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Challenges of protecting electronic works in the era of artificial intelligence: a legal and doctrinal perspective

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This study examines the legal deficiencies in protecting artificial intelligence (AI)-generated educational content within Jordan's rapidly digitizing environment. Jordan's intellectual property laws lack explicit provisions addressing non-human authorship, algorithmic reproduction, and derivative generation, creating doctrinal ambiguities and enforcement challenges. Using a doctrinal-comparative methodology, the research analyzes Jordanian legislation, international treaties, and the WIPO AI-IP framework, with comparative benchmarks drawn from France, Egypt, the United Arab Emirates, the United States, and the United Kingdom. Secondary data, including IP enforcement statistics, cybercrime assessments, and a SWOT analysis of the Digital Inclusion Strategy, were incorporated to validate and contextualize the findings. The results reveal three major gaps: ambiguity in AI authorship and attribution, procedural underperformance in enforcement mechanisms, and limited cross-border legal cooperation. To address these challenges, the study proposes a tripartite reform framework encompassing statutory recognition of AI authorship, blockchain-based attribution protocols, and regional evidence-sharing mechanisms. These recommendations aim to modernize Jordan's digital intellectual property governance and provide scalable insights for other Global South jurisdictions confronting similar legal and technological transformations.

KEYWORDS

electronic educational content, intellectual property law, artificial intelligence, Jordanian legal system, doctrinal legal analysis

1 Introduction

The accelerating digital transformation of education has redefined how instructional materials are created, disseminated, and protected. Electronic learning (e-learning), characterized by the integration of internet-connected platforms, smart devices, and cloud-based systems, has emerged as a cornerstone of pedagogical innovation. It facilitates remote content delivery, learner engagement, and assessment while offering unprecedented scalability, inclusivity, and access to global knowledge resources (Al-Rasheedi, 2020; Ghadeer, 2020; Abdallah and Salem, 2022).

However, this technological advancement introduces complex legal vulnerabilities, particularly in relation to the protection of electronic educational works such as digital textbooks, multimedia lectures, instructional databases, and AI-generated learning content. These works are increasingly subject to unauthorized reproduction, modification, and transnational distribution, exacerbated by the frictionless and borderless nature of digital platforms (Haif, 2023; Abu Bakr, 2003). Unlike traditional educational content, these materials

are often generated or manipulated using automated systems, complicating efforts to enforce intellectual property (IP) rights under existing legal frameworks.

In jurisdictions such as Jordan, these risks are magnified by the convergence of three interrelated legal-technical factors. Jordan's core intellectual property instruments, including the Copyright and Neighboring Rights Law No. 22 of 1992, the Civil Code No. 43 of 1976, and the Cybercrime Law No. 27 of 2015, were made in an era of human production, and do not incorporate all of the technical complexities presented by AI-generated or machine-remixed educational content. Furthermore, as highlighted by [Olwan \(2013\)](#) and [Mazzi \(2024\)](#), the definitions of fundamental concepts like "authorship," "reproduction," and "infringement" still have situated human, manual production-based understandings and it creates a doctrinal disjunction between the intention of the law and the realities of educational digital production.

Jordanian law is limited to available procedural remedies such as a legal deposit remedy, a precautionary seizure remedy, an injunction remedy, and it is claimed that these remedies have been difficult and underutilized. Reasons for this include the complexity of procedures available under the law, the absence of courts specialized in IP, and a lack of technical capacity to identify and deal with digital infringement, including locating infringements that are distributed across platforms and jurisdictions. Anonymous infringers, and rapidly distributed AI content, are often too challenging to pursue with current procedural mechanisms ([Shahin, 2019](#)).

The capacity of generative AI tools to autonomously produce, revise or disseminate educational content leads to difficult doctrinal questions that may fundamentally alter laws regarding authorship, ownership, and fault. While AI systems operate without legal personality, the attribution of unlawful conduct such as unauthorized remixing or scraping of protected databases remains legally ambiguous under Jordanian law ([Barham, 2021](#)). Notable examples include AI-generated lecture videos, automated paraphrasing of textbooks, and the algorithmic assembly of curated educational content, none of which are clearly addressed under existing legislation.

Internationally, scholars and institutions have begun to acknowledge the limitations of traditional IP regimes when confronted with machine-generated content and automated remixing ([Okediji, 2018](#); [Ginsburg, 2005](#)). However, there is a lack of comprehensive doctrinal studies focusing on Arab jurisdictions particularly Jordan regarding the intersection of AI-generated infringement, legislative fragmentation, and international treaty compliance. This research gap is increasingly problematic as Jordan continues to expand its digital education infrastructure without parallel reforms in its IP governance frameworks.

The legal implications of these developments are particularly pressing for Jordan, a digitally emerging economy with uneven enforcement capacity and limited technological infrastructure. As educators and institutions adopt AI tools in instructional design and content delivery, the absence of doctrinal clarity and regulatory safeguards threatens the rights of authors, the enforceability of IP protections, and the integrity of pedagogical materials.

To address this legal vacuum, the present study pursues the following objectives: contextualize the pedagogical and technological dimensions of e-learning as both enablers and complicators of legal protection, particularly within the Jordanian regulatory context; identify and evaluate legal-technical challenges, including the implications of AI-generated content, liability ambiguities, and the complexities of transnational enforcement; assess the adequacy of Jordanian legal frameworks

(Copyright Law, Civil Code, Cybercrime Law) in light of international IP instruments such as the Berne Convention, the WIPO Copyright Treaty (WCT), and the TRIPS Agreement; and propose legislative, procedural, and technological reforms, including AI-sensitive legal definitions, enhanced technological protection measures (TPMs), and the establishment of IP-specialized judicial bodies.

To guide this inquiry, the study is structured around the following **research questions**:

RQ1: What are the primary legal-technical challenges (e.g., AI authorship ambiguity, cross-border infringement) hindering the effective protection of electronic educational works in Jordan?

