



Ethical structures and risks in digital learning ecosystems: implications for physical activity learning

Estructuras éticas y riesgos en los ecosistemas digitales de aprendizaje: Implicaciones para el aprendizaje de la actividad física

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Received: 11-05-26

Accepted: 28-05-26

How to cite in APA

Ritonga, R. F., Mahanal, S., Ibrohim, I., & Aminullah, A. (2026). Ethical structures and risks in digital learning ecosystems: implications for physical activity learning. *Retos*, 81, 768-781. <https://doi.org/10.47197/retos.v81.119447>

Abstract

Introduction: Data-driven systems, artificial intelligence, and digital learning platforms reshaped educational practice across diverse learning environments. These changes also became relevant to activity-oriented learning contexts, where ethical concerns related to privacy, equity, safety, academic integrity, and learning quality require closer attention.

Objective: This systematic review aimed to examine how ethics was conceptualised and positioned in digital learning ecosystems between 2015 and 2025, with attention to risk dynamics, governance, pedagogy, institutional responsibility, and implications for physical activity learning.

Methodology: A systematic review design was applied. Eighteen open-access empirical studies indexed in Scopus were selected through predefined eligibility criteria and examined using qualitative content analysis and thematic synthesis.

Results: The results showed that scholarly attention to ethics increased after 2022. Four interconnected domains were identified: data privacy and governance, academic integrity and responsible use of artificial intelligence, digital security and user readiness, and equity, changing roles, and institutional responsibility. These domains indicated that ethical issues were not isolated problems, but elements of a wider risk structure within digital learning environments.

Conclusions: Ethics is a structural requirement for trustworthy, equitable, and sustainable digital learning ecosystems, including those used to support physical activity learning.

Keywords

Ethics in digital learning; data governance; institutional responsibility; physical activity learning; systematic review.

Resumen

Introducción: Los sistemas basados en datos, la inteligencia artificial y las plataformas de aprendizaje digital han transformado la práctica educativa en diversos entornos de aprendizaje. Estos cambios también son relevantes en contextos de aprendizaje orientados a la actividad, donde las preocupaciones éticas relacionadas con la privacidad, la equidad, la seguridad, la integridad académica y la calidad del aprendizaje requieren una atención más cercana.

Objetivo: Esta revisión sistemática tuvo como objetivo examinar cómo se conceptualizó y posicionó la ética en los ecosistemas de aprendizaje digital entre 2015 y 2025, prestando atención a la dinámica de riesgos, la gobernanza, la pedagogía, la responsabilidad institucional y las implicaciones para el aprendizaje basado en la actividad física.

Metodología: Se aplicó un diseño de revisión sistemática. Se seleccionaron dieciocho estudios empíricos de acceso abierto indexados en Scopus mediante criterios de elegibilidad predefinidos y se analizaron utilizando análisis de contenido cualitativo y síntesis temática.

Resultados: Los resultados mostraron que la atención académica a la ética aumentó después de 2022. Se identificaron cuatro dominios interconectados: privacidad y gobernanza de datos, integridad académica y uso responsable de la inteligencia artificial, seguridad digital y preparación del usuario, y equidad, roles cambiantes y responsabilidad institucional. Estos dominios indicaron que los problemas éticos no eran cuestiones aisladas, sino elementos de una estructura de riesgo más amplia dentro de los entornos de aprendizaje digital.

Conclusiones: La ética es un requisito estructural para ecosistemas de aprendizaje digital confiables, equitativos y sostenibles, incluidos aquellos utilizados para apoyar el aprendizaje basado en la actividad física.

Palabras clave

Gobernanza de datos; ética en el aprendizaje digital; responsabilidad institucional; aprendizaje basado en la actividad física; revisión sistemática.

Introduction

Over the past decade, digital technologies have become a key component of learning transformation. The emergence of platforms such as learning management systems, adaptive learning environments, and artificial intelligence-based tutors has fundamentally reshaped how learning is designed, implemented, and evaluated (Alotaibi, 2024; Naseer & Khawaja, 2025; Wiradimadja et al., 2021). These developments provide significant opportunities to enhance personalised learning experiences, instructional effectiveness, and academic administrative efficiency (Albahli, 2025; Khrisat & Fakhouri, 2024; Salimi et al., 2025; Shekerbekova et al., 2025; Xu, 2025). However, as digital technologies become increasingly integrated into learning processes, ethical concerns have emerged that cannot be overlooked. Ethical considerations in the use of digital technologies in learning are not merely normative; they represent a strategic necessity to ensure that digital transformation proceeds responsibly, inclusively, and sustainably (Alibigloo, 2025; Anitha & Harsha, 2013; Hortal et al., 2025; Krishnan et al., 2024).

