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From Platforms to Performance: A Systematic Review of E-Learning, Digital Literacy, and Digital Reading in Higher Education

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Abstract

A growing body of research has examined e-learning in higher education, yet findings remain fragmented across platforms, competencies, and learning outcomes, making it difficult to understand how digital environments translate into academic performance. Persistent gaps exist in synthesizing the combined roles of digital literacy, self-efficacy, and digital-reading behaviors in shaping e-learning effectiveness. This review, therefore, aims to integrate evidence on e-learning modalities, digital competencies, and digital-reading practices to clarify the pathways linking platforms to performance in higher education. A systematic literature review following PRISMA 2020 and PRISMA-S guidelines was conducted, drawing from multidisciplinary databases and applying explicit inclusion criteria for empirical studies on LMS, MOOCs, videoconferencing, VR, and AI-supported learning. Narrative synthesis was used due to heterogeneity in measures and contexts. Findings show that while e-learning adoption is high, outcomes are inconsistent. Digital literacy and self-efficacy reliably predict engagement and improved learning, whereas digital reading presents mixed cognitive effects, with benefits for selective reading but reduced deep comprehension. Contextual constraints, such as infrastructure, affordability, connectivity, and institutional policy, significantly

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moderate effectiveness. The review concludes that platform availability alone is insufficient; meaningful learning gains occur only when digital competencies, reading strategies, and supportive contextual conditions align.

Keywords: Digital literacy, Digital reading, E-learning, Higher education.

Introduction

Higher education has undergone a decisive digital turn, shaped by the widespread diffusion of learning management systems (LMS), institutional repositories, and synchronous tools that scaled rapidly during the pandemic era (Stecuła & Wolniak, 2022; Wolniak & Stecuła, 2024). Survey evidence also documents deep infrastructural readiness, such as Wi-Fi, online libraries, and LMS, alongside extensive blended/online offerings across European institutions (Kryukov & Gorin, 2024). These shifts normalised e-learning as a mainstream pedagogic modality rather than an emergency substitute, yet persistent questions remain about quality, equity and outcomes across contexts (Wolniak & Stecuła, 2024).

A core insight across studies is that platforms alone do not guarantee learning gains; learners' and instructors' digital competencies are pivotal mediators of effectiveness (Falloon, 2020; Vuorikari et al., 2022). Empirical work links higher digital literacy to greater utilization of electronic resources and improved performance (Ilori et al., 2021; Romi, 2024). Among teaching staff, competence with e-learning tools predicts perceived ease-of-use and integration for instruction (Adenekan et al., 2023). Moreover, large-sample studies show that digital literacy, personal cognitive skills and e-learning habits jointly and positively affect online learning effectiveness, though with different weights across populations (Vaszkun & Szakacs, 2025). Complementary findings suggest targeted digital-thinking and skills programs can raise students' competencies, reinforcing the case for systematic capacity building (Al-Ghammaz et al., 2025).

Concurrently, a rich strand interrogates digital reading, ranging from its prevalence, affordances, and cognitive/behavioural consequences in university learning. In some systems, digital reading remains marginal or task-specific due to device access, value perceptions and entrenched print preferences (Cardoso et al., 2021; Mizrachi et al., 2018). Elsewhere, students report that interface features (e.g., search, bookmarking, adjustable fonts/backgrounds) encourage selective and interactive reading but may trade off with sustained attention and deep reading (Divya & Mohamed, 2020; Dani, 2023). Studies of mobile reading practices and screen-based comprehension further highlight modality-linked differences that educators must factor into design and assessment (Liu & Huang, 2016; Kazazoğlu, 2020).

Beyond mainstream LMS and e-texts, universities now leverage MOOCs, immersive media, and AI-enabled tools to extend access and diversify pedagogy. Surveys in Nigerian universities, for instance, report substantial MOOC uptake and completion among undergraduates, illuminating motivations and facilitating conditions as salient drivers (Otitoju & Nwagwu, 2023; Otitoju & Nwagwu, 2024). Experimental and mixed-methods evidence suggests VR reading can heighten engagement and support accurate recall, expanding the palette of digital reading environments (Demir & Büyükbaykal, 2024). In parallel, e-tutors report growing confidence with AI tools for online education, even as policy frameworks lag behind practice (Usman, 2025). Yet adoption remains uneven: infrastructure costs, unstable connectivity, cyberbullying risks and affordability differentials between public and private institutions continue to moderate benefits (Adelowo et al., 2023; Chigbundu & Oluwabiyi, 2023).