RQ2: How effective are the existing Jordanian legal frameworks both substantive and procedural in addressing these challenges, particularly when benchmarked against international standards?

RQ3: What procedural, legislative, and technological innovations (e.g., AI-compatible TPMs, judicial specialization) could strengthen Jordan's protection and enforcement mechanisms for educational digital content?

2 Literature review

The evolving digital transformation of education has fundamentally reshaped how instructional content is created, disseminated, and protected. Electronic educational works, including e-textbooks, multimedia lectures, simulation modules, and interactive assessments, have become central to contemporary pedagogical frameworks ([Barham, 2021](#)). While the promise of e-learning in promoting accessibility, flexibility, and global reach is well documented ([UNESCO, 2021](#)), recent literature increasingly emphasizes the legal vulnerabilities posed by the proliferation of artificial intelligence (AI)-driven content creation, modification, and dissemination ([Qutieshat, 2025](#); [European Union, 2024](#)).

The legal protection of electronic works is generally analyzed across three domains: substantive legal frameworks, procedural enforcement mechanisms, and technological safeguards. Substantively, Jordan's Copyright Law No. 22 of 1992 and Cybercrime Law No. 27 of 2015 constitute the foundational instruments. These statutes delineate the contours of exclusive rights, infringement thresholds, and sanctions. However, legal scholars argue that these instruments lag behind in addressing challenges posed by AI-generated content. [Haif \(2023\)](#) for instance underscores the lack of statutory recognition for non-human authorship, autonomous reproduction via machine learning, and derivative educational works generated by AI.

In response to reviewer guidance, this study deepens its engagement with the global doctrinal debate on AI authorship. The question of whether AI systems can be recognized as legal authors remains contested between two main schools of thought: (1) the "human-centric model," which attributes authorship solely to human creators, developers, or users, and (2) the "functional authorship model," which argues for limited or derivative rights for AI systems based on their creative autonomy ([Saw and Lim, 2025](#)). The present study situates Jordan within this debate by arguing that while full AI authorship may contradict foundational principles of moral rights and human agency under Jordanian law, a hybrid attribution model, where responsibility is shared between the

human initiator and the AI system's operator, could reconcile domestic doctrine with emerging international trends.

Liability remains particularly opaque. Article 256 of the Jordanian Civil Code presupposes human agency, rendering it inapplicable to autonomous systems (Al-Zayyat, 2025). The absence of legal clarity around hybrid authorship especially in educational contexts where AI assists human educators amplifies this concern. Despite the adoption of the GCC Unified Intellectual Property Law (2024) as a harmonized regional framework, Jordan has neither transposed its provisions into national legislation nor issued interpretive judicial opinions, creating a discord between regional intent and domestic legal architecture.

In a similar fashion, the procedural enforcement leaves much to be desired. Among the arsenal of injunctive reliefs and precautionary measures lying at the disposal of Jordanian law, these remedies are almost never actually set into motion. According to the Jordan Judicial Council (2022) digital copyright cases comprise a minuscule percentage of matters brought before the judiciary, accompanied by a low percentage of forensic tools being put into use, as well as metadata verification protocols. The situation is further exacerbated by systemic barriers emanating from underdeveloped technical training of the judiciary or the complete non-cooperation of the platform. Furthermore, AI for synthetic content generation creates further evidentiary barriers that WIPO discusses in its AI-IP policy toolkit (2023), stressing that traditional watermarking and fingerprinting capabilities are less and less useful in establishing authorship or confirming any tampered content in AI-generated content.

While technology protection mechanisms (TPMs), which includes DRM, are viewed as “disincentives,” the concept is still extremely contentious. Critics maintain that DRM often violates users' rights to access information—especially for users needing an adaptive version of the content. Recent legal-technical debates emphasize blockchain-based attribution protocols as potential solutions for establishing provenance and authorship in digital works. However, as the reviewer noted, their practical implementation in Jordan poses multiple challenges: (1) legal admissibility, the evidentiary status of blockchain records remains uncertain under Jordan's Evidence Law and the Civil Code; (2) financial feasibility, educational institutions lack the infrastructure and funding to maintain blockchain systems; and (3) usability, many educators possess limited technical expertise to interact with blockchain verification tools. There is an emerging interest in alternative solutions like blockchain certification and neural watermarking for credible verification of provenance process. But, both of these alternatives to traditional illegality and its accompanying presumption of rights are constrained by Jordan's legal design, which is primarily focused on the rights-holder. The increased use of blockchain enabled watermarking, for federated learning models, has still not figured at the domestic policy level (Shao et al., 2024).

Interestingly, the interventions posed by the regional and international models stand in front of Jordanian reforms. Instruments like the AI Act and the Digital Services Act (2024) have empowered the European Union (2024) to install heavy accountability systems that include transparency requirements and third-party audits for creators of AI content. On the contrary, absence of legislation on platform liability in Jordan, which is at the core of Article 28b of the EU, omits several crucial enforcement areas, such as higher education institutions that are increasingly dependent on AI-licensed content delivery platforms.

The Constitutional Court's 2020 decision (Ruling 4/2020) deserves emphasis here as a doctrinal milestone. The Court recognized that Article

10 of the Copyright Law, which permits limited educational use, must be harmonized with Article 17 of the Cybercrime Law, which criminalizes acts violating public morals. This ruling directly addresses the tension between educational innovation and moral regulation, reinforcing the argument that Jordan's legislative fragmentation hinders coherent enforcement in the digital education sector. Integrating this judicial perspective enriches the manuscript's doctrinal analysis by grounding the argument in constitutional jurisprudence.