Ethics in digital learning refers to responsible practices grounded in principles, norms, and values governing the integration of technology into educational contexts (Chen et al., 2025; DeWitt & Alias, 2025; Gudmundsdottir & Hatlevik, 2020; Jiali, 2024). This theme has gained increasing attention alongside growing public concerns regarding risks associated with digital technologies in education. Data breaches in cloud-based learning platforms highlight serious challenges related to learner data security, privacy, and academic data protection (Amo et al., 2021). Other studies indicate that algorithms embedded in adaptive learning systems and learning analytics may introduce bias, producing unfair learning recommendations for students from lower socio-economic backgrounds and those with diverse learning characteristics (Jain & Menon, 2023; Katona & Gyonyoru, 2025; Majjate et al., 2025; Recalde Drouet et al., 2024).

Moreover, the rapid rise of artificial intelligence, particularly since 2023, has introduced new ethical challenges in learning processes, including dependency on automated responses, misinformation, and unclear accountability when systems produce inaccurate outputs (Kharis et al., 2024). Recent empirical research examining students' acceptance of generative artificial intelligence tools highlights the central role of trust and perceived usefulness in shaping ethical and sustainable adoption in higher education (Faizin et al., 2025; Rahman et al., 2023). These developments underscore that while digital technologies in learning are innovative, they are inseparable from ethical risks and implications that directly affect equity, privacy, and academic integrity (Alsarayreh, 2025; Bing & Leong, 2025; Jiali, 2024).

Technological advancement often outpaces user readiness and capacity (Thohir et al., 2021). Mass adoption of digital platforms without comprehensive ethical guidance may lead to non-transparent learning practices and undermine learner autonomy (Majjate et al., 2025; Tantakov et al., 2025). This imbalance reflects a gap between the pedagogical potential of technology and its actual implementation, particularly when ethical principles, such as algorithmic transparency, educational data governance, meaningful consent mechanisms, and the protection of learner rights and privacy, are not prioritised. Such conditions influence not only the quality of learning experiences but also the long-term sustainability of digital learning ecosystems.

Prior reviews and empirical studies have provided valuable insights into specific areas such as data use in educational assessment (Murchan & Siddiq, 2021), the educational implications of generative artificial intelligence (Vargas-Murillo et al., 2023), and media discourse surrounding artificial intelligence in science, technology, engineering, and mathematics (Nam & Bai, 2023). However, these studies remain limited to particular thematic or technological scopes and have not fully explained how ethical concerns collectively shape digital learning practices across different contexts and platforms. This indicates a broader epistemological gap in educational technology research, where ethics is often positioned as an additional concern rather than a structural condition influencing pedagogical design, institutional governance, and learner experience. As a result, ethical risks are frequently examined in isolation, limiting understanding of how digital transformation redistributes power, responsibility, and vulnerability among educational actors.

This issue is also relevant to learning contexts associated with physical activity, where digital platforms, mobile applications, data-driven monitoring, and artificial intelligence-supported learning environments increasingly shape how learners engage with movement, health-related knowledge, and activity-oriented educational practices (Botagariyev et al., 2023). Although the present review does not limit its corpus exclusively to physical activity studies, its synthesis offers conceptual implications for understanding how ethical governance, data responsibility, and pedagogical accountability may inform digital learning environments that support active and embodied forms of learning.

In response, this study adopts a focused systematic review approach that moves beyond issue-based synthesis toward conceptual integration by examining how ethics is conceptualised, problematised, and operationalised in digital learning research over the past decade. By synthesising patterns across empirical studies, this article seeks to reposition ethics as a structural dimension of digital learning transformation that informs technological adoption, governance, pedagogical accountability, and the sustainability of learning ecosystems. In addition, the study clarifies the interconnection between ethical issues, risks, and responsibilities, while identifying future research directions that move beyond problem identification toward the development of ethically grounded digital learning systems and policies.

Accordingly, the study addresses the following research questions:

- 1) What is the research landscape concerning the ethics of digital technology use in learning over the past decade?
- 2) What key ethical issues are identified in the literature on digital technology use in learning?
- 3) How does the literature describe the risks and ethical implications of digital technology use in learning, particularly for responsible digital learning ecosystems with implications for physical activity learning?

Method

Search strategy and inclusion criteria

This study employed a focused systematic review design to examine how ethics is conceptualised and positioned within digital learning research, prioritising conceptual depth rather than comprehensive coverage. The review followed PRISMA 2020 guidelines to ensure transparency, replicability, and traceability in the identification and selection of studies (Grant & Booth, 2009; Page et al., 2021).

