REVISITING THE USE OF MOBILE DEVICES FOR ONLINE LEARNING: ENHANCING ACCESSIBILITY IN HIGHER EDUCATION IN MOZAMBIQUE

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ABSTRACT

The integration of mobile devices into online learning has emerged as a critical strategy for expanding pedagogical practices and enhancing access to higher education, particularly in remote and underserved contexts such as Mozambique. This study aims to examine how mobile devices contribute to widening access to higher education, focusing on the case of Universidade Aberta ISCED. The methodology adopted was a case study, with an exploratory-descriptive orientation and qualitative approach, supported by document analysis, semi-structured interviews and questionnaires to capture diverse stakeholder perspectives. The findings demonstrate that mobile devices enable flexible and inclusive learning trajectories, allowing students to balance academic, professional, and personal responsibilities. They also show that mobile learning aligns well with Mozambique's socioeconomic context, offering cost-effective opportunities for participation in online higher education. However, significant barriers were identified, including gaps in technological infrastructure, limited digital literacy, and insufficient institutional strategies for large-scale implementation. The study concludes that mobile devices are a viable tool for improving equity in higher education but that their effective integration requires coordinated efforts in policy, training, and infrastructure development. These results provide practical insights for higher education institutions and policymakers in Mozambique and other developing countries, supporting the design of scalable and sustainable digital learning ecosystems.

KEY WORDS

distance learning; higher education; accessibility; mobile devices; digital inclusion; Mozambique.

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REVISITANDO O USO DE DISPOSITIVOS MÓVEIS PARA A APRENDIZAGEM ONLINE: REFORÇANDO A ACESSIBILIDADE NO ENSINO SUPERIOR EM MOÇAMBIQUE

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RESUMO

A integração de dispositivos móveis no ensino *online* tem-se afirmado como uma estratégia crucial para expandir as práticas pedagógicas e ampliar o acesso ao ensino superior, particularmente em contextos remotos e desfavorecidos, como o de Moçambique. Este estudo tem como objetivo examinar de que forma os dispositivos móveis contribuem para a democratização do acesso ao ensino superior, tomando como caso de análise a Universidade Aberta ISCED. A metodologia adotada foi o estudo de caso, com orientação exploratório-descritiva e abordagem qualitativa, sustentada por análise documental, entrevistas semiestruturadas e questionários, de modo a captar diferentes perspetivas dos intervenientes. Os resultados demonstram que os dispositivos móveis possibilitam trajetórias de aprendizagem flexíveis e inclusivas, permitindo que os estudantes conciliem responsabilidades académicas, profissionais e pessoais. Revelam também que a aprendizagem móvel se adequa ao contexto socioeconómico de Moçambique, oferecendo oportunidades de participação no ensino superior *online* a custos mais reduzidos. Contudo, foram identificadas barreiras significativas, incluindo lacunas na infraestrutura tecnológica, limitações na literacia digital e insuficiência de estratégias institucionais para uma implementação em larga escala. O estudo conclui que os dispositivos móveis são uma ferramenta viável para promover a equidade no ensino superior, mas a sua integração eficaz requer esforços coordenados em termos de políticas públicas, formação e desenvolvimento de infraestrutura. Estes resultados oferecem contributos práticos para instituições de ensino superior e decisores políticos em Moçambique e noutros países em desenvolvimento, apoiando o desenho de ecossistemas digitais de aprendizagem escaláveis e sustentáveis.

PALAVRAS-CHAVE

ensino a distância; ensino superior; acessibilidade; dispositivos móveis; inclusão digital; Moçambique.

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REVISITAR EL USO DE DISPOSITIVOS MÓVILES PARA EL APRENDIZAJE EN LÍNEA: MEJORANDO LA ACCESIBILIDAD EN LA EDUCACIÓN SUPERIOR EN MOZAMBIQUE

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RESUMEN

La integración de dispositivos móviles en la enseñanza en línea se ha consolidado como una estrategia crucial para expandir las prácticas pedagógicas y ampliar el acceso a la educación superior, particularmente en contextos remotos y desfavorecidos, como el de Mozambique. Este estudio tiene como objetivo examinar de qué manera los dispositivos móviles contribuyen a la democratización del acceso a la educación superior, tomando como caso de análisis la Universidade Aberta ISCED. La metodología adoptada fue el estudio de caso, con una orientación exploratoria-descriptiva y un enfoque cualitativo, sustentado en análisis documental, entrevistas semiestructuradas y cuestionarios, con el fin de captar diferentes perspectivas de los actores implicados. Los resultados demuestran que los dispositivos móviles posibilitan trayectorias de aprendizaje flexibles e inclusivas, permitiendo que los estudiantes concilien responsabilidades académicas, profesionales y personales. Asimismo, revelan que el aprendizaje móvil se ajusta al contexto socioeconómico de Mozambique, ofreciendo oportunidades de participación en la educación superior en línea a costes más reducidos. No obstante, se identificaron barreras significativas, entre ellas, carencias en la infraestructura tecnológica, limitaciones en la alfabetización digital e insuficiencia de estrategias institucionales para una implementación a gran escala. El estudio concluye que los dispositivos móviles son una herramienta viable para promover la equidad en la educación superior, pero su integración eficaz requiere esfuerzos coordinados en términos de políticas públicas, formación y desarrollo de infraestructura. Estos resultados ofrecen aportes prácticos para las instituciones de educación superior y los responsables de políticas en Mozambique y en otros países en desarrollo, apoyando el diseño de ecosistemas digitales de aprendizaje escalables y sostenibles.

PALABRAS CLAVE

educación a distancia; educación superior; accesibilidad; dispositivos móviles; inclusión digital; Mozambique.

