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THE IMPACT OF DIGITAL READING ON LEARNING OUTCOMES IN HIGHER EDUCATION: A SYSTEMATIC LITERATURE REVIEW

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Abstract

The rapid digital transformation in higher education has systematically replaced or supplemented traditional print media with digital reading configurations. This Systematic Literature Review (SLR) investigates the multi-dimensional impact of digital reading on cognitive learning outcomes among university students. Operating strictly under the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) framework, a comprehensive electronic search was executed across Scopus and Web of Science databases, ultimately synthesizing core empirical literature. The findings reveal a profound cognitive dichotomy: while digital reading offers unprecedented logistical convenience and accessibility, screen-based reading inherently risks triggering superficial skimming behaviors, accelerated cognitive fatigue, and lower long-term comprehension retention due to a lack of spatial-temporal tactile mapping. However, these cognitive vulnerabilities are not absolute but are highly contingent upon task design and pedagogical architecture. When evaluated through the ICAP framework, passive digital reading yields no academic advantages, whereas shifting students into constructive and interactive tasks—such as peer-to-peer digital annotations, hypertext concept-mapping, and collaborative text analysis—significantly elevates deep analytical processing. Furthermore, successful digital reading integration requires a supportive ecosystem combining students' internal self-regulated learning strategies with the advanced digital pedagogical competencies of university faculty. Ultimately, higher education institutions must address both macro-infrastructural barriers and localized instructional designs to engineer optimal digital reading environments tailored to high-density academic training.

Keywords: *Cognitive Processing; Digital Reading; Higher Education; ICAP Framework; Learning Outcomes; Systematic Literature Review*

INTRODUCTION

In recent decades, higher education institutions worldwide have experienced a massive wave of digital transformation (Singun, 2025). The integration of Information and Communication Technology (ICT) is no longer merely a supporting tool, but has completely redefined the entire landscape of pedagogy, administration, and academic interaction (Farias-Gaytan et al., 2023). This ongoing digital acceleration demands that higher education students not only master basic technical devices but also possess comprehensive digital literacy to successfully navigate a complex, modern academic ecosystem (Audrin & Audrin, 2022; Gutiérrez-Angel et al., 2022). One of the most tangible and immediate manifestations of this digital shift at the university level is the transition of everyday learning materials from traditional print to screen-based media, a phenomenon widely known as digital reading.

Although accessibility to e-books, digital journal articles, and online university repositories provides extraordinary logistical convenience for students, the abrupt shift to

digital reading brings significant cognitive and psychological challenges. Reading at the higher education level demands deep comprehension, synthesis analysis, and long-term critical concentration. However, a number of early empirical studies show a cognitive paradox; reading through digital screens often triggers non-linear skimming behavior and a high susceptibility to multitasking distractions, which in turn potentially reduces the quality of text comprehension compared to reading print media (Agnia & Alifah, 2024). This phenomenon raises critical questions among academics regarding the extent to which digital reading truly contributes positively to students' actual learning outcomes.

The uncertainty of this impact is further complicated by the fact that the successful processing of information from digital texts does not occur in a vacuum. On one hand, students' learning outcomes are heavily influenced by internal factors, such as their self-regulated learning abilities and independence in managing cognitive load when interacting with online media (Edisherashvili et al., 2022). On the other hand, external factors, such as teachers' digital competence in designing online instructions (Basilotta-Gómez-Pablos et al., 2022) and the specific types of academic digital tools used (Lin & Yu, 2023), exert great control over the intensity and quality of technology adoption. Based on student engagement frameworks such as the ICAP Taxonomy (Passive, Active, Constructive, Interactive), students' interaction with digital content is proven to have an optimal impact on academic achievement only if the digital media is designed to trigger constructive and interactive cognitive activities, rather than mere passive PDF reading (Wekerle et al., 2022). Therefore, a systematic mapping is required to see the big picture of how these micro-level cognitive processes and macro-level institutional pedagogy intertwine.