Literature searches were conducted in the Scopus database due to its extensive coverage of peer-reviewed publications in educational technology and its consistency in indexing high-quality research. Searches were conducted in late 2025 using a structured Boolean query combining keywords related to ethics, digital technology, and learning contexts: (“digital ethic” OR “data protection” OR “cybersecurity” OR “ethical use”) AND (“digital technolog” OR “educational technolog*”) AND (“teaching” OR “learning” OR “education”). The search was limited to publications between 2015 and 2025. The initial search yielded 518 records. All documents were exported in CSV and RIS formats and managed using Mendeley for deduplication and reference organisation.

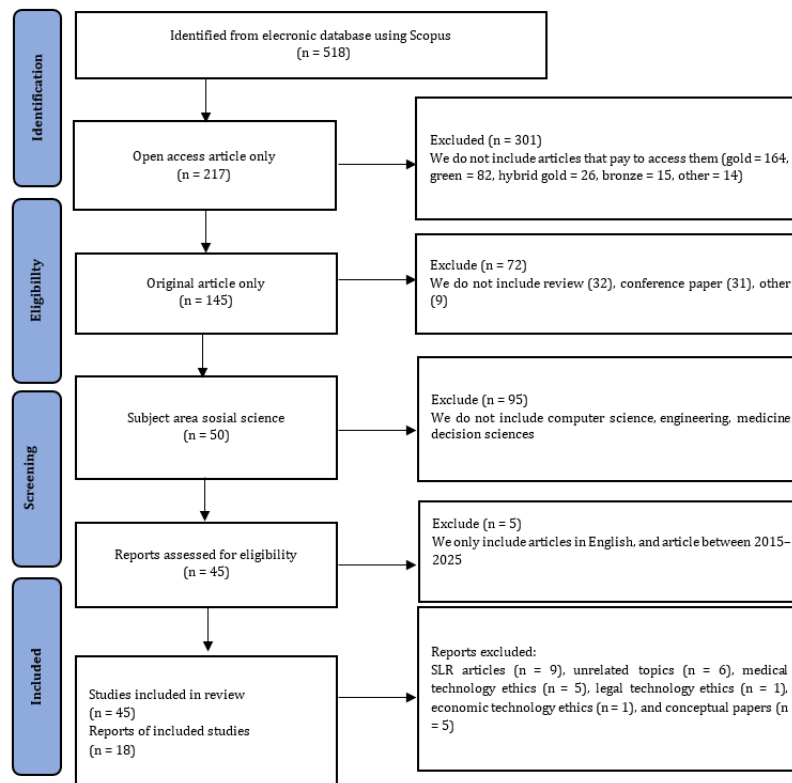
Study selection was conducted in three stages, namely title screening, abstract screening, and full-text review, based on predefined inclusion criteria:

- 1) Open-access articles;
- 2) Empirical research, excluding reviews, editorials, and opinion pieces;
- 3) Situated within the social sciences;
- 4) Written in English;
- 5) Published between 2015 and 2025;
- 6) Explicitly addressing ethical dimensions of digital technology use in learning.

Screening was conducted independently by two researchers to reduce selection bias. Discrepancies between reviewers were resolved through discussion and negotiated consensus until agreement was

reached. This review was intentionally designed as a focused systematic review prioritising studies that position ethics as the primary analytical lens rather than as a secondary implication of technological adoption (Grant & Booth, 2009). Studies that mentioned ethics only implicitly, did not centre on learning contexts, or lacked methodological clarity were excluded during the screening process to ensure conceptual depth and analytical relevance. A total of 18 articles met all inclusion and methodological criteria and were retained for analysis, as illustrated in the PRISMA flow diagram (Figure 1).

Figure 1. PRISMA flow diagram of study selection



This relatively small number reflects the intentionally selective nature of the focused review, which prioritised studies explicitly positioning ethics as a primary analytical lens rather than as a peripheral consideration in digital learning research. Quality appraisal was conducted using criteria adapted from established systematic review appraisal principles, focusing on methodological transparency, clarity of research objectives, appropriateness of research design, adequacy of data sources, and coherence of analysis (Gough, 2007). Appraisal functioned as a baseline screening mechanism to ensure methodological credibility rather than to rank or weight study findings.

The selected studies were analysed thematically using qualitative content analysis (Elo & Kyngäs, 2008; Hsieh & Shannon, 2005). The analysis proceeded through iterative stages of familiarisation, open coding, category development, and cross-study comparison to identify recurring patterns in research focus, ethical issues, and reported risks. Coding was conducted manually by the research team. Inter-coder agreement was achieved through iterative comparison, discussion, and negotiated consensus, a common procedure in qualitative systematic reviews to ensure analytical consistency (Ridder et al., 2014).

This analytical process enabled cross-study conceptual synthesis, identifying thematic structures that explain how ethical concerns are conceptualised, problematised, and operationalised within digital learning research.