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Revisiting the Use of Mobile Devices for Online Learning: Enhancing Accessibility in Higher Education in Mozambique

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INTRODUCTION

The global massification of higher education has intensified the demand for learning models that are both accessible and adaptable, a need particularly acute in contexts such as Mozambique, where conventional higher education infrastructure remains inadequate to absorb growing student populations (Ministry of Science, Technology and Higher Education - MCTES, 2023). Recent advances in artificial intelligence, big data analytics, and cloud computing have accelerated the shift from classroom-based instruction to digitally mediated modalities, including online and mobile learning. In parallel, governments and higher education institutions across the globe have increasingly embraced digital education agendas, framing them as strategic responses to the imperatives of lifelong learning and the creation of flexible, resilient educational systems (Zhang & Saadat, 2025). Trow (2007) pointed out that higher education systems in developing countries face persistent challenges in accommodating the rapid growth of student enrolments, largely constrained by limited financial resources and inadequate infrastructure. And this has not changed much in recent years. The concentration of most higher education institutions in urban centres further reinforces spatial inequalities, disproportionately disadvantaging students from rural and less developed regions. According to UNESCO (2023), rural populations in Sub-Saharan Africa face significant barriers to higher education, including economic limitations and inadequate infrastructure. A considerable number of students face persistent difficulties in reconciling academic demands with employment and family responsibilities, which makes compliance with rigid classroom-based schedules particularly challenging. Although traditional distance education offers a degree of flexibility, it has often been characterised by limited learner engagement, reduced opportunities for synchronous interaction with instructors, and difficulties in monitoring and assessing learning progress. These limitations undermine its effectiveness in higher education and highlight the urgent need for more adaptive, technology-enabled learning models (Shi, 2022).

The use of mobile devices in learning presents a viable solution to these accessibility challenges, particularly within distance education models. While mobile learning refers to a structured pedagogical approach that leverages mobile technologies for instructional purposes (Zhang & Saadat, 2025), the integration of mobile devices in learning specifically implies that students and teachers engage with mobile technology as part of the learning process (Hwang et al., 2019). Furthermore, the use of mobile devices in education is a natural progression that can expand the reach of higher education, particularly in contexts where traditional classroom-based instruction is impractical (Alyoussef, 2021). The portability, accessibility, and personalised nature of

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mobile devices allow students to engage with educational content beyond conventional classroom settings, fostering self-directed learning and interactive experiences (Alizadeh, 2024; Lima, 2016).

The widespread availability of mobile devices and internet access has revolutionised educational delivery (Attah et al., 2025; Carvalho, 2015). The evolution of distance education, particularly through the use of mobile devices, has introduced new paradigms in teaching and learning. Unlike traditional education, which is confined to fixed schedules and physical spaces, the use of mobile devices in distance learning enables students to engage with content across multiple learning contexts: formal, non-formal, and informal through various digital tools and interactive resources. This adaptability is particularly relevant for distance education students, as it enables them to balance academic pursuits with professional and personal responsibilities (Alyoussef, 2021; Serhan, 2020).

The skills demanded from students, educators, and faculty for effective engagement with mobile learning environments, such as information management, critical use of digital tools, and online collaboration (Bajamal et al., 2023; Garzón et al., 2023), are equally vital for participation in the broader digital economy and society of the 21st century. Gómez-García et al. (2020) conducted a study showing that integrating mobile devices in education improves student learning outcomes and critical thinking skills. Similarly, Dias and Victor (2017) found that both teachers and students are optimistic about the use of mobile devices in learning, reporting enhancements in motivation, communication, collaboration, and research skills. Additionally, Dahri et al. (2023) emphasised the importance of training teachers in mobile technologies for learning to ensure effective integration and long-term sustainability. Being able to access learning materials anytime and anywhere aligns with the needs of working professionals, adult learners, and students in remote areas, offering a viable alternative to conventional higher education models. Additionally, Tsai et al. (2011) highlight that the use of mobile devices in learning fosters personalised learning experiences, allowing students to engage with content based on their individual needs and learning styles.

Mozambique, like many other countries, has sought to leverage digital transformation in education to expand higher education access through distance learning initiatives (INED, 2023). Institutions such as Universidade Aberta ISCED (UnISCED) have incorporated the use mobile devices in the development of digital learning strategies, including providing tablets and laptops to students upon enrolment. These devices serve as both a communication tool and a digital learning resource, supporting students throughout their academic journey, usually within a larger blended learning context (Flam et al., 2024). However, despite many initiatives, there remains a significant gap in research and policy regarding the effective integration and utilisation of mobile devices in learning within Mozambique's higher education system. So, this study aims to examine the use of mobile devices in the context of digital learning, focusing on the strategies set out at UnISCED, seeking to offer practical recommendations for improving the use of mobile devices and the accessibility strategies in Mozambique's higher education sector.

The main research question guiding this study is: How can the use of mobile devices enhance learning accessibility in the context of Mozambique's higher education? The primary objective was to assess how mobile devices contribute to improving accessibility within a digital learning strategy. In this study we did not attempt to gather quantitative evidence of the impact of mobile learning in student performance as this would be a follow-up study.

Regarding the structure, this article is divided into five sections: (i) Introduction; (ii) Literature Review; (iii) Methodology; (iv) Results and Discussion; and (v) Conclusion and Recommendations.

LITERATURE REVIEW

DISTANCE EDUCATION IN AFRICA

Distance Education (DE) has emerged as a critical mechanism for expanding access to higher education, particularly in developed economies such as the United States, Japan, and the United Kingdom. However, DE has also gained significant traction in developing economies, particularly in African countries, where it is being increasingly recognized as a strategic tool to overcome structural barriers to education and promote lifelong learning. By addressing persistent challenges such as geographical disparities, limited institutional capacity, and infrastructural constraints, DE has the potential to transform educational landscapes across the continent (Smith, 2023).

The growing demand for tertiary education in sub-Saharan Africa and beyond, coupled with resource limitations in traditional in-person models, has required the adoption of alternative educational delivery systems. Governments and higher education institutions are turning to DE models to bridge access gaps and expand learning opportunities, particularly for marginalized and underserved populations. Various studies, including Allen and Seaman (2016), Seaman et al. (2018) and Makworo (2020), have explored DE from multiple perspectives, with research consistently highlighting its role as a fundamental driver of educational democratization and socio-economic development.