The quest towards technology application is anchored in established technology-adoption models and competency frameworks that explain intention, use and value realisation. Constructs from TAM/UTAUT, including performance expectancy, effort expectancy, social influence and facilitating conditions, consistently predict platform adoption in higher education contexts (Ayaz & Yanartaş, 2020; Scherer et al., 2020). Competence models such as the Teacher Digital Competency framework and DigComp 2.2 supply curricular targets for skills, knowledge and attitudes, while work on digital self-efficacy clarifies psychological enablers of

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effective technology use (Falloon, 2020; Ulfert & Schmidt, 2022; Vuorikari et al., 2022). Together, these lenses connect platform features and beliefs to observable behaviours (utilisation, engagement) and outcomes (achievement, satisfaction), yet operationalisation and measurement vary widely across studies and settings (Otitoju & Nwagwu, 2024; Wolniak & Stecuła, 2024).

Despite accumulating evidence, synthesis gaps persist. Findings remain fragmented across modalities (LMS, MOOCs, videoconferencing, VR), competence (digital literacy, self-efficacy), and outcomes (digital reading behaviour, performance, satisfaction), with limited integrative mapping of the pathways that convert platform use into measurable academic performance in higher education (Ilori et al., 2021; Romi, 2024). Evidence from the Global South has grown but is under-aggregated relative to policy needs, and heterogeneous instruments complicate cross-study comparison (Adelowo et al., 2023; Chigbundu & Oluwabiyi, 2023). In response, this systematic review aims to (i) map the e-learning landscape in higher education; (ii) synthesise how digital literacy and related competencies shape learning effectiveness; (iii) consolidate evidence on digital reading behaviors and consequences; and (iv) identify contextual enablers, barriers and theoretical pathways that link platforms to performance across diverse university settings.

Statement of the Problem

Across higher education, institutions have rapidly expanded learning management systems, digital repositories and synchronous tools. This is an adoption wave intensified by the COVID-19 period. However, persistent uncertainty remains about how these platforms translate into measurable learning quality and student performance (Kryukov & Gorin, 2024; Stecuła & Wolniak, 2022; Wolniak & Stecuła, 2024). While evidence points to substantial uptake of MOOCs and other e-learning modalities, outcomes appear uneven across contexts and populations, suggesting that access and usage alone do not guarantee effectiveness (Otitoju & Nwagwu, 2023; Otitoju & Nwagwu, 2024). Emerging studies on immersive reading (e.g., VR) report heightened engagement and recall, but these findings coexist with concerns about scalability, cost and pedagogical alignment (Demir & Büyükbaykal, 2024). Moreover, infrastructural constraints, affordability gaps, unstable connectivity and online safety concerns, which are often sharper in public institutions and in low-resource settings, continue to moderate the benefits of e-learning (Adelowo et al., 2023; Chigbundu & Oluwabiyi, 2023). Even where students rate platforms as usable, institutional innovation and resource readiness vary, producing heterogeneous learner experiences and outcomes (Wolniak & Stecuła, 2024). Consequently, the literature remains fragmented across platforms and settings, making it difficult for universities to identify the conditions under which digital environments reliably improve academic performance.

Another unresolved issue concerns the linkage between competency and outcome. Multiple studies have associated digital literacy and self-efficacy with higher e-resource utilization and better academic outcomes; however, proficiency levels are uneven, measurement is inconsistent, and guidance for capacity building lacks integrative synthesis (Ilori et al., 2021; Romi, 2024). Among faculty, technology competence affects perceived ease-of-use and integration into teaching, yet professional development models are variably operationalised across institutions (Adenekan et al., 2023). Digital reading research further complicates the picture: while interface affordances (search, annotation, font/background controls) can boost selective and interactive reading, studies also document potential trade-offs in sustained attention and deep reading, with persistent print preferences in academic contexts (Cardoso et al., 2021; Dani, 2023; Divya & Mohamed, 2020; Kazazoğlu, 2020; Liu & Huang, 2016; Mizrachi et al., 2018). Although adoption frameworks (e.g., TAM/UTAUT) and digital-competence models (e.g., TDC; DigComp 2.2) explain intention and use, their constructs and instruments vary, impeding cross-study comparison and policy translation (Ayaz & Yanartaş, 2020; Falloon, 2020; Scherer et al., 2020; Ulfert & Schmidt, 2022; Vuorikari et al., 2022). For institutions to create interventions that consistently move from platforms to performance, a theory-informed, context-sensitive synthesis that elucidates the pathways connecting platforms, competencies, and digital reading practices to learning effectiveness is lacking, particularly in under-aggregated Global South contexts.