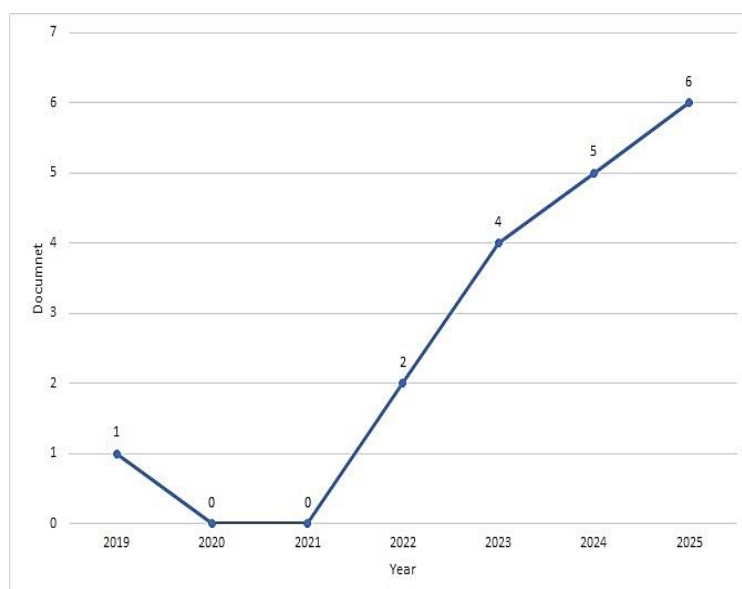
Results

This section synthesises findings from the 18 included studies to explain how ethical concerns emerge, cluster, and translate into risks within digital learning ecosystems. The analysis addresses three aspects: (1) the research landscape of ethics in digital learning, (2) key ethical issues identified across studies, and (3) ethical risks and implications associated with the use of digital technologies in learning.

Research landscape of ethics in digital learning (RQ1)

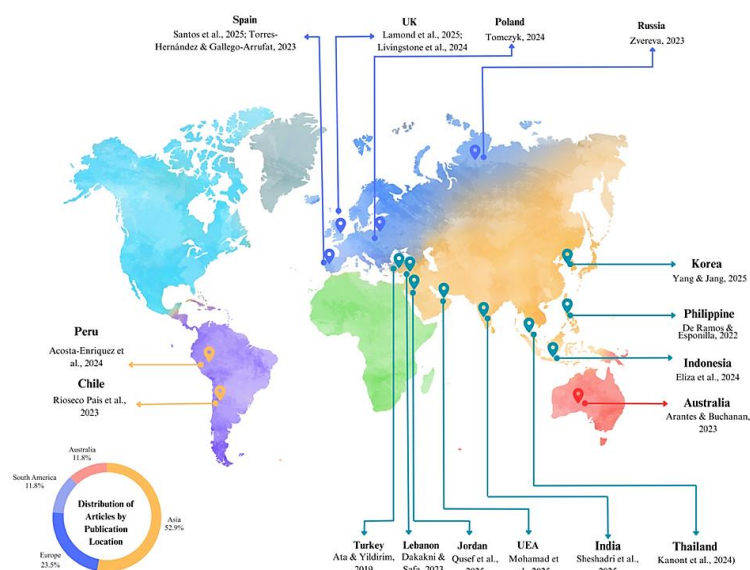
Temporal distribution indicates that research on ethics in digital learning is relatively recent and has intensified after 2022. Within the 2015–2025 search period, the first study meeting the inclusion criteria appeared in 2019 (Ata & Yildirim, 2019), followed by a more consistent increase between 2022 and 2025. This pattern suggests that ethical inquiry is emerging alongside the rapid expansion of data-driven and artificial intelligence-mediated learning practices, particularly in the post-pandemic educational contexts within the reviewed corpus (Arantes & Buchanan, 2023; Mohamad et al., 2025; Qusef et al., 2025; Sheshadri et al., 2025). This temporal trend is presented in Figure 2.

Figure 2. Temporal distribution of publications



Geographically, the reviewed studies originate from multiple regions, including Asia, Europe, South America, and Australia. This distribution indicates that ethical concerns in digital learning are not limited to technologically advanced systems but are also present in contexts undergoing rapid digital adoption (De Ramos & Esponilla, 2022; Eliza et al., 2024; Rioseco Pais et al., 2023). However, the represented landscape remains partial and reflects specific regional perspectives (Figure 3).

Figure 3. Geographical distribution of studies



In terms of technological focus, the literature covers data-driven and artificial intelligence-based learning systems, generative artificial intelligence, digital platforms such as learning management systems and mobile learning environments, and technologies in teacher education and professional development. Studies involving multiple technologies were classified according to their dominant learning-related use. This mapping provides a structured overview of how digital technologies are positioned in learning contexts and how ethical inquiry develops alongside their pedagogical integration (Table 1). Across categories, ethical concerns mainly relate to data governance, institutional preparedness, algorithmic decision-making, and digital competence gaps (Arantes & Buchanan, 2023; Ata & Yildirim, 2019; Livingstone et al., 2024; Torres-Hernández & Gallego-Arrufat, 2023).