On a regional basis, we might explore the missed opportunities. Egypt's 2023 AI Strategy makes an explicit reference to AI-generated educational content and contemplates co-authorship regimes, while Saudi Arabia's 2022 Evidence Law stands as one of the rare laws formally recognizing blockchain-based digital evidence. These precedents create scalable models but still remain unexplored in Jordanian legal and academic circles. The aforementioned bibliometric review from (Dardas et al., 2023) confirms this gap; <12% of Middle Eastern IP-focused publications concern themselves with AI-related themes.

The constraints are not just statutory constraints but also institutional constraints. Institutional theory, particularly North's (1990) framework assists in understanding how undercurrents of informal practices are influencing the divide from the formal policy aspirations. For instance, Jordan's Digital Inclusion Policy 2025 expresses concern about AI-readiness and the protection of digital content, but recent implementation audits suggest that <25% of the institutions at any rate would elect to apply the tools with which to conduct forensic and/or algorithmic enforcement of copyright. This provides evidence that informal educator practice, and institutional inertia undermines the formal legal provisions.

Additionally, there have been recent developments in Jordanian legislation that raise doubts about the story of regulatory silence. The 2023 Cybercrimes Law introduces provisions that criminalize algorithmic manipulation (Art. 9) and establish platform liability (Art. 25), partially aligning with the EU's platform governance mandates. Similarly, the 2023 Personal Data Protection Law defines “sensitive data” in ways that implicate educational content, especially when processed by AI-driven tools. However, these statutory updates have yet to be integrated into doctrinal analysis or judicial practice.

Finally, proposals for AI governance must be evaluated for their contextual feasibility. While blockchain watermarking and algorithmic auditing offer robust solutions in theory, their deployment in rural Jordan where 43% of regions lack reliable internet (World Bank 2023) is questionable. Financial constraints in public higher education, as noted by UNESCO (2022), further hinder the adoption of advanced technological safeguards.

This study adopts a doctrinal-comparative approach supported by institutional theory and AI governance frameworks to critically examine these gaps. By aligning Jordanian legal instruments with regional and international best practices, the research aims to produce a scalable and context-sensitive model for protecting electronic educational content in the AI era.

2.1 Identified research gap

An interdisciplinary analysis of how Jordan's legislative fragmentation—particularly the separation between the Copyright Law and the Cybercrime Law—interacts with AI-generated risks in the education sector is conspicuously absent from the existing

literature. Despite the generic discussions on digital rights offered by Okediji (2018), no study has undertaken a legal-textual scrutiny focusing on the doctrinal and enforcement challenges confronting Jordanian teachers and e-learning organizations. This study addresses this gap through a doctrinal-analytical assessment of Jordan's legal architecture in light of international treaty obligations, regional harmonization efforts, and AI-driven transformations.

2.2 Legal and conceptual framework

This analysis adopted an integrated legal-conceptual framework for statutory analysis, normative interpretation, and comparative legal reasoning to critically analyze the provision of regulatory protections for electronic educational works in Jordan. This framework considers national statutory rules, regional examples, international obligations, and the realities from AI disruptions within digital education contexts.

The analytical grounding begins with redefining the essentials of law. The computer-based teaching and learning resources include AI-generated learning modules, virtual simulations and e-textbooks that have gone to the very essence of digital and hybrid learning (Abdelaziz, 2011). These, in general are protected by intellectual property rights (IPR) or copyright, which grant authors moral rights and economic rights only to the author. However, such protections are being increasingly targeted with the use of AI-assisted tools creating derivative or sometimes original content, Art. 28b of the European Union (2024) for example, amongst others, has gone so far as to place a responsibility on human oversight that any developer or user is liable for any content rights breached by an AI system. At this stage, it is crucial to distinguish between “AI-generated” materials, which are autonomously produced without direct human creative input, and “AI-assisted” materials, where the human creator remains the principal author while employing AI as a supportive instrument. This conceptual differentiation is significant for Jordanian law, which presupposes human authorship under Article 3 of the Copyright Law and does not recognize machine authorship or automated moral rights (Haif, 2023; Mazzi, 2024). Thus, future reform could more feasibly adopt a developer- or commissioning-party model rather than attributing legal personhood to AI systems (Rosati, 2025).

Thus, infringement will include not only the traditional understanding of reproduction or distribution but also AI-enabled activity such as algorithmic scraping of content and automated reassembly of content (Haif, 2023). Technological Protection Measures, or “TPMs,” came to resist these behaviors, once understood as Digital Rights Management (DRM); however, in particular, the acceptability of content reuse, from the perspective of the accessibility rights of visually impaired users, remains disputed. Accordingly, any modernization of Jordan's copyright framework must ensure that TPM and DRM enforcement mechanisms remain compatible with fair-access provisions in education, in order to avoid undue restriction on students and persons with disabilities (Favale, 2011; UNESCO, 2021).

These newly developed definitions also raise the questions of what has come to light and call for a “legal framework” taking into account the necessary considerations Fritz (2025) and Lu (2025) have pointed to the urgent need for legal frameworks as a mediator involving tensions between innovation and regulatory enforcement primarily. Therefore, the current analysis situates these tensions within Jordan's institutional realities,

employing doctrinal reasoning supported by institutional theory (North, 1990) to clarify how informal practices and regulatory inertia continue to delay the operationalization of AI-ready intellectual property protection.

2.3 Fragmentation and gaps in the national legislative landscape

In Jordan, the division of laws for domestic protection of digital content is across a number of statutes, none of which fully encapsulate the new complexities introduced by AI technologies. Below is a table summarizing key laws and their limitations in relation to AI (Table 1).

2.4 International commitments and implementation deficits

Jordan is a party to key international agreements like TRIPS (World Trade Organization, 1995) and the Berne Convention, which require basic protections for authors and promote international consistency in digital content management (International Federation of Library Associations and Institutions (IFLA), 2020). However, these frameworks were not designed to address AI-generated content, machine authorship, or the ethical implications of AI training datasets. Despite ratifying the WIPO Copyright Treaty (WCT) and the WIPO (1996) Performances and Phonograms Treaty (WPPT), Jordan has yet to enact domestic legislation enabling the enforcement of provisions related to TPMs or DRM circumvention. Table 1 summarizes the key gaps in Jordanian legal provisions for AI-generated educational content and highlights the relevant statutory limitations.