Furthermore, many African nations have reformed their education policies to expand participation in higher education through open, online, and distance education models (Makoe, 2018). These technology-enhanced learning environments are increasingly recognized as viable, scalable, and cost-effective solutions to widening educational access. Findings from policy analyses in developing countries highlight the integration of digital technologies into DE frameworks as critical drivers for higher education accessibility and inclusion (Makoe, 2018; Smith, 2023; UNESCO, 2013, 2016).

Although DE is not a new phenomenon in Africa, its evolution has been heavily influenced by technological advancements, shifting policy landscapes, and socio-economic imperatives. The COVID-19 pandemic further underscored the importance of distance learning as a resilient and adaptive mode of instruction. As schools and universities worldwide suspended in-person learning, institutions that had already developed robust DE infrastructures were able to sustain educational continuity (Aljawarneh, 2020). This unprecedented global shift towards remote learning served as a catalyst for policy transformation, with governments and educational institutions accelerating investments in online and blended learning models.

Projections indicate that the global online education market will experience exponential growth, reaching USD 350 billion by 2025, a substantial increase from USD 18.66 billion in 2019 (Li & Lalani, 2020). While these advancements signal greater investment and recognition of DE as a transformative learning model, persistent barriers to Information and Communication Technologies (ICTs) continue to hinder its full potential, particularly in developing regions such Africa countries (Franco, 2021), significantly constrained by persistent digital infrastructure deficits, high internet costs, and widespread digital literacy challenges. Furthermore, despite the growing recognition of online learning as a viable alternative to traditional education, enrolment in distance

education programmes across the continent remains relatively low, averaging at just 7% of eligible learners (Smith, 2023).

In addition, DE has emerged as one of the few viable pathways for adult learners and working professionals seeking to balance education with employment and other commitments. This is particularly relevant in rural and underserved areas, where traditional higher education institutions are scarce or entirely absent. In response to these challenges, Mozambique's higher education system has undergone significant reforms and digital expansion since the 1990s, with increasing government investment in digital learning initiatives (Ministry of Science, Technology and Higher Education - MCTES, 2023). However, despite these advancements, critical challenges persist, particularly in internet accessibility, ICT literacy, and digital infrastructure, disproportionately affecting rural populations (Ministry of Transport and Communication - MTC, 2024). Recognizing these challenges, several initiatives are underway to enhance digital inclusion. The Mozambique Digital Acceleration Project, launched by the World Bank (2022), aims to expand mobile broadband access to over 2 million people in rural areas, deploy free public Wi-Fi networks, and introduce affordability programs to make smartphones and mobile services more accessible to marginalized communities.

Despite these advancements, financial barriers and socioeconomic disparities persist, continuing to limit equitable access to quality education and reinforcing structural inequalities within Mozambique's higher education system (Bonde & Matavel, 2022). The Strategic Plan for Education 2020-2029 (INED, 2020) further underscores the critical role of technology-enhanced learning as a key driver in reducing educational inequalities and modernizing higher education delivery models. In essence, the growing demand for flexible education models reflects rapid socio-economic transformations and evolving labour market requirements, as more individuals seek to advance their qualifications to remain competitive in a knowledge-driven economy. Consequently, DE has transitioned from a marginal alternative to a strategic solution for overcoming higher education accessibility barriers. It is increasingly recognized for its efficiency and quality, particularly among adult learners and working professionals who require flexible study schedules (Franco, 2021).

Nevertheless, the primary challenge for DE in Mozambique and across Africa extends beyond technological access; it lies in the effective integration and pedagogical utilization of digital learning tools. For instance, while access to mobile technologies and online platforms has improved significantly, the pedagogical effectiveness of DE remains dependent on well-structured instructional design, faculty training, and robust student support systems (Franco & Bidarra, 2022). Addressing these factors is essential for ensuring that DE evolves into a sustainable, high-quality, and widely accepted educational model.

In this context, the use of mobile technologies in learning has emerged as a transformative force, not by redefining distance education, but by amplifying dimensions already intrinsic to it, most notably flexibility and learner autonomy. While flexibility has long constituted a cornerstone of distance education, mobile technologies intensify this attribute by enabling continuous access to educational resources across diverse temporal and spatial settings, thus facilitating their seamless integration into students' daily routines (Franco & Bidarra, 2022). This reinforcing effect is especially salient in Africa, where rising mobile penetration rates open unprecedented opportunities to mitigate structural barriers, bridge educational gaps, and extend participation to traditionally underserved populations.

The adoption of online distance learning in Sub-Saharan Africa has gained momentum, with Kenya and South Africa emerging as notable examples of successful implementation. In Kenya, the government has introduced several initiatives aimed at

enhancing digital education, notably through the e-Learning Project in Primary Schools. A study by Makworo (2020) highlights that this initiative has significantly expanded access to digital learning resources, equipping approximately 21,000 primary schools with internet connectivity and digital devices. Furthermore, the study underscores measurable improvements in learning outcomes, reinforcing the effectiveness of online distance learning in enhancing educational quality across the country.

In South Africa, the expansion of online distance learning has been largely driven by institutions such as the University of South Africa (UNISA). As one of the largest distance education providers globally, UNISA has played a pivotal role in promoting digital education in the region. A study by Leta and Cloete (2019, cited in Smith, 2023) highlights that UNISA's online learning model has been instrumental in widening access to higher education, particularly for economically disadvantaged students. Their research indicates a steady increase in online enrolments, with a 29% rise recorded between 2012 and 2017, reflecting a growing demand for flexible and accessible learning solutions.

Similarly, in Mozambique, the adoption of distance learning and the use of mobile devices is gaining traction, particularly within institutions such as ISCED, Institute of Distance Education (IED) and other higher education institutions which integrates tablets and laptops into its educational framework (Franco, 2021). These efforts align with broader regional trends emphasizing technology-driven learning to bridge accessibility gaps in higher education. However, despite promising advancements, successful implementation of DE in Mozambique and across Africa remains contingent upon several critical factors as mentioned before. These include multi-sectoral collaboration, institutional commitment, and sustained investment in technological infrastructure.