Table 1. Focus of technology use in learning in the reviewed literature

Technology category	Primary focus	Representative studies (n = 18)
Artificial intelligence- and data-driven learning systems	Use of artificial intelligence, learning analytics, and machine learning to support personalisation, performance monitoring, and data-informed instructional decision making	Arantes & Buchanan, 2023; Qusef et al., 2025; Sheshadri et al., 2025
Generative artificial intelligence in education	Use of generative artificial intelligence tools, particularly text-based systems, as learning assistants to support task completion, learning activities, and assessment-related processes	Acosta-Enriquez et al., 2024; Dakakni & Safa, 2023; Kanont et al., 2024; Mohamad et al., 2025; Santos et al., 2025
Digital learning platforms	Use of platform-based digital learning ecosystems, including learning management systems, mobile learning applications, and cloud-based infrastructures, as the primary setting for digital learning ecosystems	De Ramos & Esponilla, 2022; Eliza et al., 2024; Livingstone et al., 2024
Digital technologies in teacher education	Use of digital technologies within teacher education and professional development contexts to support digital competence, pedagogical readiness, and professional practice in digital learning environments	Ata & Yildirim, 2019; Lamond et al., 2025; Riosco Pais et al., 2023; Tomczyk, 2024; Torres-Hernández & Gallego-Arrufat, 2023

Ethical issues identified in digital learning (RQ2)

Across the reviewed studies, ethical issues emerge as multidimensional and frequently intersecting. Individual studies often contribute to more than one ethical category. Mapping was therefore based on explicitly reported ethical concerns rather than the primary technology examined. The synthesis indicates that ethical issues form recurring patterns across technologies and educational levels, shaped by system autonomy, data practices, and user interaction in learning environments. Four major categories were identified, representing recurring ethical domains across the reviewed studies (Table 2).

Table 2. Ethical issues identified across the reviewed studies

Ethical issue category	Key ethical focus identified in the literature	Representative studies (n = 18)
Data privacy, protection, and educational data governance	Ethical concerns related to the collection, processing, storage, and governance of learner data in digital learning ecosystems, including limited data protection competence, unclear consent practices, institutional responsibility, platform governance, and risks of commercial data exploitation in artificial intelligence- and platform-based learning	Arantes & Buchanan, 2023; Livingstone et al., 2024; Qusef et al., 2025; Sheshadri et al., 2025; Torres-Hernández & Gallego-Arrufat, 2023; Yang & Jang, 2025
Academic integrity and ethical use of artificial intelligence	Ethical challenges associated with the use of artificial intelligence, particularly generative artificial intelligence, in learning, including plagiarism, overreliance on automated responses, declining critical thinking and originality, and the need for pedagogical frameworks and institutional policies to guide responsible artificial intelligence use	Acosta-Enriquez et al., 2024; Dakakni & Safa, 2023; Kanont et al., 2024; Mohamad et al., 2025; Santos et al., 2025
Digital security and user readiness	Ethical concerns arising from limited cybersecurity awareness, insufficient digital security competence, weak institutional infrastructure, and security practices that do not align with user age or context, increasing learner vulnerability in digital and mobile learning environments	De Ramos & Esponilla, 2022; Eliza et al., 2024; Lamond et al., 2025; Rioseco Pais et al., 2023
Equity, changing roles, and responsibility in digital learning ecosystems	Ethical issues related to unequal access and digital competence, shifting professional roles of educators, digital citizenship, and institutional responsibility to ensure that digital and artificial intelligence integration is equitable, inclusive, and aligned with educational ethics	Arantes & Buchanan, 2023; Ata & Yildirim, 2019; Mohamad et al., 2025; Qusef et al., 2025; Tomczyk, 2024

Data privacy, protection, and governance

Privacy, data protection, and educational data governance emerge as central ethical concerns at both individual and institutional levels. At the system level, studies report ethical challenges related to the collection, processing, storage, and governance of learner data, including unclear consent practices and potential commercial exploitation of educational data in artificial intelligence- and platform-based environments (Arantes & Buchanan, 2023; Livingstone et al., 2024; Qusef et al., 2025; Sheshadri et al., 2025).

At the individual level, learners and pre-service teachers demonstrate awareness of data-related risks but often report limited practical competence in data protection, regulatory compliance, and responsible data handling (Torres-Hernández & Gallego-Arrufat, 2023; Yang & Jang, 2025). Institutional responsibility is emphasised in relation to governance mechanisms, policy clarity, and the development of digital ethics frameworks to sustain trust and accountability (Arantes & Buchanan, 2023; Livingstone et al., 2024). Ethical complexity increases when teachers function as intermediaries between platforms and student data, particularly in artificial intelligence-supported personalisation and learning analytics contexts (Arantes & Buchanan, 2023; Qusef et al., 2025; Sheshadri et al., 2025).