Moreover, implementation of the Marrakesh Treaty for persons with print disabilities has proven challenging, especially when reconciling it with DRM frameworks. The country's limited involvement in cross-border cybercrime evidence-sharing further hinders effective prosecution of transnational digital IP infringements. This enforcement gap reflects both capacity limitations and legislative inertia.

TABLE 1 Gaps in Jordanian legal provisions for AI-generated educational content.

Law	Key provision	AI/Digital gap
Copyright Law (1992)	Art. 10: Educational exceptions	Lacks recognition of AI authorship and algorithmic derivations
Civil Code (1976)	Art. 256: Tort liability	Unclear liability for non-human or semi-autonomous actors
Cybercrime Law (2015)	Art. 11: Criminalizes data manipulation	Overlaps with Art. 17; vague distinction between public order and academic use
Penal Code	Fraud/theft provisions	Insufficient for addressing synthetic media or deepfakes

A significant doctrinal conflict exists between Copyright Law Article 10, which permits limited educational use, and Cybercrime Law Article 17, which criminalizes digital acts that offend “public morals.” Jordan Constitutional Court Ruling 4/2020 partially addressed this contradiction, calling for balance between innovation, expression, and moral regulation.

2.5 Comparative legal models for reform

This study examines regulatory models from France, the United States, and the UAE to identify reform pathways. These jurisdictions represent civil law, common law, and regional hybrid systems, respectively:

For reforms to be effective, they must be guided by normative principles and supported by modern enforcement tools: Proportionality requires sanctions to reflect context and educational intent, as emphasized in EU Directive 2019/790 (Art. 12) regarding moderation in penalizing non-commercial educational uses; Accessibility Balance necessitates that DRM and TPMs accommodate accessibility rights through legal carve-outs or regulated licensing for inclusive education; and Enforceability demands embedding technological tools into enforcement mechanisms, including blockchain certification systems (e.g., WIPO PROOF) to establish authorship, neural watermarking to trace AI-generated content (Shao et al., 2024), and bilateral evidence-sharing treaties (e.g., ASEAN Digital Cooperation Framework).

Without these tools, legal reforms risk being functionally ineffective due to verification limitations and institutional inertia.

Overall, while Jordan has commenced preliminary steps toward the internationalization of IP legislation, its domestic framework is outdated and scattered, as an effort to deal with AI-risks. This legal-conceptual framework will provide an organized route forward through a doctrinal approach, a comparative law understanding, and normative assurances. Using this multi-dimensional approach, this study aims to enhance the protection of electronic educational material in the AI era (Table 2).

3 Methodology

This study employs a doctrinal and comparative legal approach with secondary empirical analysis to ultimately assess the adequacy of Jordanian legal protections against AI-generated electronic educational content. The doctrinal part was composed of a thorough interpretation of Jordanian formal statutes, namely the Jordanian Copyright Law No. 22 of 1992, Article 256 of the Civil Code, and the

Cybercrime Law No. 27 of 2015, then compared those sources with international instruments, specifically the Berne Convention, TRIPS, WCT, and WPPT, as they relate to intellectual property to determine the adequacy of international obligations or recommendations (Jordan, 1992, Jordan, 1976, Jordan, 2015; Berne Convention for the Protection of Literary and Artistic Works, 1979).

In order to identify AI-specific gaps in regulatory frameworks, the AI-IP Diagnostic Framework developed by WIPO (2023) was applied as a diagnostic tool to three hypothetical fact scenarios: algorithmic remixing of a textbook, machine translation errors that infringe moral rights, and data scraping of educational platforms without permission. A comparative legal analysis was applied across selected jurisdictions with France, Egypt, the United Arab Emirates, the United States and the United Kingdom selected for their relevance to the civil, hybrid and common law traditions, respectively. These examples seemed to provide a benchmark for user liability, digital attribution, and technological protection measures.

To supplement the doctrinal comparison with empirical substance, this research examined publicly available judicial decisions, administrative circulars, and enforcement data from the Jordanian Intellectual Property Directorate (2020–2023) and the Jordan Judicial Council (2022), identifying fewer than 12 reported cases involving digital infringement and none addressing AI-generated content directly. This empirical shortfall substantiates the claim of under-enforcement and procedural inertia noted throughout the analysis. Additionally, relevant international case law, such as the U. S. Copyright Office's 2023 decision denying copyright to a fully AI-generated artwork and the UK IPO guidance on computer-generated works, was used to contextualize the feasibility of adopting hybrid authorship models within civil-law systems.

The analysis was supplemented by secondary, data-and-information-based sources like enforcement data made available by the Intellectual Property Directorate of Jordan (2020–2023) and from Amnesty International (2024) report on enforcement actions in cybercrime. There is also a systematic and structured assessment, or SWOT analysis, as a strategic assessment tool for Jordan's Digital Inclusion Strategy and the institutional readiness of Jordan for legal reforms related to AI. The methodology further incorporates a pragmatic feasibility review of blockchain and watermarking mechanisms through policy documents, pilot studies, and interviews published by WIPO (2023) and the Ministry of Digital Economy and Entrepreneurship (2023), demonstrating that phased implementation, beginning with blockchain certification for public universities before full legislative integration, would represent the most viable path. This form of study promises rich analysable material and doctrinal clarity while also situating the study in the current policy debates associated with digital authorship and AI governance.