By drawing insights from global best practices and ensuring policy alignment with local socio-economic realities, Mozambique and across Africa can leverage DE as a transformative tool to democratize higher education and drive socio-economic progress. While moving forward, higher education institutions must prioritize enhancing the use of mobile devices in learning to maximize the impact of DE within Mozambique's higher education landscape. However, we agree with Veletsianos and Houlden (2024) suggesting that educational development, for example based on digital technology, is not intended to be a prescriptive process, rather it is an experimental process enabling the generation and enlargement of possibilities through practices of critical anticipation.

MOBILE DEVICES IN HIGHER EDUCATION

Higher education today faces a rapidly evolving landscape, presenting both challenges and opportunities for educational systems worldwide. Higher education institutions operate in a highly competitive environment, with challenges spanning local, national, and global levels (Garcia et al., 2022; Shumakova & Fibikh, 2020). In this context, distance education, augmented by technological advancements, has emerged as a critical enabler of greater accessibility and broader reach, playing an essential role in expanding educational opportunities for diverse populations. Coincidently, Knott (2022) asserts that mobile devices have the potential to enhance educational engagement across Africa, expanding learning opportunities and improving accessibility to education.

The widespread use of mobile technologies has introduced a new educational paradigm through the use of mobile devices in learning a decade ago. Some authors (Gómez-García et al., 2020; Sevillano-García & Vasquez-Cano, 2015) point out that mobile devices provide opportunities for innovation while challenging HEIs to rethink

traditional pedagogical models and integrate mobile technologies into their instructional frameworks. These devices empower learners to determine what, when, and how they learn, fostering self-directed learning and lifelong education (Moura & Carvalho, 2010). In recent years this trend continued and proved that the adoption of mobile devices has expanded the potential for learning, allowing individuals to continue their education across multiple contexts, including home, libraries, cyber cafés, and workplaces. Today this extends to AI applications for mobile learning (Moya & Camacho, 2024).

Applications, e-books, and online platforms provide flexible, self-paced opportunities that adapt to learners' preferences, while tools such as flashcards and simulators simplify complex content (Bajamal et al., 2023). At the same time, collaborative platforms like Google Docs and Microsoft Teams foster group work and peer interaction (Garzón et al., 2023). Mobile devices also enhance engagement by enabling real-time feedback and communication with instructors, which supports motivation, ownership of learning, and active exploration of knowledge (Attah & Anaba, 2025; Pedraja-Rejas et al., 2024; Rangel-de Lázaro & Duart, 2023).

Furthermore, Oluwatobi and Olurinola (2015) and Knott (2022) argue that mobile technologies serve as a critical solution to overcoming infrastructural limitations, offering a cost-effective alternative to conventional, resource-intensive educational models. Their research highlights that mobile device can act as a transformative tool, particularly for marginalized populations, by equipping learners with essential skills for socio-economic advancement. Moreover, given the relatively low cost and scalability of mobile technologies, they present a viable pathway for education reform in Africa, enabling greater inclusivity and accessibility. Similarly, Maingi et al. (2013) investigated the integration of mobile devices within higher education institutions in Kenya and concluded that their adoption could revolutionize instructional methodologies, fostering a significant paradigm shift that enhances learning outcomes, particularly in developing educational contexts.

Additionally, in Nigeria, the evolution of distance learning has transitioned from traditional correspondence-based methods to digital platforms that prioritize mobile-first learning environments (Salawu, 2013). This shift reflects broader efforts to modernize education and leverage mobile technologies to improve student engagement and accessibility. But this is just one part of the equation. Galatis and White (2013) highlight that while digital devices such as tablets enhance engagement and foster innovation, their effectiveness depends on integration into coherent pedagogical frameworks aligned with learner needs and institutional goals. When supported by well-structured strategies, mobile technologies broaden access to resources by providing immediate availability of textbooks, articles, multimedia, and interactive applications, thereby helping to reduce the digital divide and democratise education (Bajamal et al., 2023). They also promote learner autonomy through independent study and supplementary tools such as quizzes, forums, and digital content that enrich the learning process (Rangel-de Lázaro & Duart, 2023). Beyond individual use, mobile devices facilitate collaborative learning via platforms like Google Drive, Trello, and Slack, strengthening teamwork, problem-solving, and community building (Garzón et al., 2023; Pew Research Center, 2018). Research further links mobile learning to increased motivation and participation, as interactive tools foster autonomy, active engagement, and real-time communication with instructors (Pedraja-Rejas et al., 2024; Santas et al., 2025).

MOBILE DEVICES AND INTERNET CONNECTIVITY

The increasing adoption of mobile devices globally presents a significant opportunity for enhancing online distance education, particularly in emerging economies. Projections indicate that the global number of mobile users is expected to reach 7.49 billion by 2025 (Taylor, 2023), reflecting the growing reliance on mobile connectivity. In Sub-Saharan Africa, mobile phone penetration is projected to reach 50% of the population by 2025 (GSMA, 2021), highlighting the expanding role of mobile technologies in bridging educational gaps. Given the affordability and extensive functionality of mobile phones, policymakers are increasingly leveraging them as strategic tools to improve education accessibility.

Mozambique has experienced substantial growth in mobile device adoption, with mobile connections increasing to 18.91 million by early 2025, covering 55% of the population a notable rise from 16.72 million connections in early 2023, when mobile penetration stood at 50% (Cowling, 2024). However, despite this expansion in mobile connectivity, only 8% of the population has access to a computer (INE, 2023), underscoring the reliance on mobile devices as the primary digital access tool.

This rapid adoption of mobile technology presents an opportunity for mobile-based learning strategies to support higher education and distance learning, particularly in underserved and remote regions. However, persistent disparities in internet access, limited availability of digital resources, and insufficient faculty training continue to hinder the full-scale integration of mobile-based learning (Teixeira et al., 2022). As of 2021, only 43% of Africa's population had access to the internet, with just 24% of households connected to broadband services (ITU, 2021; World Bank, 2023). These statistics illustrate a stark digital divide, which significantly impacts equitable access to online learning, particularly in rural and low-income communities where infrastructure investments remain limited.