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Review of Related Literature

The last decade has seen an accelerated mainstreaming of e-learning in higher education, underpinned by robust infrastructure (Wi-Fi, LMS, online libraries) and catalyzed by pandemic-era adoption of synchronous platforms such as MS Teams and Zoom (Stecuła & Wolniak, 2022; Wolniak & Stecuła, 2024). Survey results across European universities further document high levels of blended/online provision and inter-institutional collaboration in course production, signalling a structural shift from supplemental to core digital provision (Kryukov & Gorin, 2024). Still, evaluations of e-learning quality reveal a nuanced picture: while students rate usability and access highly, perceived innovation and resource readiness vary widely across institutions, producing heterogeneous learner experiences (Wolniak & Stecuła, 2024). This heterogeneity foregrounds a central puzzle that motivates the present review: when and how do platforms translate into measurable academic gains, and which mechanisms and contexts enable that translation?

The dominant explanatory lenses in the available literature are technology-adoption models (TAM/UTAUT) and digital-competence frameworks, which together link beliefs, skills, and contextual supports to technology use and outcomes (Ayaz & Yanartaş, 2020; Scherer et al., 2020; Vuorikari et al., 2022). Constructs such as performance expectancy, effort expectancy, social influence and facilitating conditions consistently predict platform uptake, but operationalisation differs across studies, complicating meta-inference (Ayaz & Yanartaş, 2020; Scherer et al., 2020). In parallel, competence models (e.g., TDC; DigComp 2.2) and allied psychological enablers (e.g., digital self-efficacy) are used to set curricular targets and interpret variability in academic technology use, yet measurement tools and cut-offs are far from standardized (Falloon, 2020; Ulfert & Schmidt, 2022; Vuorikari et al., 2022). This theoretical pluralism offers rich explanatory power but also encourages instrument proliferation, which partly explains inconsistent effect sizes across settings.

Across student populations, digital literacy and self-efficacy emerge as robust correlates of online learning effectiveness and e-resource utilisation, though the magnitude of association varies by context and skill dimension (Ilori et al., 2021; Romi, 2024). Evidence from multi-institution surveys shows that digital literacy, cognitive skills, and e-learning habits/conditions each exert positive, distinct effects on self-evaluated online learning effectiveness, suggesting that competence is necessary but not sufficient without conducive habits and environments (Vaszkun & Szakacs, 2025). On the staff side, LIS lecturers report generally competent technology use and high perceived ease-of-use of e-learning systems, reinforcing the role of instructor competence in adoption and instructional design (Adenekan et al., 2023). Interventions targeted at strengthening digital thinking and skills show promising, if moderate, gains, underscoring the value of structured capacity-building in curricula and professional development (Al-Ghammaz et al., 2025).

At the same time, digital reading introduces a distinctive set of considerations about comprehension, attention and study behaviors in screen-rich environments (Mizrachi et al., 2018; Divya & Mohamed, 2020). Cross-national findings reveal that digital reading can be marginal or task-specific where device access is limited, or e-texts are undervalued, while interface affordances (e.g., search, bookmarking, adjustable fonts/backgrounds) support selective and interactive reading yet may trade off with deep, sustained reading (Cardoso et al., 2021; Divya & Mohamed, 2020). Research on screen-based comprehension and mobile reading practices shows modality-linked differences that educators must accommodate through instructional scaffolds and assessment design (Dani, 2023; Kazazoğlu, 2020; Liu & Huang, 2016). Collectively, this literature suggests that reading outcomes are not platform-neutral; design choices and reading strategies interact with format preferences and cognitive load.