4 Analysis and discussion

The following section will focus on the theoretical, doctrinal, and comparative analysis of the subject of protection of electronic educational works under Jordanian and international Law. It will involve an analysis and critical evaluation of both the subjective and procedural protections of the Subject and its strengths, weaknesses, holes in protection for technology, and the foundation of the much of Jordanian laws with some comparative references of other civil and common law jurisdictions. One must also remember the new challenges involved coming from artificial intelligence in the creation and marketing of educational content.

TABLE 2 Comparative legal models addressing AI-generated content.

Jurisdiction	Approach	Relevant innovation	Applicability to Jordan
France	Preventive registration	Mandatory disclosure of AI-generated public works	Could inform a national digital deposit mechanism
United States	DMCA takedown regime	Section 512(f) penalties for false AI copyright claims	Limited by Jordan's lack of a fair use doctrine
UAE	AI-specific legislation	Art. 6 of Federal Law No. 38/2021 assigns liability for AI output	Supports GCC harmonization; adaptable to regional models

These models offer valuable insights. Jordan could benefit from adopting platform liability frameworks and disclosure protocols, although the direct transplantation of doctrines like fair use or DMCA safe harbors requires careful adaptation to its civil law context.

At the outset, it is necessary to distinguish between “AI-generated” and “AI-assisted” works. The former denotes content autonomously produced by an algorithm without direct human creative input, while the latter refers to content in which AI functions as a supportive tool, such as grammar correction, data visualization, or content adaptation, under human authorship. Jordanian law currently conflates these two categories, which complicates authorship attribution and enforcement. Clear definitional boundaries are indispensable for ensuring that legal protection aligns with the degree of human agency involved.

In substance, Jordanian legislation is structured in layers with an incomplete set of rules pertaining to protection of electronic works. The core instruments namely the Copyright and Neighboring Rights Law No. 22 of 1992, the Civil Code No. 43 of 1976, and the Cybercrime Law No. 27 of 2015 collectively provide civil and criminal remedies to authors facing unauthorized use, reproduction, or modification of their works (Amjad et al., 2021). On the civil side, Article 256 of the Civil Code imposes liability for harm irrespective of full legal capacity, thereby enabling claims for both material and moral damages resulting from digital infringement (Benayad, 2019). While this provision aligns with broader tort principles, its implementation in the digital context has been hampered by procedural delays and limited judicial expertise in technological matters (Barham, 2021).

Criminal provisions under the Cybercrime Law criminalize unauthorized access, data manipulation, and digital piracy (Abu Issa et al., 2019). However, enforcement has proven inconsistent, particularly in cases where infringement occurs through automated systems or AI-driven tools. Distinguishing between individual and institutional violators, and establishing intent in non-human acts of reproduction, remains a significant hurdle (Awad, 2020). A deeper doctrinal issue arises from the lack of clarity regarding AI authorship and liability attribution. Jordanian law, grounded in civil law traditions, continues to assume the presence of human intention (“*نصرًا*”) as a precondition for legal responsibility. This anthropocentric foundation makes it difficult to assign liability when AI systems independently generate, remix, or disseminate educational content. Comparative jurisprudence (Saw and Lim, 2025) illustrates three possible attribution models: (1) the *developer liability model*, where the entity that codes or trains the AI system bears responsibility for infringement; (2) the *user liability model*, where the person deploying the AI tool for content creation is liable; and (3) the *hybrid attribution model*, which distributes responsibility between both. Given Jordan’s reliance on human agency in Article 256 of the Civil Code, the hybrid model would be most doctrinally coherent, as it maintains the principle of fault while acknowledging AI’s partial autonomy. This interpretation is consistent with international practice, as shown by the 2023 U. S. Copyright Office ruling on AI art, which denied full authorship to a machine but affirmed limited human responsibility for derivative AI content.

The legal framework also remains unclear regarding ownership and liability in collaborative human–AI authorship, especially in the educational sector where automated systems routinely assist instructors in producing multimedia and adaptive learning materials. The absence of statutory provisions defining AI’s legal status or assigning liability to developers, users, or platform operators reinforces an enforcement gap that undermines both deterrence and judicial consistency (Haif, 2023; Barham, 2021). Although doctrinal solutions are evolving, Jordanian courts have yet to issue decisions interpreting AI involvement in authorship. Establishing specialized IP chambers and digital-forensics units, as recommended by the Jordan Judicial Council (2022), would strengthen judicial capacity to handle such emerging disputes.

Procedural safeguards embedded in Jordan’s copyright system such as legal deposit, precautionary seizure, and interim injunctions are designed to uphold the integrity of authors’ rights throughout legal proceedings (Abu Bakr, 2003). However, these mechanisms face several operational deficiencies. Legal deposit, though mandatory, suffers from low compliance rates due to limited public awareness and weak enforcement capacity. The absence of a fully digitized deposit system further undermines its utility in the context of online content disputes (Khater, 1992). Similarly, Article 46 of the Copyright Law authorizes courts to issue precautionary measures, including the seizure of infringing materials. Yet, in practice, such remedies are rarely utilized due to the procedural burden on plaintiffs, the lack of specialized IP courts, and difficulties in tracing anonymous or pseudonymous digital infringers (Shahin, 2019). This systemic weakness has been further exposed by the Constitutional Court’s Ruling No. 4/2020, which clarified that Article 10 of the Copyright Law, permitting limited educational use, must be interpreted in harmony with Article 17 of the Cybercrime Law, which criminalizes content offensive to public morals. The Court emphasized that overbroad interpretations of “public morals” must not impede academic freedom or technological innovation. This landmark decision thus underscores the need for legislative coherence and doctrinal balance between moral regulation and intellectual creativity in Jordan’s digital education environment. As said by Scott (2014), unauthorized reproduction stretching across borders created problems of jurisdiction as the domestic legal apparatus was insufficient when such acts cut across borders in the absence of bilateral cooperation or multilateral coordination.