In Mozambique, while mobile connectivity has expanded, internet penetration remains relatively low, restricting the widespread use of mobile devices for educational purposes. As of early 2023, only 6.92 million individuals, 20.7% of the population, had access to the internet (DATAREPORTAL, 2024). This low internet penetration significantly restricts the full potential of mobile learning for a large proportion of the population, particularly those in rural areas who may rely heavily on mobile devices for educational access but lack consistent and affordable internet connectivity.

A demographic breakdown of internet users further reveals that 64% are over 50 years old, 19% are between the ages of 10 and 50, 8% are under 10 years old, and 8% fall into an unspecified age category (INE, 2023). These figures indicate that a significant proportion of mobile users primarily rely on voice and SMS services rather than internet-based applications, thereby limiting engagement with digital learning platforms.

Despite the overall low internet penetration rate, Mozambique exhibits significant regional disparities in access to digital technologies. Provinces with higher population densities such as Cabo Delgado, Niassa, Manica, Nampula, and Zambézia record lower internet usage rates, whereas less populated provinces, such as Maputo Province and Maputo City, exhibit higher connectivity levels, reinforcing a persistent digital divide.

According to the Ministry of Transport and Communications (MTC, 2024), approximately 73% of Mozambicans remain excluded from internet services, despite mobile network infrastructure covering nearly 80% of the national territory. This discrepancy between network availability and actual usage highlights a misalignment between telecommunication infrastructure deployment and digital adoption. Additionally, broadband internet costs remain prohibitively high, particularly for rural

populations, many of whom live on less than one dollar per day, making digital access and technological inclusion financially inaccessible (Lumbela, 2017). For many Mozambicans, particularly those in rural areas living on limited incomes, these high costs present a significant financial barrier to accessing online educational resources via mobile devices, despite the increasing availability of mobile networks.

Furthermore, urban-rural disparities in digital literacy and technological adoption persist. A 2019 study by Gillwald et al. found that 63% of urban mobile users engaged with mobile money platforms, whereas only 29% of rural users utilized digital financial services, reflecting broader challenges in digital literacy, financial inclusion, and mobile technology adoption. These barriers are particularly pronounced in sub-Saharan Africa, where higher education accessibility remains highly uneven, disproportionately affecting students in remote and underserved regions. In addition to the inadequate infrastructure, other issues must be considered such as limited teacher training, and suboptimal support, as hindering the full potential of technology to be applied effectively (Zhao et al., 2024).

MOBILE DEVICES AS A TOOL FOR LEARNING

The successful integration of mobile devices in learning requires a comprehensive approach that considers institutional context, pedagogical culture, and existing educational practices. The effectiveness of mobile learning is shaped not only by technological infrastructure (Khan & Abid, 2021) but also by the interactions between students, faculty, and institutions, as well as stakeholders' perceptions and engagement with digital learning environments. Quicios and Sevillano-García (2013) highlight that student autonomy and engagement are crucial factors when incorporating mobile devices into learning models, particularly in geographically dispersed learning communities.

Naveed et al. (2023) provide a comprehensive analysis of mobile-based learning in higher education through a systematic literature review of 161 articles published between 2016 and 2022. The study employs the TCCM (Theory, Context, Characteristics, Methods) framework to examine key aspects of mobile-based learning, including theories supporting its implementation, its adoption in developing and developed countries, and factors influencing its effectiveness.

Key findings highlight that behaviourism, constructivism, cognitivism, situated learning, problem-based learning, socio-cultural theory, and connectivism are among the most applied theories in mobile-based Learning studies. Additionally, 70.8% of the studies focused on developing countries, emphasizing the increasing role of mobile technologies in overcoming educational barriers. The research identifies 19 unique factors affecting mobile-based Learning adoption, including accessibility, digital literacy, ease of use, technological infrastructure, pedagogical integration, and institutional support. In this regard, Lima and Bidarra (2015) emphasize that effective mobile learning integration extends beyond the mere distribution of devices and requires a robust instructional design, faculty preparedness, and sustainable digital infrastructure to facilitate impactful and enduring learning experiences.

Dahri et al. (2023) investigate the adoption of mobile learning technologies in teacher training programs in Saudi Arabia and Pakistan, employing the Unified Theory of Acceptance and Use of Technology (UTAUT) framework to examine critical determinants of technology acceptance. The study evaluates key factors, including performance expectancy, effort expectancy, facilitating conditions, social influence, mobile self-

efficacy, and student self-efficacy, which collectively influence teachers' willingness to integrate mobile learning into pedagogical practices. A survey of 619 teachers demonstrated a positive correlation between these factors and mobile learning adoption, reinforcing the significance of structured training programs and mobile self-efficacy in fostering effective technology integration. Furthermore, the study underscores that developing 21st-century digital skills through mobile learning is instrumental in advancing sustainable education, contributing to greater accessibility, flexibility, and digital competence among educators.

Given that mobile devices are already ingrained in students' daily routines, they offer unparalleled flexibility, accessibility, and engagement in distance education models. When complemented by videoconferencing, video lectures, interactive chat systems, and collaborative platforms, mobile learning redefines the student experience, enabling real-time interaction with tutors and peers, thereby enhancing participation and fostering collaborative learning. But, despite these advancements, the use of mobile devices in learning continues to face structural and pedagogical limitations (Selwyn et al., 2025).

METHODOLOGY

This study employs an exploratory-descriptive approach to investigate the use of mobile devices for learning and the possibility of enhancing accessibility to higher education in Mozambique. Given the scope and relevance of the research theme, this qualitative methodology was chosen to provide insights into stakeholders' perceptions and experiences while analysing key factors influencing the adoption of mobile devices in higher distance education. The study is based on a case study involving Universidade Aberta ISCED (UnISCED) in Beira, Sofala province, serving as the primary research site.