Although literature on digital literacy in higher education continues to surge, most existing systematic reviews tend to focus on the macro umbrella of digital transformation (Farias-Gaytan et al., 2023), institutional infrastructure barriers (Singun, 2025), or the implementation of specific learning models such as the flipped classroom (Baig & Yadegaridehkordi, 2023). Conversely, systematic reviews that specifically isolate the digital reading variable and dissect its direct impact on learning outcomes in higher education remain very limited. Most existing digital reading studies instead heavily explore children or readers at the primary school level (Bray et al., 2023). The absence of a comprehensive synthesis of literature at the university student level creates a distinct research gap, even though the characteristics of academic reading loads and demands in higher education are far more complex.

To bridge this gap, this study aims to conduct a Systematic Literature Review (SLR) regarding the impact of digital reading on learning outcomes in higher education. The primary purpose of this review is to address three main objectives: (1) mapping the trends and types of digital academic tools used by university students, (2) analyzing the cognitive impact of screen reading on their comprehension and learning outcomes, and (3) identifying moderating factors—both from the perspective of students' self-regulation and teachers' pedagogical interventions—that determine the success of digital text processing. Through a rigorous SLR methodology approach, this study is expected to provide a theoretical contribution to the development of digital educational psychology, while offering practical recommendations for lecturers and curriculum designers in higher education to optimize digital-based instructional materials for maximizing student learning outcomes.

METHOD

This study adopts a Systematic Literature Review (SLR) research design to synthesize empirical evidence regarding the impact of digital reading on learning outcomes in higher education. The methodology strictly adheres to the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) framework (Singun, 2025). This approach utilizes a transparent, reproducible, and multi-stage procedure to identify, evaluate, and map existing literature, thereby minimizing selection bias and maximizing the analytical validity of the synthesized outcomes.

As a systematic review, the environmental site of this research encompasses digital academic landscapes, specifically targeting peer-reviewed studies conducted within higher education institutions (HEIs) globally (Singun, 2025). The institutional contexts analyzed are bounded by modern university settings including lecture halls, virtual learning environments (VLEs), and digital libraries where traditional print media has been systematically supplemented or replaced by digital reading configurations (Gutiérrez-Angel et al., 2022).

The target population for this review comprises international, peer-reviewed empirical studies published within high-impact databases, specifically Scopus and Web of Science (WoS), over the last decade (Farias-Gaytan et al., 2023). The final sample consists of specific core empirical articles that meet strict eligibility parameters: explicitly isolating undergraduate or postgraduate university students as the human subjects, evaluating digital reading devices (computers, tablets, or e-readers), and measuring objective or subjective learning outcomes (Lin & Yu, 2023; Wekerle et al., 2022).

The method of data collection follows a systematic electronic database search protocol. A comprehensive search string was executed using specific Boolean operators (AND, OR) to bridge the core variables: ("digital reading" OR "screen reading" OR "digital text processing") AND ("learning outcomes" OR "academic performance" OR "comprehension") AND ("higher education" OR "university students"). The retrieved citations were compiled into reference management software (Zotero) to systematically identify, track, and eliminate duplicate items across the databases before commencing the screening phases (Singun, 2025).

Data collection was executed through a rigorous multi-tier screening technique consisting of four sequential phases: Identification, Screening, Eligibility, and Inclusion. First, titles and abstracts were screened against explicit inclusion criteria (empirical studies, higher education focus) and exclusion criteria (primary or secondary education focus, grey literature) (Bray et al., 2023). Second, a full-text review technique was applied to the remaining pool of articles to verify methodological soundness. Finally, a structured content-extraction matrix was used to pull critical data fields, including author metadata, geographic region, digital reading tools investigated, and specific learning outcome metrics (Wekerle et al., 2022).

RESULTS AND DISCUSSION

RESULTS

Search Results and Data Selection

The data collection process for this Systematic Literature Review (SLR) was initiated by executing an electronic literature search across two high-impact, peer-reviewed international databases: Scopus and Web of Science (WoS). Targeted search strings and

Boolean operators were deployed to capture the intersection between digital reading practices, cognitive learning outcomes, and higher education contexts. During the initial identification phase, this comprehensive search strategy successfully retrieved a total of 154 academic records. All bibliographic citations were subsequently extracted and imported into the Zotero reference management software to streamline data organization and cross-database tracking.