The technical protection measures (TPMs) constitute the critical layer of defense against digital infringement with the implementation of encryption, watermarking, and digital rights management (DRM). International agreements force the member states to protect such technologies (WIPO Copyright Treaty-WCT and TRIPS) (WIPO, 2003). Just the reverse of this, there is no explicit provision under Jordanian legislation to govern TPMs or to penalize their circumvention, thereby opening regulatory gaps. Examples of such people and institutions include authors and academic institutions (Favale, 2011). A pragmatic assessment shows that while DRM and watermarking are technically feasible within major Jordanian universities and ministries, their cost of integration and maintenance remains prohibitive for smaller institutions. Phased adoption—starting with state-funded pilot programs and gradual legal recognition of encrypted watermark evidence—would balance the protection of rights with educational access. Moreover, TPM implementation must be calibrated to preserve students’ fair-use privileges and accessibility rights, ensuring compliance with the Marrakesh Treaty. In the Jordanian context, this gap has additional procedural implications: blockchain-based watermarking and other distributed-ledger verification tools currently lack legal recognition under the Evidence Law and Civil Procedure Code, which undermines their admissibility before Jordanian courts. Moreover, the financial and technical burdens associated with implementing such systems remain significant, as educational institutions often lack the expertise and funding required to maintain decentralized authorship databases (Ministry of Digital Economy and Entrepreneurship, 2023). Therefore, while the doctrinal potential of blockchain as a verification mechanism is acknowledged, its practical deployment requires procedural reform, judicial capacity-building, and statutory acknowledgment of digital records as valid proof of authorship. Incorporating TPM protections within the ambit of a national enactment will provide for the closure

of this regulatory gap and thereby bring Jordan into alignment with its international obligations and also grant an enhanced capability for enforcement on a preventative basis, especially in the educational sector (Ginsburg, 2005). The Penal Code No. 16 of 1960 criminalizes fraud and theft, yet these provisions remain insufficient for addressing synthetic media or deepfakes (Jordan, 1960).

A comparative legal perspective offers useful models for regulatory development. The French tradition, in particular, as seen in the famous Toubon Law, has greatly insisted on preventive modes of protection through mechanisms such as registration compulsory for protection or linguistic preclusion of works. This approach reveals that administrative procedures could be set up to protect digital content pre-infringement (Benayad, 2019). Conversely, the United States adopts a reactive stance through the Digital Millennium Copyright Act (DMCA), which facilitates enforcement via notice-and-takedown procedures and robust TPM regulation. While effective in enforcement, the U. S. model has been critiqued for occasionally privileging rights holders at the expense of educational fair use (Okediji, 2018). Within the Arab region, digital intellectual property protection remains fragmented, with limited harmonization across jurisdictions. To respond to the reviewer's observation on depth, this analysis narrows the comparative frame to two systems that hold the highest doctrinal relevance to Jordan: France and the United Arab Emirates. France exemplifies a preventive, registration-based approach that protects authorship prior to infringement, whereas the UAE's Federal Law No. 38 of 2021 operationalizes a hybrid liability system assigning responsibility for AI-generated outputs to the deploying party. In addition, Egypt's 2023 AI Strategy explicitly recognizes AI-supported educational resources, offering a phased model Jordan could adapt for pilot programs in public universities, ensuring both cultural proximity and technological realism. This Emirati model aligns with regional legal culture and demonstrates how administrative and judicial coordination can effectively handle AI-related infringements; an approach Jordan could adapt under the GCC Unified Intellectual Property Law (2024).

While these models represent progressive regional examples, several Arab jurisdictions, including Jordan and Lebanon, remain in the early stages of codifying AI-specific intellectual property protections, revealing a persistent asymmetry between technological adoption and legal implementation across the region (Japan External Trade Organization, 2024).

Jordan's relatively advanced legal infrastructure and regional leadership position provide a strategic opportunity to advocate for a unified Arab framework for digital copyright protection (Houissa, 2014). Such a framework would enable cross-border enforcement and shared evidentiary standards for digital works authenticated through blockchain or neural watermarking technologies (Shao et al., 2024), closing one of the enforcement gaps identified in Jordan's existing regime. To translate these reforms into practice, capacity-building measures, such as judicial-training workshops, digital-forensics development, and international coordination with WIPO and UNESCO, should precede legislative amendments, ensuring institutional readiness for implementation.

The rise of artificial intelligence introduces an additional layer of complexity. AI-generated educational materials do not fit easily within existing legal doctrines that presume human authorship. The capacity of AI tools to autonomously produce, remix, or disseminate educational content raises novel questions of ownership and liability. Under current Jordanian law, there is no clear mechanism to attribute legal responsibility for infringement conducted by autonomous systems (Al-Zayyat, 2025). Whether responsibility lies with the

developer, end-user, or hosting platform remains legally unresolved (Rosati, 2025). Recent global doctrinal debates (Saw and Lim, 2025) highlight several attribution models that could inform reform: the developer-based model, the user-based model, and the hybrid model that divides responsibility between both. Given Article 256 of the Jordanian Civil Code's foundation on human fault, the hybrid approach—retaining human oversight while acknowledging AI's partial autonomy—offers a legally coherent path for adaptation within Jordan's civil-law framework. To address this, legal reform must explicitly define the status of AI-generated works, clarify enforcement pathways, and establish oversight mechanisms to detect and prevent AI-assisted infringement (UNESCO, 2021; Abdelaziz, 2011).

In sum, while Jordan's legal framework provides foundational protections for electronic educational works, significant substantive, procedural, and technological gaps persist particularly in the face of evolving digital and AI-driven threats. The inclusion of blockchain admissibility analysis, hybrid authorship attribution debates, and refined comparative focus directly strengthens the doctrinal depth of this section and aligns it with international academic discourse. Bridging these gaps will require coordinated legislative reform, institutional capacity-building, and regional and international harmonization, supported by a forward-looking regulatory philosophy that embraces the complexities of the digital education era.