Adoption patterns for MOOCs illustrate both opportunity and complexity: surveys of Nigerian undergraduates report substantial MOOC uptake and notable completion rates, aligning with UTAUT constructs that emphasize facilitating conditions and social influence (Otitoju & Nwagwu, 2023; Otitoju & Nwagwu, 2024). Studies of distance learners similarly report positive, significant associations between engagement with large-scale online courses and academic performance, indicating that well-designed open courses can deliver measurable benefits (Ohanyelu & Nwauwa, 2025). Nevertheless, cross-sectional designs and geographically bounded samples limit causal inference and generalizability, calling for longitudinal or quasi-experimental

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approaches in future work (Otitoju & Nwagwu, 2024). Moreover, within-country divides in access and support complicate uniform implementation strategies for MOOCs in blended university systems.

Beyond MOOCs and LMS, emerging modalities, notably VR-mediated reading and AI-enabled tutoring, expand the repertoire of digital learning but surface questions about scalability, cost, and pedagogy (Demir & Büyükbaykal, 2024; Usman, 2025). Experimental evidence suggests VR reading can heighten engagement and support accurate recall, inviting further exploration of when immersive affordances foster deeper learning rather than cognitive overload (Demir & Büyükbaykal, 2024). Concurrently, field evidence from e-tutors indicates growing confidence with AI tools, though policy frameworks lag, highlighting a governance gap between innovation and institutional regulation (Usman, 2025). Short-course interventions during the pandemic demonstrated that targeted digital training can rapidly expand learners' toolkits (e.g., whiteboard animation, 3D video, simple graphics), yet sustained integration into curricula remains uneven (Obim & Izuakolam, 2025).

Also crucial are equity and context that mediate effectiveness. Public–private comparisons in Nigeria show that students in public universities face unstable Internet, device affordability constraints, and lower platform navigation skills relative to their private-sector peers, with corresponding differences in platform portfolios used (Adelowo et al., 2023). Broader surveys also identify cyberbullying, electricity instability, and participation costs as deterrents that push students toward face-to-face preferences despite digital proficiency (Chigbundu & Oluwabiyi, 2023). At the same time, studies of digital resources and reading habits in Nigerian universities report frequent use and positive perceptions of digital resources, suggesting that once access barriers are addressed, students recognize academic value in digital environments (Ogunbodede & Sawyerr-George, 2023). These findings caution against technology-determinist assumptions and argue for context-sensitive provisioning and support.

Methodologically, a large share of studies relies on descriptive surveys with reliability checks (e.g., Cronbach's $\alpha = 0.84$ in Igboroodowo & Chukwuemeke; $\alpha = 0.76$ in Ogunbodede & Sawyerr-George), offering breadth but limited causal leverage (Igboroodowo & Chukwuemeke, 2022; Ogunbodede & Sawyerr-George, 2023). Some works employ inferential models, such as t-tests/ANOVA, regression and PCA, to parse relationships among adoption drivers and outcomes, strengthening internal validity but often within single-site or city-bounded samples (Adenekan et al., 2023; Otitoju & Nwagwu, 2024). Experimental designs are emerging (e.g., VR reading) but remain small-N and context-specific, warranting replication across disciplines and learner profiles (Demir & Büyükbaykal, 2024). Collectively, it is suggested that future studies would benefit from triangulated designs that combine usage analytics, learning outcomes, and competency assessments over time.

Synthesising across strands, the literature suggests a pathway in which platforms enable opportunities for engagement; digital literacy and self-efficacy condition uptake and quality of interaction; digital reading strategies shape cognitive outcomes; and institutional contexts (infrastructure, policy, equity) moderate effects on performance (Ilori et al., 2021; Romi, 2024; Wolniak & Stecuła, 2024). Yet key gaps persist: inconsistent constructs and instruments across studies; under-aggregation of Global South evidence; and limited integrative testing of the full platform to competence/reading to engagement and performance pathway (Adelowo et al., 2023; Chigbundu & Oluwabiyi, 2023; Otitoju & Nwagwu, 2024). Harmonised metrics, multi-site longitudinal designs, and interventions that focus on infrastructure, skills, and pedagogic design in tandem will be necessary to close these gaps and shift systems from platforms to performance consistently.

Methodology

Design and protocol

This study is a systematic literature review (SLR) conducted and reported in line with the PRISMA 2020 guideline; the search component is documented following the PRISMA-S extension to ensure transparency and reproducibility. The review question is aligned with our article focus, how e-learning platforms in higher education relate to learning effectiveness, considering the roles of digital literacy/self-efficacy and digital reading.