Following the initial compilation, a multi-stage screening procedure was systematically applied to the gathered dataset. First, automated and manual duplicate checks were performed, which eliminated 46 overlapping documents and left 108 unique articles for evaluation. Next, these 108 manuscripts were screened based on an intensive review of their titles and abstracts. In this phase, 66 articles were excluded for failing to meet specific inclusion criteria, such as focusing primarily on early childhood or elementary school populations, constituting non-empirical literature, or falling under the category of grey literature.

During the eligibility phase, the remaining 42 articles underwent a comprehensive full-text review. From this rigorous evaluation, 38 articles were excluded due to strict methodological parameters, primarily because they did not isolate digital reading as the core independent variable or failed to explicitly measure objective learning outcomes at the higher education level. This multi-tiered screening process ultimately yielded 4 core empirical articles that fully satisfied all quality benchmarks and were deemed ready for data synthesis. The chronological progression and quantitative breakdown of this literature elimination and screening process are structured systematically in Table 1.

Table 1. Reference screening and selection stages based on PRISMA workflow

PRISMA Phase	Selection Stage and Methodological Description	Remaining Records	Excluded Records
Identification	Initial comprehensive electronic search execution across Scopus and Web of Science databases	154	0
Screening 1	Automated and manual evaluation to detect and eliminate duplicate citations	108	46
Screening 2	Preliminary evaluation based on intensive review of titles, abstracts, and grey literature parameters	42	66
Eligibility	Comprehensive full-text analysis assessing higher education context and learning outcomes variables	4	38
Inclusion	Final synthesis of core empirical higher education articles for comparative matrix analysis	4 Articles	—

Core Data Extraction Matrix

Following the final selection of the 4 primary empirical articles via the PRISMA framework, a rigorous data extraction procedure was executed to map the essential characteristics of the literature. The specific parameters isolated from each primary study included author metadata and publication year, geographic context, specific digital tools or reading platforms utilized by university students, methodological design alongside sample size, N and key findings directly impacting students' learning outcomes.

The extracted data points are structured within a conceptual matrix table to facilitate an objective, comparative visualization across the baseline studies without introducing

subjective interpretations at this stage. The comprehensive mapping of these primary data sources is presented in detail in Table.

Table 2. Conceptual matrix of primary digital reading studies in higher education

No	Author and Year	Geographic Context	Digital Tools / Reading Platform	Methodology & Sample Size	Key Learning Outcomes Identified
1.	Agnia & Alifah (2024)	Indonesia	On-screen digital text files vs. Traditional printed media	Experimental Comparative Design N= 84 Undergraduate Students)	Digital reading triggers skimming behavior, decreases comprehension retention, and increases cognitive fatigue compared to print reading.
2.	Alfaruque dkk. (2023)	Arab Saudi	Interactive hypertext tool, digital annotation, & visualization platform	Mixed-Methods Design N = 120 Literature Students)	Hypertext features have been shown to enhance in-depth analytical understanding of literature, critical interpretation, and active engagement.
3.	Lin & Yu (2023)	China	Computer-based academic reading device	Structural Equation Modeling N= 412 University Students)	The acceptance of reading devices is strongly driven by expectations of academic achievement and positive responses from lecturers on campus.
4.	Wekerle dkk. (2022)	Jerman	Device-based educational texts (ICAP Taxonomy Framework)	Quantitative Survey & Regression N = 315 Pre-service Teachers)	Passive digital reading activities have no impact on learning. Learning outcomes improve through constructive and interactive tasks.

DISCUSSION

The Cognitive Dichotomy of Digital Reading: Comprehension vs. Convenience

The empirical evidence synthesized within the results section demonstrates a profound cognitive dichotomy regarding the utilization of digital reading media among university students. On one end of this spectrum, as robustly established by Agnia and Alifah (2024), digital reading configurations introduce serious processing vulnerabilities when compared directly to traditional physical print. Higher education textbooks and academic journal papers carry immense informational density that requires sustained cognitive focus, linear analytical processing, and deep structural mapping.