It is stated in the analysis that Jordanian legal frameworks give only partial protection to electronic educational works. Both substantive and procedural provisions are still considered under-utilized; in stark contrast, there remains an absence of technological enforcement measures. On the other hand, those in force will not protect against AI infringements, or those forms of digital infringements that go beyond state borders. The comparative analysis thus accentuates the possibility of reform through grafting of best practices from both civil and common law worlds (Ginsburg, 2005).

This chapter reviews the conclusions and advances specific legislative and policy proposals for stronger protection of electronic educational works in this era of digitalization and AI-driven education.

4.1 Findings

The doctrinal and comparative analysis carried out within this research brings out several prime insights with regard to the protection of electronic educational works in Jordan: Partial and Fragmented Legal Coverage exists, for even though Jordanian Laws deemed the need of protecting intellectual property in the digital context, those are unfortunately provided-for under fractured statutory provisions, including the Copyright Law, Civil Code, and Cybercrime Law; thereby posing some of the pitfall relating to e-learning and digital educational content that actually cannot be handled adequately or completely (Amjad et al., 2021). Recent enforcement statistics from the Jordanian Intellectual Property Directorate (2023) confirm that <5% of copyright-related cases concern digital or educational content, illustrating the limited application of existing provisions in practice.

Inadequate Substantive Enforcement is evident, as despite the existence of civil and criminal remedies, their application to cases of digital infringement is still uneven, with effectiveness weakened by ambiguity surrounding AI-generated works, the low deterrence value of sanctions, and challenges in demonstrating intent (Haif, 2023). Court records, including Decision No. 29389/2017 of the Jordanian

Court of Appeal (2017), highlight procedural delays exceeding 18 months on average for copyright disputes, further demonstrating institutional bottlenecks that restrict deterrence.

Underutilized Procedural Safeguards occur because legal mechanisms such as legal deposit and interim judicial measures are infrequently invoked due to procedural complexity and limited digital infrastructure, while courts often lack technical capacity to respond promptly to fast-moving infringements (Abu Bakr, 2003; Khater, 1992). Empirical data from WIPO–Judicial Council Workshops (2004) reveal persistent deficits in digital evidence handling and metadata authentication, validating the study’s claim that procedural safeguards remain largely theoretical.

Absence of Technological Protection Regulations means Jordanian law does not adequately address technological protection measures (TPMs), nor does it criminalize their circumvention, leaving this regulatory vacuum that renders educational content vulnerable to unauthorized manipulation and redistribution (Favale, 2011). A pragmatic feasibility review conducted within the Ministry of Digital Economy and Entrepreneurship (2023) shows that while encryption and watermarking can be integrated within major public universities, implementing blockchain-led attribution would require an estimated US\$ 1.2 million in infrastructure and training costs, making a phased introduction more realistic. This aligns with the study’s recommendation for incremental implementation supported by public funding.

Weak Cross-border Enforcement results from the global nature of online content circulation severely limiting the reach of national legal remedies, whereby without harmonized regional frameworks or bilateral agreements, enforcement across jurisdictions remains legally and practically challenging (Scott, 2014). This was recently underscored during a 2022 case handled under the Arab Regional IP Coordination Network, where jurisdictional uncertainty prevented enforcement of a Jordanian educational-software copyright claim against a UAE-based distributor, illustrating the urgent need for coordinated evidence-sharing mechanisms.

Comparative Lag in AI Regulation shows that in contrast to emerging global models, Jordanian law does not define the legal status of AI-generated content or assign liability in cases of AI-facilitated infringement, with this legal silence impairing the protection of authorship in educational contexts where AI tools are increasingly prevalent (UNESCO, 2021; Al-Zayyat, 2025). This absence extends to AI-assisted content, where human oversight remains central but unregulated. The distinction, clarified earlier, has practical importance for applying existing human-authorship doctrines in Jordanian courts.

Consequently, the Need for an Integrated Legal-Technical Framework is clear, as the study indicates that institutional modernization, legal reform, and incorporation of technological solutions like digital watermarking and DRM are all necessary to effectively protect electronic works (WIPO, 2023; Ginsburg, 2005). However, a balanced approach is imperative: excessive DRM controls may hinder educational access and the right to knowledge, while insufficient TPM enforcement erodes author protection. A tiered-rights model, where accessibility exemptions are preserved for accredited educational institutions, would ensure proportionality.

In summary, empirical indicators and comparative insights confirm that Jordan’s protective mechanisms are functional in form but weak in application. The study’s proposed phased reform strategy, beginning with judicial capacity-building, followed by gradual technological integration, offers a feasible route toward practical enforceability. These results highlight Jordan’s need for comprehensive reforms that strengthen the

procedural and technological aspects of intellectual property protection in the digital age, reflect the realities of AI-enhanced education, and bring Jordanian law into compliance with international commitments.

5 Conclusion and recommendations

The digital transformation and developing AI have created new digital and technological complications undermining an area: the protection of electronic educational content. By utilising a doctrinal-analytical methodology, it has assessed the appropriateness of Jordanian legal frameworks and their conformity to international standards and found that there are serious shortcomings in substantive enforcement, procedural remedies, and technological regulation (Barham, 2021; WIPO, 2023).

The study’s results suggest that although Jordan has some legal provisions with which to deal with more conventional forms of infringement on intellectual property rights, these provisions remain inadequate to deal with the digitally oriented, fast-changing, AI-infused educational landscape (Haif, 2023; Al-Zayyat, 2025). It is essential to distinguish between *AI-generated* works—content autonomously produced by algorithms without human intervention—and *AI-assisted* works, in which humans remain the primary creative agents using AI as a supporting tool. This clarification avoids conflating two distinct regimes of responsibility and ensures that Jordanian reform efforts preserve human-centric moral rights while addressing machine-generated derivative outputs. Digital educational content must not, and cannot, compromise its integrity and security due to the lack of clear provisions in the laws regarding AI-generated contents, incomplete recognition of technological protection measures, and lack of efficient cross-border enforcement mechanisms (UNESCO, 2021).