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Eligibility criteria

We included empirical studies (qualitative, quantitative, mixed-methods) conducted in higher education that examined at least one e-learning modality (LMS, MOOCs, videoconferencing, VR/AR, AI-enabled tools) and reported outcomes related to utilization/engagement, satisfaction/quality, academic performance, or digital reading (e.g., comprehension, attention, format preference). We excluded non-empirical pieces (editorials, commentaries), K–12-only studies, and papers lacking extractable data on exposures/outcomes of interest; all reasons for exclusion are recorded for the PRISMA flow.

Information sources and search strategy

To capture multidisciplinary evidence, we searched Scopus, Web of Science Core Collection, ERIC, PsycINFO, Education Source (EBSCO), IEEE Xplore, and used Google Scholar for supplementary citation chasing.

Study selection

All records were de-duplicated and screened in two stages (titles/abstracts, then full texts) by two independent reviewers, with disagreements resolved through discussion or a third reviewer; screening counts and reasons for exclusion are presented in the PRISMA 2020 flow diagram. This process safeguards against selection bias and aligns with best-practice reporting.

Data extraction

Using a pilot-tested form, two reviewers independently extracted: bibliographic details; country/discipline/institution type; sample characteristics; platform/modality (LMS, MOOC, videoconferencing, VR/AR, AI); theoretical framing (e.g., TAM, UTAUT, competence frameworks); measures (digital literacy/skills, self-efficacy, reading behaviors) with reported reliability; outcomes (utilization/engagement, satisfaction/quality, academic performance, comprehension/attention); and study design/analysis (e.g., regression/ANOVA/PCA/experimental contrasts).

Synthesis approach

Given expected heterogeneity, we used a structured narrative synthesis organized by: (i) platform/modality (LMS, MOOCs, videoconferencing, VR/AI), (ii) competencies (digital literacy), and (iii) digital reading outcomes (comprehension, attention, preferences), while considering contextual moderators (infrastructure, affordability/policy). Where constructs and measures are sufficiently homogeneous, we estimated pooled effects under a random-effects model and explored subgroups (e.g., public vs. private; Global North vs. South), reported per PRISMA 2020.

Findings

Overview of the evidence base

The included studies span multiple higher-education systems and modalities, such as LMS/portals, videoconferencing (MS Teams, Zoom), MOOCs, immersive media (VR), and AI-enabled tools. It also examines outcomes such as utilization/engagement, usability/quality, digital reading behaviors, and academic performance (Demir & Büyükbaykal, 2024; Otitoju & Nwagwu, 2024; Stecuła & Wolniak, 2022; Wolniak & Stecuła, 2024; Usman, 2025). Most reports are cross-sectional surveys or descriptive studies with reliability checks (e.g., $\alpha = 0.84$ in Igboroodowo & Chukwuemeke, 2022; $\alpha = 0.76$ in Ogunbodede & Sawyerr-George, 2023), complemented by experimental/quasi-experimental evidence in niche areas such as VR reading (Demir & Büyükbaykal, 2024).

Adoption and use of e-learning modalities

Institutional platforms are mainstream: European university surveys document strong LMS/online infrastructure and broad provision of blended/online learning (Kryukov & Gorin, 2024). The pandemic era accelerated synchronous tool use, especially MS Teams and Zoom, and reinforced continued reliance on LMS and email; students' usage clustered into (i) popular services/apps adapted to e-learning, (ii) synchronous meeting tools, and (iii) other synchronous/asynchronous methods (Stecuła & Wolniak, 2022). Furthermore, MOOCs show notable penetration and value: among Nigerian undergraduates, 77.8% reported using MOOCs, 72% enrolled, and 60.8% completed courses, while separate analyses link MOOC engagement to significantly better academic performance among distance learners

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(Ohanyelu & Nwauwa, 2025; Otitoju & Nwagwu, 2023). Similarly, emerging modalities are visible but uneven: VR-mediated reading increases engagement and recall in small-N experiments, and AI tools are increasingly utilized by e-tutors, though policy frameworks lag practice (Demir & Büyükbaykal, 2024; Usman, 2025).

Digital literacy/self-efficacy and learning outcomes

Across contexts, higher digital literacy and self-efficacy consistently predict greater e-resource utilization and better outcomes (Ilori et al., 2021; Romi, 2024). In large management cohorts, digital literacy, personal cognitive skills, and e-learning habits/conditions each show positive, distinct effects on self-evaluated e-learning effectiveness (Vaszkun & Szakacs, 2025). Among instructors, technology competence aligns with perceived ease-of-use and integration of e-learning systems (Adenekan et al., 2023), and targeted digital-thinking/skills programs further enhance student competence (Al-Ghammaz et al., 2025).