Academic integrity and ethical use of artificial intelligence

Academic integrity represents a significant ethical domain in relation to generative artificial intelligence use in educational settings. At the learner level, studies highlight concerns about plagiarism, overreliance on automated responses, diminished critical engagement, and reduced originality in artificial intelligence-supported tasks (Acosta-Enriquez et al., 2024; Dakakni & Safa, 2023; Kanont et al., 2024; Santos et al., 2025). At the educator level, ethical perceptions influence decisions about whether and how artificial intelligence tools are integrated into teaching practice (Acosta-Enriquez et al., 2024; Mohamad et al., 2025). At the institutional level, the absence of clear pedagogical frameworks and policy guidance is identified as a factor contributing to ambiguity in responsible artificial intelligence use and academic accountability (Dakakni & Safa, 2023; Kanont et al., 2024; Santos et al., 2025).

Digital security and user readiness

Digital security and user readiness constitute a distinct ethical concern in digital learning ecosystems. At the learner level, several studies report limited cybersecurity awareness, insufficient data protection practices, and gaps in threat recognition and incident response (De Ramos & Esponilla, 2022; Rioseco Pais et al., 2023).

At the institutional level, limitations in infrastructure, internal digital security capacity, and policy implementation further contribute to learner vulnerability in platform-based and mobile learning environments (Eliza et al., 2024; Lamond et al., 2025).



Equity, changing roles, and responsibility in digital learning ecosystems

Structural ethical concerns relate to unequal access, evolving educator roles, and institutional responsibility in digitally mediated learning systems (Arantes & Buchanan, 2023; Ata & Yildirim, 2019; Mohamad et al., 2025; Qusef et al., 2025; Tomczyk, 2024).

At the educator level, digital transformation highlights the need for expanded competencies, including awareness of technological risks, data ethics, and responsible artificial intelligence integration in pedagogical practice (Ata & Yildirim, 2019; Tomczyk, 2024; Torres-Hernández & Gallego-Arrufat, 2023).

At the systemic level, insufficient policy alignment and institutional support may reinforce inequalities in access, participation, digital competence, and decision-making power within data-intensive educational ecosystems (Arantes & Buchanan, 2023; Qusef et al., 2025).

While RQ2 identifies recurring ethical issue domains across digital learning contexts, the reviewed studies extend beyond describing concerns. Many explicitly articulate the potential consequences that may emerge when these ethical issues remain insufficiently addressed. The analysis therefore moves from identifying ethical domains (RQ2) to examining their associated risks and systemic implications (RQ3), highlighting how ethical concerns translate into concrete vulnerabilities within digital learning ecosystems.

Ethical risks and implications of digital technology use in learning (RQ3)

Beyond identifying ethical issues, the literature explicitly describes risks and implications emerging from the use of digital technologies in learning. These risks operate across individual, pedagogical, institutional, and systemic levels and are closely linked to technological autonomy, data governance practices, and user readiness.

Four major categories of ethical risk were identified, linking ethical concerns to their systemic implications within digital learning ecosystems (Table 3).

Table 3. Risks and ethical implications identified across the reviewed studies

Risks and implications category	Key ethical risk focus identified in the literature	Representative studies (n = 18)
Risks to privacy, autonomy, and data rights	Risks of privacy violations and reduced learner autonomy associated with artificial intelligence- and data-driven learning systems, including opaque data practices, limited control over educational data, weak consent mechanisms, and dependence on platform governance and third-party providers in digital learning ecosystems	(Arantes & Buchanan, 2023; Livingstone et al., 2024; Qusef et al., 2025; Sheshadri et al., 2025; Torres-Hernández & Gallego-Arrufat, 2023; Yang & Jang, 2025)
Risks to academic integrity and learning quality	Risks to academic integrity and learning quality linked to the use of generative artificial intelligence, including plagiarism, overreliance on artificial intelligence outputs, a shift toward instrumental task completion, and weakening of critical and reflective thinking processes	(Acosta-Enriquez et al., 2024; Dakakni & Safa, 2023; Kanont et al., 2024; Mohamad et al., 2025; Santos et al., 2025)
Cybersecurity risks and user safety	Ethical risks stemming from limited cybersecurity readiness among users and institutions, including vulnerability to data breaches, account misuse, exposure to online threats, and misalignment between security practices and learners' developmental capacities in digital learning contexts	(De Ramos & Esponilla, 2022; Eliza et al., 2024; Lamond et al., 2025; Rioseco Pais et al., 2023)
Structural risks and equity concerns	Structural risks related to the reproduction of inequalities in access and digital competence, marginalisation of vulnerable groups, shifting ethical responsibility to educators without adequate institutional support, and the absence of governance frameworks ensuring equitable, inclusive, and responsible technology integration	(Arantes & Buchanan, 2023; Ata & Yildirim, 2019; Mohamad et al., 2025; Qusef et al., 2025; Tomczyk, 2024)