However, the screen interface structurally alters the reader's neurological habits. When higher education students read academic material via laptops or smartphones, they automatically default into an information-gathering posture characterized by rapid scrolling, non-linear scanning, and keyword spotting—a behavioral pattern academically classified as "skimming." This skimming phenomenon induces what cognitive psychologists' term shallow processing. Because the tactile feedback of turning a physical page is absent, students struggle to construct an internal cognitive map of the text's physical architecture, which impairs spatial-temporal memory anchor points. Consequently, while students experience unprecedented logistical convenience, their long-term memory retrieval and deep conceptual comprehension suffer significant decrements.

Conversely, this cognitive vulnerability can be completely transformed when the text transitions from a static digital replicate (such as a flat PDF file) into an active hyper-textual environment. Alfaruque et al. (2023) demonstrated that in university literature courses, the integration of interactive digital reading tools, dynamic hyperlinks, embedded dictionaries, and collaborative annotation software significantly elevated students' deep analytical comprehension. Under this configuration, the digital medium ceases to be a liability and becomes a cognitive scaffold. Hypertext allows university students to instantly trace cross-references, explore contextual historical etymologies, and visually map thematic connections in ways that physical print cannot easily mirror. Therefore, the critical observation derived here is that digital reading is not inherently inferior to print media; rather, its cognitive impact on learning outcomes is fundamentally contingent upon whether the digital textual interface forces passive consumption or facilitates dynamic intellectual interaction.

Behavioral Intentions and Technology Acceptance Drivers

To understand how these digital reading habits manifest across university campuses, it is essential to explore the structural psychological drivers that compel students to adopt digital academic reading tools on a daily basis. By extending the classical Technology Acceptance Model (TAM), Lin and Yu (2023) established that university students' behavioral intentions to use digital academic tools are intensely predicted by two primary dimensions: their explicit expectations of academic achievement and the perceived usefulness of the technology. University students are pragmatic actors; if they perceive that a specific computer-based digital reading tool can accelerate their data extraction, streamline citation workflows, and directly support their academic grades, their attitude shifts positively towards digital adoption.

Importantly, Lin and Yu (2023) highlighted an external catalyst that remains critical to this equation: the positive responses and directional guidance of university lecturers. Higher education students do not independently master the optimal configurations of digital reading tools in an academic vacuum. If a professor actively recommends, models, and integrates specialized digital reading platforms within the course architecture, students demonstrate significantly higher self-efficacy and find the platform significantly easier to navigate.

However, an unexpected trend emerged from Lin and Yu's (2023) structural model: advanced academic experience (senior students) often correlates negatively with uncritical technology acceptance. Senior undergraduate or graduate students develop a heightened, protective critical awareness regarding the limitations of certain digital reading interfaces. They become highly sensitive to screen glare, software incompatibility, and the cognitive friction caused by poorly designed user interfaces, leading them to be more selective in their digital adoptions compared to freshman students.

Transforming Engagement via the ICAP Framework and Active Tasks

The absolute necessity of transforming digital text engagement from a passive habit into an active learning process is grounded firmly in the findings of Wekerle et al. (2022). Utilizing the renowned ICAP (Passive, Active, Constructive, Interactive) cognitive engagement taxonomy framework, their research investigated how digital technology utilization impacts subjective learning gains and overall student satisfaction in higher

education. The statistical regressions executed by Wekerle et al. (2022) revealed an essential truth: purely passive digital learning activities—such as instructing a student to open a digital text file on a computer screen and read it line by line without supplementary cognitive tasks—demonstrates zero or even slightly negative correlations with successful learning outcomes.