Digital reading practices, preferences and cognitive consequences

Patterns are mixed and context-dependent: in Portugal, digital reading remains marginal, with limited device access and undervaluation of e-books even in academic settings (Cardoso et al., 2021). When students do read digitally, interface affordances (search, save/download, bookmark; font/layout/background controls) support selective/interactive reading, yet students also report reduced deep reading and sustained attention relative to print (Divya & Mohamed, 2020; Mizrachi et al., 2018). Research on smartphone/screen reading and print-vs-digital comprehension demonstrates modality effects that educators should factor into course design and assessment (Liu & Huang, 2016; Kazazoğlu, 2020). Insightfully, experimental findings indicate that VR reading can heighten engagement and recall, suggesting promise where immersive affordances match learning goals (Demir & Büyükbaykal, 2024).

Contextual enablers and constraints

Equity, infrastructure, and affordability are decisive: compared with peers in private universities, public-university students in Nigeria face unstable Internet, device affordability constraints, and narrower platform portfolios, all of which dampen realized benefits (Adelowo et al, 2023). Students also identify cyberbullying, electricity instability, and participation costs as deterrents, which can push preferences back toward face-to-face settings despite digital proficiency (Chigbundu & Oluwabiyi, 2023). Conversely, where access barriers are eased, undergraduates report frequent use of digital resources and positive academic value (Ogunbodede & Sawyerr-George, 2023). On the staffing side, e-tutors report growing confidence in AI tools but cite policy vacuums as a key barrier to effective integration (Usman, 2025).

Quality/usability and association with outcomes

Students generally rate the usability of institutional platforms as high (e.g., ease of login and navigation), and perceived quality correlates with IT familiarity, resource ownership, and the innovation level of university solutions (Wolniak & Stecuła, 2024). Specifically, the pandemic-era analyses show increased familiarity with MS Teams/Zoom and propose a decision model linking interest in innovative tools and resource readiness to the optimal teaching mode (e-learning vs. traditional vs. hybrid) (Stecuła & Wolniak, 2022).

Theoretical/measurement landscape

Technology-adoption studies commonly apply TAM/UTAUT; among Nigerian undergraduates, performance expectancy, effort expectancy, social influence, facilitating conditions and Internet access significantly influence MOOC usage, though a few coefficients carry unexpected signs, highlighting contextual or measurement nuances (Otitoju & Nwagwu, 2024). Competency work references teacher digital competence and DigComp; instruments and operational definitions vary, complicating comparability. Reliability reporting is common (e.g., $\alpha = 0.84$, $\alpha = 0.76$), but the dominance of single-site, cross-sectional designs limits causal claims (Igboroodowo & Chukwuemeke, 2022; Ogunbodede & Sawyerr-George, 2023).

Integrative pathway and evidence gaps

Findings coalesce around a pathway in which platform availability, competence, quality of engagement and digital reading strategies are linked to academic

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performance and satisfaction, with infrastructure/affordability/policy acting as moderators (Ilori et al., 2021; Romi, 2024; Wolniak & Stecuła, 2024). Evidence gaps include heterogeneous measurement of competence/reading constructs, under-aggregation of Global South evidence beyond city-bounded samples, limited experimental/longitudinal work on VR/AI at scale and occasional counter-intuitive adoption coefficients needing mediator/moderator tests (Adelowo et al., 2023; Chigbundu & Oluwabiyi, 2023; Otitoju & Nwagwu, 2024).

Discussion

Mainstreaming of platforms and the quality paradox

This review confirms that LMS, online repositories, and student portals have become structural to university teaching, while the pandemic consolidated videoconferencing (MS Teams, Zoom) and blended provision as routine (Stecuła & Wolniak, 2022; Wolniak & Stecuła, 2024). European-wide reporting similarly indicates strong infrastructure and extensive blended/online offerings, reinforcing that adoption is high (Kryukov & Gorin, 2024). Yet quality and innovation remain uneven across institutions, which helps explain heterogeneous learner experiences despite high usability ratings (Wolniak & Stecuła, 2024).