Risks to privacy, autonomy, and data rights

Data-driven and artificial intelligence-based learning systems introduce risks of privacy violations and diminished learner autonomy, particularly when data practices are opaque and governance mechanisms are unclear. Arantes & Buchanan (2023) show how teachers' engagement with commercial platforms can create tensions between pedagogical agency and platform dependency. Similarly, Livingstone et al. (2024) demonstrate that platform-based ecosystems such as Google Classroom may weaken children's data protection and expose learners to commercial data exploitation.

At the level of artificial intelligence-enabled analytics, Qusef et al. (2025) highlight concerns regarding algorithmic bias and limited transparency in systems used to identify learning difficulties. Sheshadri et

al. (2025) further report insufficient integration of sustained ethical and privacy analysis within educational data science practices. Complementing these findings, Torres-Hernández & Gallego-Arrufat (2023) identify gaps in data protection competence among pre-service teachers, despite relatively high levels of risk awareness. In professional settings, Yang & Jang (2025) describe ethical dilemmas arising from ambiguous governance frameworks and privacy vulnerabilities in digitally mediated clinical environments. Collectively, these studies indicate that risks to privacy and autonomy are intensified when user literacy, institutional safeguards, and regulatory clarity remain limited.

Risks to academic integrity and learning quality

The integration of generative artificial intelligence in learning environments is consistently associated with risks to academic integrity and learning depth. Dakakni & Safa (2023) document widespread unethical artificial intelligence use among second-language learners, including submission of artificial intelligence-generated work without authentic engagement. Santos et al. (2025) report similar concerns among teachers, particularly regarding plagiarism and diminished critical thinking in secondary education. Acosta-Enriquez et al. (2024) demonstrate that ethical concern significantly influences students' intention to use ChatGPT, indicating that perceived risk shapes behavioural adoption patterns. Kanont et al. (2024) find that ease of use may encourage instrumental task completion rather than meaningful learning engagement. Mohamad et al. (2025) further warn that excessive reliance on generative artificial intelligence in engineering education may weaken higher-order cognitive development and professional competence.

Across these studies, academic risk is framed not only as misconduct, but as a broader transformation of epistemic practices and assessment integrity in artificial intelligence-mediated learning contexts.

Cybersecurity risks and user safety

Cybersecurity risks emerge primarily from limited preparedness at both user and institutional levels. Eliza et al. (2024) report low cybersecurity readiness among university students in mobile learning contexts, particularly regarding regulatory awareness and incident response. De Ramos & Esponilla (2022) document recurring institutional vulnerabilities, including account misuse, malware exposure, and insufficient cloud security infrastructure.

Rioseco Pais et al. (2023) identify disparities in digital safety competence shaped by gender and educational background, suggesting uneven exposure to online risks. In primary education contexts, Lamond et al. (2025) reveal misalignment between cybersecurity practices and children's developmental capacities, especially in password management and phishing awareness.

These findings indicate that cybersecurity risks are systemic and pedagogical, not merely technical, underscoring the need for coordinated policy and institutional alignment.

Structural risks and equity concerns

Several studies identify structural risks associated with uneven access, competence gaps, and institutional governance limitations. Ata & Yildirim (2019) demonstrate that digital citizenship competencies among pre-service teachers remain inconsistently developed. Tomczyk (2024) argues that without comprehensive curricular reform, teacher education programs risk producing graduates insufficiently prepared for ethical digital integration.

Arantes & Buchanan (2023) show how platform governance structures can shift responsibility onto educators without proportional institutional support. Qusef et al. (2025) caution that artificial intelligence implementation without fairness safeguards may reproduce bias and disadvantage vulnerable learners. Mohamad et al. (2025) further highlight geopolitical and resource disparities influencing generative artificial intelligence adoption across educational contexts.

