Reimagining Peer Review: Insights from a Systematic Review of Decentralized Academic Publishing

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Abstract

Peer review is the backbone of scholarly trust yet remains opaque, inefficient, and misaligned with the incentives of modern academia. Drawing on a systematic review of seventy-nine studies examining reforms to peer review, this paper identifies recurring challenges—bias, reviewer fatigue, and lack of recognition—and synthesizes emerging solutions centered on transparency, decentralization, and incentive alignment. We argue that blockchain-based systems, particularly within the Cardano ecosystem, can offer verifiable, reputation-driven, and scalable alternatives that preserve academic rigor while addressing systemic weaknesses.

Introduction

For more than three centuries, peer review has served as the *consensus mechanism of science*: a distributed process through which experts validate and legitimize knowledge before it enters the scholarly record. Yet the system designed for an era of printed journals is straining under digital-age demands. Reviewers are overextended, decision timelines are lengthy, and the process is largely invisible to the public. Despite its flaws, peer review remains foundational to academic credibility. Consequently, the question is not whether peer review should continue, but how it might be re-engineered to preserve rigor while improving transparency, equity, and efficiency.

In this context, blockchain technology provides an intriguing parallel. Just as distributed ledgers secure financial consensus without centralized intermediaries, a decentralized peer-review architecture could record scholarly validation in a transparent and tamper-proof way. The Cardano blockchain, emphasizing verifiable identity, governance, and sustainability, offers a natural environment for testing such ideas. This paper summarizes the first stage of the Agnostica project—an extensive literature review of innovations in academic peer review—and highlights the insights most relevant to designing a blockchain-based review system.

Methods

This research followed the **PRISMA 2020** guidelines for systematic reviews. Searches were conducted in Google Scholar, PsycINFO, Scopus, EBSCO, and PubMed using refined Boolean logic to capture work related to *decentralized, open, or blockchain-enabled peer review*. From approximately 40,000 initial records, 500 were selected for screening; 234 abstracts were examined, and seventy-nine met inclusion criteria.

Articles were included if they analyzed or proposed peer-review models—traditional, open, or technology-enabled—and excluded if they merely presented research that *used* peer review without reflecting on its process. Two reviewers independently coded each article using a structured schema that captured both predefined themes and emergent patterns.

The predefined codes were: (1) incentives to publish, (2) incentives to review, (3) the peer review process, (4) critiques of peer review, (5) certification and reputation, and (6) technological infrastructure. Inductive coding revealed additional motifs such as *overlay journals*, *token economies*, and *reviewer recognition platforms*. Together, these codes provided a panoramic view of the shifting landscape of peer-review reform.

Results

1. Misaligned Incentives

Across disciplines, the literature documents profound misalignment between what academia rewards and what peer review requires. Publication output and journal prestige dominate career advancement, while reviewing remains unpaid and largely invisible. Studies suggest that roughly 20 percent of academics perform up to 90 percent of all reviews, a disproportionate load that fuels burnout and inequity. Authors such as Kovanis et al. (2016) and Warne (2016) emphasize that until reviewing is recognized as legitimate scholarly labor—through credit, certification, or remuneration—quality and participation will remain unstable.

Emerging proposals include *reviewer-of-record* badges, credit integration via ORCID and Publons, and tokenized reward systems in which reviewers earn reputation or utility tokens redeemable for conference discounts or submission priority. These mechanisms mirror decentralized finance's shift from altruistic participation to incentive-aligned contribution.

2. Critiques of Traditional Models

Traditional single- or double-blind peer review is criticized for opacity, bias, and inconsistency. Numerous studies describe gender, institutional, and regional biases favoring established scholars, as well as the absence of formal training for reviewers. Because reviews and decision letters are confidential, there is little accountability or opportunity for community learning. At the same time, the process is slow: months or years can elapse between submission and publication, delaying the dissemination of findings. Yet despite these weaknesses, most authors regard peer review as indispensable—arguing that reform, not replacement, is the path forward.

3. Emergent Models

Recent innovations experiment with transparency and timing. *Open Peer Review (OPR)* publishes reviewer names and reports; *Post-Publication Peer Review (PPPR)* invites public commentary after release; *overlay journals* curate reviews of preprints, decoupling certification from ownership. Each model tests a new balance between speed, openness, and rigor. Empirical work shows that transparency can improve civility and accountability, but may introduce new social pressures.

Technological augmentation is also expanding. AI-assisted review tools support scalability by screening manuscripts for quality or detecting plagiarism, while blockchain-based proposals ensure immutability and provenance of review data. However, automation raises questions about oversight and accountability—paralleling debates in algorithmic governance across other domains.

4. Certification, Reputation, and the Trilemma

The literature repeatedly returns to a “peer-review trilemma”: the difficulty of simultaneously achieving decentralization, scalability, and quality assurance. Traditional systems are decentralized and secure but inefficient; community review platforms are open and scalable but risk uneven quality; and centralized reputation systems enhance trust but reintroduce gatekeeping.

Solutions point toward hybrid architectures—distributed but identity-verified networks, where reputation accrues transparently on-chain. In such systems, reviewers’ past contributions inform their influence in consensus decisions, aligning incentives without sacrificing rigor.

Discussion and Conclusion

The findings highlight a field in transformation, propelled by digital infrastructure yet constrained by legacy incentive structures. The literature converges on a shared insight: *peer review is not broken, but misaligned*. Its strengths—distributed judgment, self-correction, and professional accountability—mirror the very principles that underlie blockchain consensus. Therefore, the challenge is not to replace peer review but to translate its logic into a transparent, verifiable, and economically sustainable framework.

Drawing from the review, we identify ten **actionable design insights** for building a decentralized peer-review system on Cardano:

1. **Transparent, Immutable Records:** Each submission and review should be permanently recorded on-chain to ensure accountability.
2. **Open but Accountable Review:** Reviews published alongside articles foster transparency and professional conduct.
3. **Tokenized Incentives:** Reviewers should receive on-chain rewards tied to quality and timeliness, verified through community or editorial ratings.
4. **Reputation Systems:** Reviewers' cumulative history should generate verifiable reputational scores, serving as a proxy for trustworthiness.
5. **Quality Control Mechanisms:** Layered validation—editorial, algorithmic, and community-based—maintains rigor despite decentralization.
6. **Dispute Resolution:** Smart-contract-based appeals and community arbitration provide transparent mechanisms for addressing conflicts.
7. **Decentralized Governance:** A DAO model empowers stakeholders to vote on editorial policies, token economics, and platform evolution.
8. **Verified yet Private Identities:** Integration with systems such as **Atala PRISM** or **ORCID** allows verification without exposing personal data.
9. **Scalability Optimization:** Employ layer-2 or off-chain indexing to manage throughput and transaction cost.
10. **Interoperability:** Align with DOI, ORCID, and institutional repositories to encourage adoption by traditional academia.

Together, these principles sketch a blueprint for *Agnostica's next development phase*: an open-source, Cardano-native protocol that redefines peer review as a decentralized consensus process. The long-term vision is an ecosystem where reviewers, authors, and readers are all stakeholders in the integrity of scholarly communication—where

transparency replaces opacity, incentives reward rigor, and trust is earned through verifiable contribution rather than institutional prestige.

In short, the literature signals a moment of convergence: academic publishing and blockchain technology are approaching the same frontier—the creation of decentralized, auditable systems of knowledge validation. Building upon this foundation, Cardano's infrastructure offers a path toward peer review that is not only *trusted* but *trustless*, ensuring that scientific legitimacy is governed by the collective intelligence of its community.