and interactive applications such as "Seppo" and "Kahoot!" into their curricula, stimulating student interest and facilitating deeper engagement. These tools have been particularly effective in subjects like science and mathematics, where interactive simulations can enhance understanding of complex concepts. However, the success of these tools also depends on continuous professional development so that teachers can integrate technology into their pedagogy effectively. Likewise, Australia has leveraged mobile learning to deliver quality education to remote areas, overcoming barriers caused by geographic isolation (Zhang et al., 2019). Programs like "School of the Air" have used mobile technology to connect students in the Outback with teachers and peers, significantly improving literacy and digital skills. This initiative highlights the broader global trend towards digital inclusion and educational equity. Nonetheless, sustaining

these efforts requires ongoing investment in technology and teacher training to ensure educators can effectively utilise mobile learning tools.

Meanwhile, in Africa (Kaliisa & Picard, 2019), innovative educational solutions have been driven by overcoming infrastructure limitations and providing customised educational content for diverse communities. Initiatives like "Moodle" and "Ubongo" have provided educational resources where traditional infrastructure is lacking. These findings underscore the importance of customised content and infrastructure development to support sustainable educational initiatives. For example, localised content reflecting African students' cultural and linguistic diversity has been crucial in engaging learners and improving educational outcomes. However, the success of these initiatives also hinges on collaboration between governments, NGOs, and private sector partners to build and maintain the necessary infrastructure.

These findings underscore the transformative potential of mobile learning in democratising education and adapting pedagogical practices to the digital era. By leveraging mobile technology, educational institutions can address long-standing challenges of accessibility and equity, ensuring that all students can engage with high-quality educational resources regardless of their geographic location or socioeconomic background. The adoption of mobile learning improves educational outcomes and prepares students for an increasingly digital global economy, equipping them with essential digital literacy skills and fostering lifelong learning habits.

However, these findings also emphasise the need for a comprehensive policy framework and continued investment in infrastructure and teacher training to maximise the benefits of mobile learning on a broader scale. For example, national education policies should prioritise equitable access to technology and developing culturally relevant content. Additionally, continuous professional development for teachers is essential to ensure the effective integration of mobile learning tools into classroom practice.

Future research should investigate the effectiveness of different mobile learning strategies across diverse socioeconomic contexts. For instance, comparative studies examining rural versus urban implementations could provide valuable insights into context-specific challenges and best practices. Additionally, research should explore the policy implications and institutional strategies that encourage the continued integration of mobile learning into national education systems. Understanding how different countries develop and implement mobile learning policies can inform global efforts to enhance educational equity and quality.

Future studies can address these areas and contribute to a more nuanced understanding of mobile learning and its role in transforming education worldwide.

5 Conclusion

This study underscores the transformative impact of mobile learning on global education, seen in its ability to expand accessibility, increase student engagement, and equip students to meet the challenges of the digital age. In Indonesia, mobile learning initiatives have successfully bridged geographic gaps and increased access to education in remote and underserved areas. Likewise, in the United States and Finland, the integration of mobile technology has increased learning flexibility and student engagement through interactive platforms and personalised learning experiences. Australia has leveraged mobile learning to deliver quality education to remote areas, overcoming barriers caused by geographic isolation. Mobile learning has driven innovative educational solutions in Africa, overcoming infrastructure limitations and providing customised educational content for diverse communities. Despite these advances, ongoing challenges such as unequal internet access and adaptation of relevant local content remain essential. This research provides invaluable insights for shaping future education policies and strategies globally, emphasising the importance of leveraging mobile technology to increase educational equity, improve learning outcomes, and encourage inclusive education practices worldwide.

Conflicts of interest

The authors declare that they have no conflict of interest.

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