The true breakthrough in academic performance occurs exclusively when higher education pedagogy intentionally forces students up the ICAP hierarchy into Constructive and Interactive spheres. As structured in Table 3, when university instructors combine digital reading assignments with explicit active commands (such as highlighting core thematic concepts), constructive tasks (such as generating independent digital summary nodes or concept maps), and interactive behaviors (such as debating text interpretations on digital discussion boards), students' learning outcomes spike dramatically. Constructive activities force the working memory to manipulate the digital information actively, preventing the cognitive drift and superficial scanning identified by Agnia and Alifah (2024). Interactive configurations, furthermore, externalize the cognitive processing, allowing peer-to-peer validation of textual interpretation. Thus, the ICAP framework provides a clear blueprint for engineering higher education digital reading spaces: to secure high learning outcomes, digital texts must be embedded within complex, multi-layered pedagogical tasks.

Table 3. Cognitive engagement levels and digital tasks based on the ICAP framework

Engagement Level	Student Behavior and Cognitive Processing	Instructional Context / Digital Task Examples
Interactive	Joint-dialogue and collaborative knowledge construction	Peer-to-peer digital text debates and shared annotations
Constructive	Generating novel mental models and external outputs	Creating digital concept maps and self-generated summaries
Active	Manipulating the physical or digital text interface	Highlighting core keywords and taking on-screen notes
Passive	Receiving information without overt physical action	Static reading of an un-scaffolded PDF file on a screen

The Intersecting Ecosystem: Student Self-Regulation and Faculty Competence

The successful execution of high-level constructive and interactive digital reading tasks is heavily moderated by the internal cognitive readiness of the student. In a completely un-scaffolded digital environment, students are constantly bombarded with notifications, hyperlink rabbit holes, and the temptation to execute parallel non-academic tasks. Edisherashvili et al. (2022) emphasized that within distance and digital learning architectures, the capacity for Self-Regulated Learning (SRL) is the primary line of defense against cognitive failure. Students with highly developed self-regulated learning strategies possess the meta-cognitive awareness needed to deliberately shut down distracting applications, budget their reading time, monitor their own level of text comprehension, and deploy proactive reading strategies (such as digital note-taking) to mitigate the superficial processing traps of screen interfaces.

However, placing the entire burden of digital adaptation on students' shoulders is a conceptual mistake. The student's internal self-regulation must be structurally met by external pedagogical competence. Basilotta-Gómez-Pablos et al. (2022) established via their systematic review that the digital competencies of university instructors are highly variable

yet absolutely vital to the digital transformation of higher education. If university faculty members only possess basic technical literacy (such as knowing how to upload a scanned PDF document to a Learning Management System), they remain incapable of executing the high-level instructional designs demanded by the ICAP taxonomy. To cultivate successful digital reading spaces, university professors must possess advanced digital pedagogical competencies. They must understand how to leverage collaborative digital curation tools, build interactive hypertext modules, and design synchronous on-screen collaborative reading seminars that guide students away from cognitive passivity and toward active text mastery.

Macro-Institutional Barriers to Digital Transformation

The practical realization of advanced digital reading environments across higher education institutions faces steep external roadblocks. As systematically mapped by Singun (2025), universities are deeply entangled in multi-dimensional barriers to digital transformation. These include acute technological infrastructure deficiencies, lack of financial resources, and widespread institutional culture resistance. If a higher education institution cannot guarantee stable digital platform access, uniform high-speed internet connectivity, or up-to-date hardware tools for its entire student body, the implementation of sophisticated interactive digital reading suites becomes an equity hazard. Students stranded on unstable connections or obsolete hardware will naturally suffer from cognitive overload due to technical friction, driving down their learning outcomes and triggering widespread academic frustration.

Furthermore, these macro barriers interact directly with the broader framework of information literacy. According to Audrin and Audrin (2022) as well as Gutiérrez-Angel et al. (2022), digital literacy cannot be treated as a singular, isolated technical skill. It is a socio-cognitive practice that requires institutional cultivation. When universities fail to provide systematic training in information literacy, students struggle to evaluate the credibility of the digital texts they consume. This creates a compounding negative effect: students are not only struggling with the cognitive fatigue of screen reading (Agnia & Alifah, 2024), but they are also intellectually overwhelmed by the task of filtering academic rigor from vast digital repositories. Therefore, resolving the digital reading paradox requires higher education institutions to address both the micro-level instructional design and the macro-level infrastructural barriers simultaneously (Farias-Gaytan et al., 2023).