UnISCED is a private higher education institution in Mozambique, established by Decree No. 27/2021 of May 6 (MCTES, 2023). Specialising in distance and open education, the university is accredited by the National Council for Quality Evaluation of Higher Education (CNAQ) and the National Institution of Distance Education (INED). UnISCED is committed to high-quality education, leveraging technology-driven methodologies to expand accessibility. Its academic programmes align with market demands, particularly in education science, agriculture, business management, and digital transformation. Currently, UnISCED has over 29,000 undergraduate and postgraduate students across five faculties: Engineering and Agriculture, Economics and Management, Social and Human Sciences, Education Science, Health Science, and Law.

A non-probabilistic convenience sampling approach was employed to select participants, ensuring that the study engaged individuals directly involved in distance learning and the use of mobile devices for education. The target population comprised UnISCED students (1st to 3rd-year undergraduate students) and academic staff, including internal tutors (course/subject designers) responsible for structuring UnISCED's digital learning platforms (Moodle), to address the pedagogical integration of mobile devices in learning. These tutors were also consulted through semi-structured interviews.

A qualitative-method data collection strategy was implemented, incorporating bibliographic research, documentary analysis, structured questionnaires, and semi-structured interviews. Documentary analysis was conducted using institutional announcements, activity reports, disclosure materials, and educational websites to further contextualise the study and examine existing learning policies and implementation strategies for the use of mobile devices.

Primary data collection was scheduled from 2020 to 2022, structured questionnaires were administered to 53 participants, including 44 undergraduate students from the Information Systems Management Degree programme and 9 tutors from five different faculties. In addition, semi-structured interviews were conducted with course designers (tutors) to gain insights into how mobile devices are integrated into course planning, instructional design, and institutional strategy. These interviews allowed for a deeper exploration of barriers and facilitators to the use of mobile devices in learning from an institutional perspective. The questionnaire design was informed by insights from the literature review and existing validated instruments used in previous studies on mobile devices in education. Specifically, it incorporated methodologies and measurement frameworks used by Pinto et al. (2020), who assessed mobile information literacy attitudes; Sharma et al. (2016), who formulated a mobile learning acceptance measure; Aznar-Díaz and Romero-Rodríguez (2021), who examined best practices in mobile learning within higher education; and Lin et al. (2016), who developed a scale for measuring mobile learning readiness. To ensure validity and reliability, the questionnaire underwent expert review and was pre-tested with a small sample of respondents before full deployment.

Questions were structured around key themes, including students' access to mobile devices and internet connectivity, perceptions of mobile devices as a tool for learning, challenges faced by students and tutors in using mobile devices for learning, institutional support mechanisms for mobile device integration, and faculty perspectives on pedagogical strategies for mobile-based learning. Data collection was carried out via Google Forms over a period of three weeks, with responses securely recorded and anonymised for ethical considerations. Interviews were conducted through Zoom and face-to-face meetings, recorded with participant consent, and transcribed for analysis.

A thematic content analysis approach was employed to examine participants' responses. Data were transcribed, coded, and categorised based on emerging themes related to the use of mobile devices in learning, accessibility to higher education, pedagogical planning, and institutional strategies. Responses were classified using an indicator-based referencing system, where A-x refers to student responses and B-x refers to tutor responses. The analysis aimed to identify recurring patterns, institutional challenges, and opportunities associated with the use of mobile devices in learning, comparing empirical findings with existing literature to derive insights into its effectiveness as an educational strategy in Mozambique. To enhance reliability, intercoder agreement checks were conducted, where multiple researchers reviewed and classified data independently before cross-verification. Discrepancies were resolved through consensus discussions, ensuring consistency in theme identification.

An empirical approach was employed to analyse the transcribed interviews, identifying the presence or absence of key characteristics and measuring the frequency of recurring fragments. Content analysis followed Bardin's (1977) three stages: pre-analysis, material exploration, and treatment of results. In the first stage, all collected material was reviewed and organised to establish indicators for interpretation. During exploration, interviews were segmented into recording units (words, phrases, paragraphs) and coded into thematic categories, including access and connectivity, pedagogical practices, student experience, and institutional readiness. This process allowed for the identification of both explicit meanings and latent messages (Fossá, 2003). In the final stage, results were synthesised to generate inferences and interpretations across interviews, documents, and observations. To ensure reliability, triangulation was applied through cross-validation of data from multiple sources, complemented by intercoder agreement checks. These strategies enhanced the credibility of findings.

Ethical approval was obtained from UnISCED prior to data collection. Participants were informed of the study's objectives, and consent was secured before survey and interview administration. Confidentiality and anonymity were maintained throughout the research process, and participation was voluntary, ensuring compliance with research ethics guidelines.

DISCUSSION OF RESULTS

From the start our initial perspective was confirmed. All respondents (100%) reported owning a mobile device with Internet access, confirming the feasibility of implementing mobile-based learning strategies. Additionally, an analysis of the UnISCED Tablet and Laptop Adherence Regulation reveals that UnISCED not only distributes but also maintains and repairs tablets and laptops for both students and tutors (UnISCED, 2022). However, while these figures suggest that students have access to mobile technology, they do not necessarily indicate effective engagement with mobile devices in learning or their direct impact on learning outcomes. Further knowledge would require a follow up study on the impact of mobile learning in student performance sustained by quantitative evidence.

Participants, aged between 20 and 45 years, were from diverse regions of Mozambique covering all country regions, including Mueda, Pemba, Ile, Memba, Alto Molocue, Massinga, Beira, Maputo, Lichinga, and Machanga, many of which lack traditional higher education institutions. This distribution highlights the geographical necessity of mobile devices in learning, as students rely on this model to access education without having to relocate. However, while mobile devices expand access, they do not eliminate structural barriers such as digital literacy gaps, internet and accessories costs, and limited instructional support, which may affect student success rates. As reflected in the following participant statements:

> The model is welcomed. It facilitates communication between students and education. However, improvements are needed in the devices provided by the institution (tablets) – these lack available accessories in the market in case of malfunction. (A-2)

To answer the research question "How can the use of mobile devices enhance learning accessibility in the context of Mozambique's higher education?" three key factors are identified: accessibility, flexibility, and institutional readiness. First, mobile devices in learning significantly improve geographical accessibility, as they enable students from remote areas to pursue higher education without needing to relocate, as illustrated from survey results and as reflected in the following participants statements:

> In my district, we do not have a university, so this is my only chance to obtain a degree. The tablet and online courses have given me access to higher education that I would not have otherwise. (A-3)

> Many young people who have difficulties accessing in-person or semi-in-person higher education are now studying through this model. However, extensive promotion of the model is needed to attract more students to higher education without borders. (B-2)

> Immediate access to public higher education at any time. (A-18)
>
> The UnISCED learning model has a great impact in Mozambique as it allows all Mozambican citizens, regardless of location, to access higher education. (A-22)

Second, flexibility in learning schedules makes it easier for working professionals and adult students to balance education with other responsibilities. As reflected in the following participants statements:

> Positive. It helps professionals achieve their dreams, as their work nature previously made it difficult to continue full-time studies, but now it is possible thanks to this UnISCED learning modality. (B-1)
>
> The impact is positive, given the conveniences offered by the model. Nowadays, I can study and work without necessarily being in a classroom. (A-5)
>
> It is positive since it helps many who want to pursue higher education but, for various reasons, are unable to attend in-person classes. (A-6)
>
> In recent years, UnISCED has seen increased demand, helping people who could not obtain a degree in their youth due to financial difficulties. Now, UnISCED is providing this opportunity, enabling people to balance work and studies, fulfilling many dreams and making Mozambique an intellectual nation. (A-10)
>
> I work full time, and without mobile-based learning, I would not be able to continue my education. I can study on my phone during breaks and access lectures whenever I have free time. (A-12)
>
> It is positive because it enables many professionals to realise their dream of obtaining a degree. Furthermore, it ensures students remain informed about all updates. A concrete example is how UnISCED continued with activities despite the COVID-19 pandemic. (A-29)

Finally, institutional readiness, including faculty training, instructional design, and digital resource availability, determines the effectiveness of mobile device integration in learning environments. Beyond providing devices, addressing the digital literacy skills of both students and faculty is crucial for effective mobile learning integration. Insufficient digital literacy can hinder the ability to navigate online platforms, utilize digital resources, and engage effectively in mobile-based learning activities. This is reflected in the following participants statements:

> The distance education model using tablets has helped and facilitated access to information (content and resources) so that students can access the platform from anywhere in the world without needing a computer. (A-5)
>
> Being mobile devices, it is easy to access content anytime and anywhere, making the learning process more dynamic and facilitating contact with tutors without needing to travel. (A-9)

> I think it is very good, although I have not received my tablet yet. However, I believe it is effective as it facilitates platform navigation, reading manuals, and deepening knowledge through online research. It is also useful for webinars with tutors as it allows participation from anywhere. (A-11)

The results from the participants perceptions as reflected in the above statements indicate that students increasingly value autonomy in their learning process, as mobile devices allow them to engage with educational content remotely, without the constraints of a physical classroom. This aligns with global trends in distance education, where working students and adult learners prefer flexible learning models that fit into their daily schedules. However, the lack of structured institutional support for mobile-based learning, particularly in pedagogical strategies and faculty engagement, may limit the long-term sustainability of mobile device integration in higher education.

In addition to student perceptions, faculty members (Respondents B) expressed strong support for the use of mobile devices in learning, emphasising their flexibility, interactivity, and efficiency in knowledge dissemination. Tutors noted that mobile devices facilitate real-time access to learning materials and interaction with students, as reflected in the following participant statements:

> The Education model using tablets that UnISCED is implementing is an effective and intuitive method, since content can be accessed anytime and anywhere. (B-4)

> They are simple and easy to use, making it easier to study and interact with digital materials. (B-7)

> It is very interesting as it helps students stay updated with course content and institutional news, keeping them aligned with their university. (B-9)

Students also confirmed these benefits. When asked about their experience using mobile devices for learning, several participants highlighted the ability to learn at their own pace and the flexibility to study around their work commitments:

> Facilitates access to content at any time. (A-2)

> I like that I can communicate with my tutors easily. If I have questions, I can send a message and get a response quickly. (A-9)

> Facilitates access to study materials, is efficient, and allows studying from any location using the same device. (A-40)

Moreover, respondents unanimously recognised the advantages of mobile devices over traditional classroom education. When asked about the benefits of mobile devices in learning, participants cited accessing learning materials, eliminating the need for physical textbooks, and enhanced interaction with faculty. Students also highlighted the ability to study at any time, making learning more flexible and adaptable to their professional and personal commitments.

However, while these factors support access, there is limited evidence in this study regarding the impact of mobile-based learning on actual learning outcomes or academic performance. A follow-up study will be needed for this purpose.

Despite its advantages, mobile-based learning in Mozambique remains a relatively recent phenomenon and is still evolving towards widespread acceptance and institutional integration. As highlighted in previous research such as Franco and Bidarra (2022), and Teixeira et al. (2022), successful adoption requires institutional culture shifts, faculty training, and investment in supportive technologies. The findings indicate that HEIs must continue improving digital literacy and refining instructional strategies to maximise the potential of mobile-based learning. However, without a comprehensive evaluation framework to assess learning effectiveness, the long-term benefits of mobile device integration in education remain uncertain.

Given that distance education is continuously evolving with advancements in ICTs, the use of mobile devices in learning represents a significant step towards modernising higher education. The ability to offer students flexible learning experiences, tailored to their geographical and personal circumstances, demonstrates its transformational impact. This study confirms the transformative impact of mobile devices in learning on higher education accessibility in Mozambique. Statements such as "Provides access to those who live in areas without in-person universities" (A-38) and "Positive, expanding education to all locations and communities" (A-42) reflect the crucial role that mobile-based learning can play in reaching underserved populations.

