

# Decentralizing Scholarly Publishing: An Innovative Blockchain Approach in Sea of Wisdom

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## Abstract:

*In the swiftly changing world of academic publishing, the Sea of Wisdom platform seizes the opportunity to innovate. By combining the technologies of blockchain, decentralized finance (DeFi), and Non-Fungible Tokens (NFTs) with traditional scholarly communication, we present a groundbreaking, decentralized solution. Our design, although adaptable, primarily uses Ethereum's Virtual Machine, tapping into its robust scientific community.*

*In der sich schnell verändernden Welt des akademischen Publizierens ergreift die Sea of Wisdom-Plattform die Chance zur Innovation. Durch die Kombination der Technologien von Blockchain, dezentraler Finanzierung (DeFi) und Non-Fungible Tokens (NFTs) mit traditioneller wissenschaftlicher Kommunikation präsentieren wir eine bahnbrechende, dezentrale Lösung. Unser Design ist zwar anpassungsfähig, nutzt aber in erster Linie die Virtual Machine von Ethereum, um die robuste wissenschaftliche Community zu nutzen.*

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## 1. Introduction

The rapid digitization of many sectors has exerted a profound pressure on organizations to keep pace with the evolving technological landscape and consumer digital demands. The scholarly publishing industry, which is integral to the diffusion of knowledge and scientific advancement, is no exception. The long-standing traditional model of publishing scholarly works has come under scrutiny, given the issues of opacity, delays in the review and publication process, and an often unfair remuneration model for authors and reviewers [1].

Simultaneously, as the scholarly publishing landscape is being critically assessed, we are witnessing the rise of promising technologies that offer transformative potential. One such technology is blockchain, which has been identified as a potent catalyst for sweeping societal and economic change [2]. From its inception in 2008, the disruptive capabilities of blockchain have been postulated to profoundly alter various business models and value chains across myriad sectors, from Fintech [3] to healthcare [4], music industry [5] and, as we propose in this paper, scholarly publishing [6].

In this study, we explore the challenges and opportunities that blockchain technology presents within the realm of scholarly publishing. The current discourse on the application of blockchain in this field is dichotomized between ardent optimists and cautious pessimists. Consequently, our goal is to offer a balanced and well-informed perspective on the value creation potentials of blockchain within this industry. Thus, the guiding research question we seek to address is:

RQ: How can the scholarly publishing industry create value with blockchain technology?

In answering the research question, we adopt a dual-strategy approach: creating an economic incentive structure for each participant and demonstrating an MVP of a decentralized publishing platform. The economic model caters to all stakeholders, ensuring fairness and promoting engagement. The MVP, embodied in the Sea of Wisdom platform, operationalizes the process, underlining blockchain's potential to reform scholarly publishing with enhanced transparency, immutability, and efficiency.

## 2. Previous Work

The scholarly work of Niya et al. (2019) illuminates the transformative potential of blockchain technology in academic publishing, however, the direct translation of these insights into a real-world application remains unexplored [6]. Similarly, Stojmenova Duh et al. (2019) provide a compelling discourse around cryptoeconomic incentives fostering cooperation among researchers, yet the practical implementation of this concept demands further elucidation [7]. Kosmarski (2020), while successfully outlining a number of challenges to blockchain adoption in academia, doesn't sufficiently focus on practical solutions to surmount these obstacles [8].

Our research and proposed platform organically grow from this solid groundwork laid by the aforementioned studies. We aim to address the identified shortcomings by not only advocating the theoretical application of blockchain technology in academic publishing but also operationalizing this theory via the creation of a Minimum Viable Product (MVP). We build upon the cooperative incentive structures proposed by Stojmenova Duh et al. (2019) and endeavor to demonstrate their functionality in a tangible context. Additionally, we respond to the challenges delineated by Kosmarski (2020) with practical solutions, illustrated through our platform. In this way, our

work contributes to existing literature by bridging the gap between theoretical potential and tangible execution in the application of blockchain technology to academic publishing.

The aspirational undertakings of numerous blockchain startups in academia, such as scienceroom.com [9], eurekaoken.io [10], DEIP [11], and orvium.io [12], further underline the aforementioned gap between theoretical postulations and practical implementation. Driven by the promise of creating a platform that transcends conventional repositories, these startups ambitiously sought to foster reputational and incentives systems, and introduce novel mechanisms for research management and collaboration.

Regrettably, the majority of these initiatives succumbed to the realities of execution, failing to progress beyond their aspirational conceptual stage to a functional Minimum Viable Product (MVP). This frequent failure to translate vision into viable execution – with Orvium standing as a notable exception – illustrates the need for a pragmatic, step-by-step approach to harnessing blockchain technology in the service of academic publishing [9, 10]. The contrast between the promise of transformative potential and the harsh reality of failed implementation underscores the necessity of our research and the platform we propose, which is designed to bridge this very gap.

### 3. Formulation of the Issue and Suggested Resolution

The pivotal element within our platform is a scholarly work - a manuscript or scientific paper proffered by the academic author. Traditional academic journals typically offer no financial incentive for authors to publish their research, with some even imposing charges for publication [13]. However, within the infrastructure of our platform, we shift this paradigm by recognizing each scholarly paper as an invaluable asset that provides an avenue for authors to accrue potential rewards.