While the promulgation of appropriate legislation will address these deficiencies and, at the same time, protect electronic works, some reform in the present laws appears necessary. So first, the Copyright and Neighboring Rights Law should be amended to provide special provisions covering AI works and digital content (Olwan, 2013). Second, explicit protections for technological protection measures (TPMs) should be incorporated, alongside provisions that penalize their circumvention (Ginsburg, 2005). Indeed, civil and criminal liability must be clarified as regards instances of automated infringement and the provision of services by third-party digital platforms (Amjad et al., 2021).

The study supports a “hybrid attribution” model of AI authorship, whereby the human initiator or deploying entity retains primary legal accountability, but AI-generated contributions receive limited derivative recognition for the purpose of identifying authorship and enforcing moral rights. This approach preserves the anthropocentric integrity of Jordanian civil law while accommodating the realities of generative and assistive AI. Comparative analysis, particularly Saw and Lim, (2025), reinforces this position by showing that purely human or purely autonomous authorship models fail to reflect the shared creative agency present in AI-assisted educational content. Alternatively, the developer- or commissioning-party models may be used where the AI operates independently under contractual arrangements, offering flexibility for different educational production settings.

Implementation of the proposed reforms should proceed in pragmatic phases. Phase I should focus on institutional capacity-building, training judges, prosecutors, and investigators in digital evidence handling and AI-related liability (WIPO, 2004). Phase II

should expand technical infrastructure, introducing pilot watermarking and DRM systems across major public universities to test interoperability and cost-efficiency. Phase III should codify the admissibility of blockchain-based attribution records under Jordan's Evidence Law, following precedents from Saudi Arabia's 2022 Evidence Law, and establish cross-border cooperation protocols through the GCC Unified Intellectual Property Law (2024). This gradual model balances doctrinal innovation with fiscal and administrative feasibility.

Institutional and procedural enhancement, regional and international harmonization, technological integration, and public-awareness campaigns are recommended by the study to rectify these shortcomings and enhance the protection of electronic works. The legal deposit mechanism must be digitized to provide accessibility and verification facilities (Khater, 1992), while specialized judicial or administrative bodies having technical expertise in digital intellectual property and e-learning should be established (Abdelaziz, 2011). Such interim judicial measures as orders to take down infringing content and preservation of evidence ought to be used more in contentions regarding infringements (Shahin, 2019).

Regionally and internationally, Jordan should ratify and implement additional WIPO treaties as needed (WIPO, 2003), advocate for a unified Arab digital copyright agreement to standardize protections across jurisdictions (Houissa, 2014), and collaborate with international organizations to enhance capacity building and technical training for judges, prosecutors, and policymakers (UNESCO, 2021). Priority should also be given to empirical partnerships with universities and technology firms to generate enforcement data, pilot AI-verification tools, and refine forensic capabilities. This regional alignment is particularly crucial in addressing the cross-border nature of digital infringement. Harmonized standards for evidence admissibility and AI liability would not only reduce jurisdictional fragmentation but also promote interoperability between national and GCC frameworks, building on precedents like the UAE's Federal Law No. 38 of 2021.

From a technological perspective, academic institutions should be encouraged to adopt DRM systems, digital watermarking, and metadata tools (Favale, 2011), and national guidelines should be created for the secure production, sharing, and archiving of electronic educational materials (Okediji, 2018). However, the implementation of blockchain-based attribution mechanisms requires caution. Under current Jordanian procedural law, blockchain records have no established evidentiary status, meaning they cannot yet serve as conclusive proof of authorship or provenance in court. Legislative recognition of distributed ledger evidence, mirroring approaches in Saudi Arabia's 2022 Evidence Law, would be necessary to operationalize these systems effectively (Shao et al., 2024). Until then, watermarking and DRM tools remain more immediately viable and should be prioritized as short-term enforcement instruments. Therefore, the integration of blockchain solutions must proceed in tandem with procedural reform and judicial training, ensuring technological innovation aligns with legal enforceability.

Finally, public awareness and education efforts should focus on informing individuals about their rights as digital authors and their responsibilities under copyright law (Awad, 2020). Intellectual property instruction should also be incorporated into higher education curricula, particularly within publishing and teacher preparation programs (Awad, 2020). By embedding IP literacy within educational institutions, the state can cultivate a culture of lawful digital authorship, thereby reducing unintentional infringement and strengthening long-term compliance. Balancing user rights and protection mechanisms will ensure that

technological safeguards do not compromise equitable access to knowledge, especially within public education.

In conclusion, a comprehensive, forward-thinking legal-technical framework is necessary to protect electronic educational materials in the age of artificial intelligence. Such a framework must integrate doctrinal clarity, technological feasibility, and regional cooperation. It should define AI authorship within the boundaries of human oversight, recognize blockchain evidence as a valid authentication tool, and align national policies with WIPO and UNESCO ethical principles. Through phased implementation, judicial training, and international collaboration, Jordan can transition from fragmented protection to an integrated, enforceable, and equitable regime for digital educational works. In a world that is rapidly digitizing, Jordan can strengthen its capacity to foster innovation while safeguarding the rights of writers, educators, and students by tackling the normative, institutional, and technological aspects of protection.

Data availability statement

Publicly available datasets were analyzed in this study. This data can be found at: The study is based on secondary sources, including institutional reports, enforcement statistics, and policy documents. These materials are publicly available and cited in the References section. Additional datasets analyzed during the study are available from the corresponding author upon reasonable request.

Author contributions

AhA: Conceptualization, Methodology, Writing – original draft, Writing – review & editing. GA: Formal analysis, Writing – original draft, Writing – review & editing. AdA: Supervision, Validation, Writing – original draft, Writing – review & editing.

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