The results of this study confirm that UnISCED possesses a strong foundation for expanding higher education accessibility through the provision and effective use of mobile devices for learning. The findings underscore that the strategic distribution of mobile devices plays a pivotal role in enhancing access to education, particularly in remote and underserved areas, as evidenced by the participants answers and the diverse geographical distribution of them across different districts of Mozambique, demonstrating that mobile-based learning effectively reaches students in regions where traditional higher education infrastructure is limited or absent. This aligns with the study by Knott (2022), which asserts that mobile devices hold significant potential for expanding learning opportunities and improving educational accessibility across Africa. Furthermore, this is supported by the increasing penetration of mobile technologies. According to Cowling (2024), the number of mobile connections in Mozambique reached 18.91 million, covering 55% of the population.

The results also provide strong evidence that the use of mobile devices for learning offers flexibility for individuals who need to balance their studies with work commitments. This finding corroborates the studies of Sevillano-García and Vasquez-Cano (2015), Gómez-García et al. (2020), and Moura and Carvalho (2010), which highlight that the adoption of mobile devices has revolutionised the learning process by enabling individuals to continue their education across multiple contexts, including home, libraries, cyber cafés, and workplaces.

The portability and accessibility of mobile devices empower learners to control their learning journey, allowing them to determine what, when, and how they learn, thereby fostering self-directed learning and promoting lifelong education. This flexibility is particularly significant in the context of Mozambique, where many students face geographical and economic barriers to accessing higher education as confirmed by the study of Bonde and Matavel (2022), which highlight that the financial barriers and socioeconomic disparities persist, continuing to limit equitable access to quality education and reinforcing structural inequalities within Mozambique's higher education system.

Finally, the findings showed that the UnISCED learning model facilitates meaningful engagement with educational content remotely, without the constraints of a physical

classroom. This was strongly confirmed by the participants' responses, which highlighted the flexibility and convenience offered by mobile-based learning. These findings corroborate the study by Quicios García and Sevillano-García (2013), which underscores that student autonomy and engagement are crucial factors when integrating mobile devices into learning models, particularly in geographically dispersed learning communities.

CONCLUSION AND RECOMMENDATIONS

This study set out to investigate the use of mobile devices to enhance learning accessibility in the context of Mozambique's higher education, using the case of UnISCED between 2020 and 2022. Through a case study approach, it sought to capture the perspectives of students and tutors, while analysing the institutional and pedagogical factors influencing the adoption of mobile technologies in distance education. The findings demonstrate that the integration of mobile devices constitutes a viable and strategic approach to addressing structural barriers to higher education in Mozambique. By expanding access to educational resources, promoting learner autonomy, and supporting flexible study pathways, mobile technologies strengthen the capacity of distance education to respond to the country's growing demand for higher education. This research contributes to the wider debate on educational equity in vulnerable contexts, underscoring the transformative role of mobile learning in bridging geographical, socioeconomic, and technological divides in the African context.

Through the literature review and the results presented in this study, it is evident that the use of mobile devices in learning is a viable and strategic approach to increasing accessibility to higher education in Mozambique. Given that the face-to-face education system is unable to meet the growing demand, distance learning has become a central solution to expanding access, particularly in remote areas. In this context, higher distance education institutions have been actively adopting innovative strategies to make their services more widely available. The integration of mobile devices plays a critical role in this transformation by enhancing student autonomy and promoting flexible learning opportunities that align with socioeconomic realities and technological advancements. This is corroborated by studies conducted by Allen and Seaman (2016), Seaman et al. (2018), Makworo (2020) and Smith (2023), which highlight the transformative potential of mobile devices in bridging educational disparities and driving innovation in distance education. The growing acceptance of the use of mobile devices in learning as a mainstream approach underscores its potential to support lifelong learning, professional development, and career progression, while also enabling students to balance work and study commitments effectively, reinforcing the conclusions of Moura and Carvalho (2010) and Quicios García and Sevillano-García (2013), who emphasize the role of online learning in promoting autonomy and engagement in education.

As evidenced by this study, the use of mobile devices in learning enhances education accessibility and self-directed learning, which are key elements for modern education models. The ability to personalise learning journeys, interact with faculty in real-time, and leverage digital tools for collaboration and research positions the use of mobile devices in learning as a transformative force in the higher education sector. This aligns with the findings of Makoe (2018) and Smith (2023), who highlight the increasing relevance of mobile-based education in addressing accessibility gaps and fostering interactive, learner-centred approaches in higher education.

Nevertheless, some limitations must be acknowledged. The study focused exclusively on a single institution and relied on a relatively small sample of participants, which constrains the external validity of its findings to the broader Mozambican higher education landscape. Moreover, while the analysis identified perceptions, challenges, and opportunities associated with mobile learning, it did not directly measure academic outcomes or long-term impacts on student performance.

Future research should therefore explore the effectiveness of mobile learning through comparative and longitudinal designs, incorporating larger and more diverse institutional samples. Investigations into how mobile learning shapes academic achievement, digital skills development, and employability would provide a more comprehensive understanding of its impact. Additionally, cross-country studies in Sub-Saharan Africa could generate valuable insights into the scalability of mobile learning models in similarly constrained contexts.

To maximize the potential of mobile learning for enhancing higher education accessibility in Mozambique, policymakers should prioritize:

a) Investing in the expansion of affordable and reliable internet infrastructure, particularly in rural and underserved areas;

b) Developing and implementing national digital literacy programs targeting students, educators, and the broader population;

c) Creating policies and funding mechanisms to support higher education institutions in developing effective mobile learning pedagogical strategies and providing adequate faculty training;

d) Exploring options for reducing the cost of mobile data and devices for students from low-income backgrounds to ensure equitable access.

Lastly, this study reaffirms that mobile devices in education are not merely auxiliary tools but essential enablers of accessibility, equity, and innovation in higher education. Their integration into coherent pedagogical and institutional strategies offers a path towards more inclusive and sustainable education systems, particularly in settings where traditional infrastructures fall short of meeting societal demand.

AUTHORS CONTRIBUTION

David Franco: Conceptualization, Data curation, Formal Analysis, Investigation, Methodology, Project administration, Resources, Software, Writing – original draft, Writing – review & editing; José Bidarra: Supervision, Validation, Visualization, Writing – review & editing; Susana Henriques: Supervision, Validation, Visualization, Writing – review & editing. All authors have read and agreed to the published version of the manuscript.

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