Competence as the engine room of effectiveness

Across contexts, digital literacy and self-efficacy are robust correlates of e-resource utilisation and achievement, echoing findings that stronger digital skills predict higher use and better outcomes (Ilori et al., 2021; Romi, 2024). Large management-education samples extend this by showing digital literacy, personal cognitive skills and e-learning habits/conditions exert positive, distinct effects on perceived online learning effectiveness (Vaszkun & Szakacs, 2025). Among teaching staff, technology competence aligns with perceived ease-of-use and integration of e-learning systems (Adenekan et al., 2023), and targeted programs to strengthen digital thinking further raise student competencies (Al-Ghammaz et al., 2025).

Digital reading: affordances, trade-offs, and context

Evidence on digital reading is mixed but patterned: interface affordances (e.g., search, annotation, bookmarking, font/background controls) support selective/interactive reading, yet students frequently report reduced sustained attention and shallower processing relative to print (Divya & Mohamed, 2020; Mizrachi et al., 2018). In settings like Portugal, digital reading remains marginal and e-books are often undervalued even for academic work, highlighting the role of access and cultural valuation (Cardoso et al., 2021). Studies of smartphone/screen reading and print-versus-digital comprehension reinforce that outcomes are not platform-neutral and require instructional scaffolds (Liu & Huang, 2016; Kazazoğlu, 2020). Notably, small experiments indicate VR-mediated reading can heighten engagement and recall when immersive affordances are well aligned to tasks (Demir & Büyükbaykal, 2024).

MOOCs: substantial adoption, promising impact, yet contingent

Findings replicate Nigerian evidence of high MOOC awareness and use (e.g., 77.8% usage; notable enrollment and completion) and show positive, significant associations with academic performance among distance learners (Otitoju & Nwagwu, 2023; Ohanyelu & Nwauwa, 2025). However, model coefficients sometimes adopt unexpected signs (e.g., negative effects for performance expectancy or facilitating conditions), implying measurement idiosyncrasies, sample heterogeneity, or unobserved moderators such as course quality and time constraints (Otitoju & Nwagwu, 2024). These patterns strengthen the case for longitudinal/quasi-experimental designs that can unpack expectancy–support–commitment dynamics over time (Otitoju & Nwagwu, 2024).

Context moderates everything: infrastructure, affordability and safety

Comparative surveys within Nigeria show that students in public universities face unstable Internet, device affordability constraints, and narrower platform portfolios, dampening realized benefits relative to private-university peers (Adelowo et al., 2023). Additional deterrents, such as cyberbullying, electricity instability, and participation costs, can shift preferences back toward face-to-face modalities

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despite digital proficiency (Chigbundu & Oluwabiyi, 2023). Where these barriers are mitigated, undergraduates report frequent use and perceived academic value of digital resources, signaling latent demand for effective e-learning (Ogunbodede & Sawyerr-George, 2023). Among e-tutors, confidence with AI tools is growing, but policy vacuums impede consistent integration, underscoring governance needs (Usman, 2025).

Theories and measures: strong scaffolds, uneven instrumentation

Technology-adoption studies frequently employ TAM/UTAUT, with performance expectancy, effort expectancy, social influence, facilitating conditions, and internet access predicting use in MOOC contexts, albeit with occasional counter-intuitive coefficients (Otitoju & Nwagwu, 2024). Competency work references teacher digital competence and DigComp, but operational definitions and instruments vary across settings, complicating cross-study comparability (Adenekan et al., 2023; Vuorikari et al., 2022). Reliability reporting is common (e.g., $\alpha \approx .76–.84$), yet single-site, cross-sectional designs predominate, constraining causal inference (Igboroodowo & Chukwuemeke, 2022; Ogunbodede & Sawyerr-George, 2023).

From platforms to performance: clarifying the pathway

Synthesising across strands yields a mechanism wherein platform availability creates opportunity; digital literacy shape depth and quality of engagement; digital reading strategies and interface choices influence comprehension and attention; and contextual moderators (infrastructure, affordability, policy/safety) determine realized outcomes such as satisfaction/quality and academic performance (Ilori et al., 2021; Romi, 2024; Wolniak & Stecuła, 2024). This pathway aligns with adoption and competence theories while extending the conversation by placing reading cognition and equity constraints at the center of performance explanations (Cardoso et al., 2021; Stecuła & Wolniak, 2022).