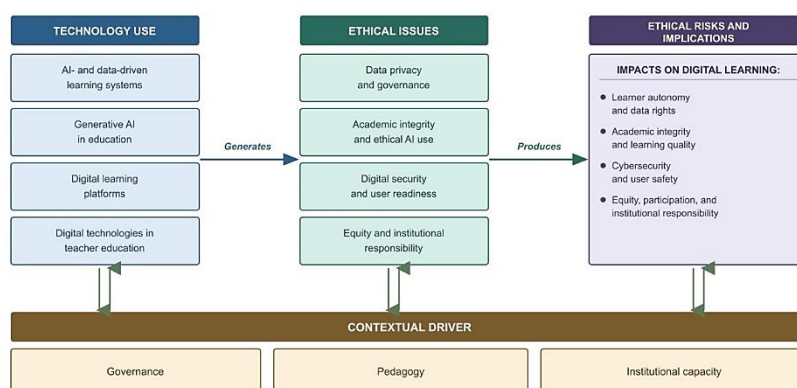
Together, these studies frame structural risk as the potential reproduction or amplification of inequality when digital transformation proceeds without equitable governance, institutional accountability, and inclusive policy design.

Discussion

This discussion integrates findings from the focused systematic review of studies that explicitly position ethics as an analytical lens in digital learning over the past decade. Rather than merely mapping issues, the synthesis frames ethics as a structural dimension shaping pedagogical quality, institutional responsibility, and the sustainability of digital transformation in education. In doing so, the synthesis advances a conceptual risk-structure framework that explains how ethical concerns evolve into systemic vulnerabilities within digital learning ecosystems.

To consolidate the relationships identified across RQ1–RQ3, Figure 4 presents a systemic model of the interaction between technology use, ethical issues, and emerging risks in digital learning ecosystems.

Figure 4. Systemic interaction of technology use, ethical issues, and ethical risks in digital learning



As conceptualised in the model, ethical issues emerge alongside technology use and may develop into multidimensional risks through governance-mediated conditions, including pedagogical practices and institutional capacity. The findings indicate that these issues are not isolated concerns, but mechanisms through which risks materialise when digital technologies are implemented without coherent systemic governance. Across the reviewed studies, such risks are recurrently embedded in technology design, platform dependence, and governance practices, particularly when ethical considerations are not integrated from the design and implementation stages.

These findings have implications for digital learning environments related to physical activity, where ethical risks extend beyond access, academic integrity, and data governance to include bodily engagement, performance monitoring, health-related information, mobile applications, wearable technologies, and platform-based feedback. Although not limited to physical activity education, the review offers a lens for examining privacy, autonomy, safety, equity, and institutional responsibility in active or movement-related learning. These risks become structural as ethical concerns are embedded in platform architectures, data practices, and algorithmic decision-making, shifting the focus from individual responsibility toward power relations, accountability, and institutional capacity.

From a temporal perspective, the increase in studies after 2022 may indicate a growing emphasis on reflective and normatively informed inquiry within educational technology research. Earlier studies often positioned ethics as implicit or secondary to technological adoption, while more recent studies foreground ethics as integral to understanding the long-term implications of data-driven and artificial intelligence-mediated learning.

Conceptually, the synthesis situates ethical issues, risks, and implications within a continuous analytical trajectory, where ethical concerns emerge alongside technology use, develop into identifiable risks, and affect pedagogical quality, learner autonomy, participation, and trust in digital learning ecosystems. However, these findings are limited to academic literature that explicitly uses ethics as an analytical lens and do not include policy documents, institutional reports, or grey literature. Future research should examine how ethical principles are operationalised in the design and governance of digital learning ecosystems across diverse educational, longitudinal, and activity-oriented learning contexts.

Conclusions

This study synthesised empirical research to examine how ethics is conceptualised and positioned within digital learning over the past decade. The findings indicate that ethical concerns are embedded in data-driven technologies, artificial intelligence systems, and digital platforms, and are closely associated with privacy, academic integrity, digital security, equity, and responsibility. These concerns do not operate in isolation, but evolve into risks that shape learning quality, learner autonomy, and the legitimacy of digital learning ecosystems.

By integrating findings across the reviewed studies, this article positions ethics as a structural dimension of digital learning rather than a secondary or reactive consideration. Ethical issues emerge through the interaction between technological affordances, pedagogical practices, and institutional contexts, especially when governance, user readiness, and instructional design are misaligned. The study contributes to a systemic understanding of responsibility, governance, and pedagogical accountability, while future research should examine how ethical principles are operationalised through institutional governance, pedagogical design, and policy implementation across diverse contexts, including physical activity learning environments where data governance, learner safety, pedagogical responsibility, and institutional accountability are central to trustworthy learning ecosystems.

Acknowledgements

The researchers, with Indonesian Education Scholarship (BPI) Registration Numbers 202231103682 and 202209091578, would like to express their sincere gratitude to the Indonesian Education Scholarship (BPI) for supporting this research through the Center for Higher Education Funding and Assessment (PPAPT) under the Ministry of Education, Culture, Research, and Technology and the Indonesian Endowment Fund for Education (LPDP), Indonesia, under Grant Nos. 03348/J5.2.3/BPI.06./10/2022 and 01099/J5.2.3/BPI.06/9/2022.

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