Generational and Developmental Divergence in Digital Text Interaction

To gain a deep critical perspective on the unique status of the university student, it is highly valuable to contrast these findings against digital reading dynamics observed within primary and secondary school populations. Systematic literature reviews focusing on lower educational levels, such as the comprehensive study by Bray et al. (2023), indicate that for young children, digital reading technology is primarily evaluated through the lenses of basic accessibility, engagement stimulation, and multimedia multi-modal supports (such as automated text-to-speech features or gamified vocabulary assistance). At the primary school level, technology serves as an initial bridge to hook basic literacy engagement and maintain attention through visual stimulation.

In sharp contrast, the higher education student profile bypassed basic literacy long ago. University students face massive informational volumes that require advanced epistemic

evaluation, critical cross-text synthesis, and long-term research construction. While a primary student benefits from simple multimedia animation alongside a digital text, a university student requires an interface that supports complex cognitive architecture, sophisticated note-retrieval matrixes, and robust digital data organization. This generational divergence reinforces why this specific SLR is critically required: higher education pedagogy cannot blindly copy technology adoption strategies from lower school levels. Universities require localized, structurally advanced digital reading frameworks designed explicitly around the heavy cognitive demands of professional and academic training.

CONCLUSION

This systematic literature review successfully addresses the core research problem formulation regarding the multi-dimensional impact of digital reading on learning outcomes within higher education. The synthesized evidence demonstrates a critical cognitive tension, revealing that while digital text environments offer unprecedented logistical accessibility and convenience for university students, screen reading inherently risks triggering superficial skimming behaviors and accelerated cognitive fatigue. This neurological habit, characterized by rapid scrolling and keyword spotting, fundamentally impairs spatial-temporal memory anchor points and diminishes long-term conceptual text retention when compared to traditional printed media.

However, this study concludes that the cognitive liability of digital media is not an absolute defect but is fundamentally contingent upon pedagogical architecture and task design. When digital reading is intentionally transformed from a passive task into an active and constructive experience, the limitations of screen processing can be systematically mitigated. The integration of advanced hypertext interfaces, structured digital annotations, and robust information literacy training allows the digital medium to transition from an intellectual liability into a powerful cognitive scaffold that enhances deep analytical comprehension.

Ultimately, achieving superior learning outcomes in the digital age relies on a symbiotic relationship between internal student factors and external institutional support. University students must cultivate highly developed self-regulated learning strategies to monitor comprehension and shield themselves from the pervasive distractions of online environments. Concurrently, higher education institutions must provide structurally advanced digital reading tools that align with the heavy analytical demands of academic research, coupled with active instructional scaffolding managed by digitally competent faculty members.

Based on the synthesized research findings, several critical recommendations are offered to optimize the future landscape of digital-based instruction in universities. Higher education institutions and policy makers should prioritize infrastructural investments that provide uniform, high-speed access to interactive digital learning repositories, alongside systematic training programs that cultivate deep information and digital literacy for both students and instructors to bridge the existing technological divides. University faculty and curriculum designers are strongly urged to move away from assigning passive screen reading tasks, such as the unguided distribution of static text files, and instead intentionally embed digital reading materials within complex, multi-layered instructional scaffolds that demand constructive note-taking, peer-to-peer digital annotations, and collaborative text mapping.

Furthermore, future researchers are encouraged to expand upon this baseline data by executing empirical longitudinal studies across diverse academic fields to capture the long-term developmental variations in screen reading behaviors. It is highly recommended that subsequent investigations evaluate the concrete efficacy of newly emerging AI-driven digital curation tools in mitigating cognitive fatigue among undergraduate and graduate populations. By broadening the methodological scope to include biometric tracking, such as eye-movement analyses during screen interaction, future academic inquiries can provide deeper, more nuanced guidelines for engineering optimal digital higher education ecosystems.

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