Where this synthesis advances the literature

First, by juxtaposing usability/quality evidence with competence and reading studies, we show why strong usability can coexist with uneven outcomes: without capability building and reading-strategy scaffolds, usability alone rarely yields performance gains (Wolniak & Stecuła, 2024; Divya & Mohamed, 2020). Second, we find innovation signals (VR, AI) can deliver engagement dividends, but scalability hinges on policy frameworks, costs, and instructional alignment (Demir & Büyükbaykal, 2024; Usman, 2025). Third, we identify measurement heterogeneity and contextual inequities as the principal obstacles to cumulative knowledge and equitable practice, concerns often noted, but seldom integrated across strands (Otitoju & Nwagwu, 2024; Adelowo et al., 2023).

Implications

Universities should pair platform investments with structured competence programs (digital literacy, self-efficacy and digital-reading strategies) and with equity interventions (connectivity/device subsidies, electricity resilience, online-safety protocols) (Ogunbodede & Sawyerr-George, 2023; Vaszkun & Szakacs, 2025). Course teams should design for cognition, using digital affordances while scaffolding deep reading via staged tasks and annotation prompts, and mixing print/digital when appropriate (Kazazoğlu, 2020; Liu & Huang, 2016). Institutions piloting VR/AI should align deployments with clear learning outcomes, sustainable cost models, and governance to avoid novelty without durable gains (Demir & Büyükbaykal, 2024; Usman, 2025).

Conclusion

This systematic review mapped a rapidly maturing e-learning landscape in higher education, spanning LMS, MOOCs, videoconferencing, immersive media and AI tools. This showed that platform availability alone does not guarantee learning gains. Rather, outcomes consistently hinge on digital literacy/self-efficacy, digital reading strategies, and contextual conditions such as infrastructure, affordability, and policy support. The evidence from European and national contexts confirms high adoption and usability of platforms, but also highlights uneven innovation climates, explaining heterogeneous student experiences across institutions.

A central contribution of this review is to connect platform use to performance through two critical mediating layers: (i) the competence layer,

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encompassing digital skills and self-efficacy for both students and staff, and (ii) the reading-cognition layer, covering how interface affordances and reading formats shape attention, comprehension, and study behaviors. We also integrated emerging evidence on MOOCs, VR, and AI: MOOCs are widely used and, for distance learners, positively linked to achievement; VR can heighten engagement and recall in controlled tasks; and AI use is rising among e-tutors, but each demands institutional readiness and governance to translate promise into durable impact.

The findings point to three practice and policy imperatives. First, pair platform investments with competence building: embed digital-skills/self-efficacy programs for students and professional development for staff, and explicitly teach digital-reading strategies to balance the convenience of screens with the cognitive demands of deep learning. Second, tackle equity constraints head-on, such as connectivity, device access, electricity reliability, and online safety, especially in resource-constrained public institutions where these barriers most depress realized benefits. Third, govern innovation: align VR/AI pilots with clear learning outcomes, cost models, and policy frameworks to avoid novelty effects without sustained gains.

For scholarship, the review underscores measurement heterogeneity and design limitations as the chief obstacles to cumulative knowledge. We recommend multi-site longitudinal and quasi-experimental studies; shared, validated scales for digital competence and digital reading; and explicit testing of mediators and moderators (e.g., competence → engagement, reading strategy → comprehension, infrastructure → satisfaction/performance) to refine the platforms → competencies/reading → engagement → performance pathway across diverse regions—including more systematic aggregation of Global South evidence.

In sum, moving from platforms to performance requires universities to synchronize technology, capability, cognition, and context: invest in human competencies, design for how students actually read and learn in digital spaces, and ensure the enabling conditions that let those capabilities flourish. Where these elements align, the literature shows that e-learning can deliver meaningful gains in engagement, quality perceptions, and academic achievement; where they do not, platforms risk becoming efficient delivery shells with modest educational returns.

Limitations and future work

As in the field at large, most available studies are cross-sectional; while reliability is commonly reported, construct validity and measurement equivalence across regions are less examined. Future work should prioritize multi-site longitudinal and quasi-experimental designs, adopt shared validated scales, and explicitly test mediators/moderators (e.g., competence and engagement; reading strategy and comprehension; infrastructure and satisfaction/performance) to refine the platforms and competencies/reading and engagement and performance pathway in diverse contexts.

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