Indeed, this conceptualization of an academic work as a distinct, ownership-verified asset corresponds seamlessly with the functionalities offered by Non-Fungible Tokens (NFTs). NFTs, unique cryptographic entities existing on a blockchain, can effectively provide indisputable proof of ownership. By wrapping each scholarly paper as an NFT, we foster a secure environment where authorship is cryptographically verified and protected. This system engenders not only an unprecedented level of transparency but also potential avenues for academic authors to realize the inherent value of their intellectual contributions.

We can postulate the work-as-an-asset idea in mathematical notations:

$$W = \text{Work}; \quad (1)$$

$$R = \text{Review}; \quad (2)$$

$$P = \text{Platform}; \quad (3)$$

We propose that the value  $V$  of the final product (scholarly paper) purchased by a reader is an additive function of  $W$ ,  $R$  and  $P$ .

Mathematically, this relationship can be expressed as:

$$V = f(W) + g(R) + q(P) \quad (4)$$

where:

$f(W)$  - value contributed by the work itself (e.g., originality, depth of research, importance of findings)

$g(R)$  - value added by the thorough review process (ensuring quality, correctness, and relevancy)

$q(P)$  - value provided by the platform (allowing for efficient distribution, communication between parties, and secure transactions)

This formulation indicates that a scholarly paper gains value not just from the inherent quality of the work itself, but also from the rigorous review process and the supportive platform that enables dissemination and dialogue around the work. As such, this model captures the comprehensive value proposition of purchasing and engaging with a scholarly paper on the SeaOfWisdom platform.

A. Monetary Incentivization and its Execution within the SeaOfWisdom Platform

- Author

Monetary incentives play an essential role within the SeaOfWisdom platform, serving to encourage authors, reviewers, and readers' active participation. Our platform revolutionizes the traditional academic publishing ecosystem by leveraging blockchain technologies to provide tangible rewards for all users involved in the publishing process.

Implementing this economically motivated construct within SeaOfWisdom is facilitated via the employment of an ERC-20 compliant token. This token serves as the primary medium of exchange within our platform, enabling a streamlined process for financial transactions and incentivization schemes. Authors are rewarded with these tokens for their contributions, reviewers receive tokens for their expert evaluations, and readers utilize these tokens to gain access to academic papers.

Our unique design cultivates an environment that fosters mutual benefit and continuous engagement within the scholarly publishing sphere, effectively driving the democratization of knowledge dissemination and acquisition.

- Reviewer

Central to the operational integrity of a decentralized publishing platform like SeaOfWisdom is the presence of high-quality content, which is largely dictated by the expertise and fairness of the individuals engaged in the reviewing process. We have instituted a mechanism within SeaOfWisdom whereby individuals possessing a PhD or a higher academic qualification can verify their expertise and partake in the reviewing process.

Upon the successful validation and publication of a paper, reviewers receive a one-time reward once a pre-defined number of purchases for the respective paper is achieved. This incentivization mechanism aims to ensure the participation of reviewers and upholds the quality of content on the platform.

This provision of a financial reward creates a compelling economic incentive for participation in SeaOfWisdom's reviewing process. Outside of traditional academia – teaching or engaging in a research program, opportunities for individuals possessing a PhD to monetize their academic qualifications are considerably limited. SeaOfWisdom disrupts this paradigm by pioneering a unique avenue for individuals to derive financial benefits directly from their scholarly credentials.

This transformative approach reevaluates the conventional understanding of a PhD qualification's value proposition, driving potential increased returns on the significant investment made in obtaining such a title. In effect, SeaOfWisdom imparts a tangible, monetizable value to the academic qualification itself, engendering a more robust and fluid academia-industry economic interplay.

In pursuit of transparency and immutability, every review, along with its associated metadata, is stored on IPFS. Each manuscript submitted for publication requires a minimum of two positive reviews before it can be officially published on the platform.

To deter fraudulent activities and uphold the integrity of the reviewing process, reviewers are necessitated to stake a deposit - a precautionary measure reminiscent of the Proof-of-Stake (PoS) mechanism in Ethereum 2.0, where validators are mandated to stake 32 Eth. The deposit staked by a reviewer in SeaOfWisdom, albeit significantly lower, serves a similar purpose. In instances where a reviewer exhibits unfair conduct, the staked deposit can be leveraged to impose penalties, thereby preserving the quality of content and the overall credibility of the platform.

- Reader

In the paradigm espoused by our platform, a scholarly paper, subjected to stringent scrutiny and approved by leading scholars with demonstrated track records (PhD or higher), is transmuted into a tangible asset bearing intrinsic value. This positions the work as a

highly desirable acquisition, stimulating a potent demand for purchase.

The principal readership is anticipated to emerge from both governmental and private academic institutions, inclusive of universities, libraries, research centers, and other entities engaged in scholarly pursuits. Reflective of their inherent value and popularity, the prices of these scholarly works are dynamically adjusted and denominated in the native SOW tokens. Furthermore, to ensure pricing stability and broaden accessibility, we envisage incorporating stable coins as an additional medium of exchange in the future.

Furthermore, we have built in mechanisms to actively encourage readers to engage deeply with the purchased work. In the subsequent versions of the platform, we plan to implement a dispute resolution mechanism, allowing users to initiate a dispute with the author, should they question any of the findings or referenced materials. Such disputes are initiated with a commensurate deposit of funds, serving to validate the sincerity of the disputant's intent. The resolution of such disputes is handled by an independent panel of reviewers, who, after evaluating the dispute, award the resolution funds to the party they deem to be correct.

Moreover, the platform is designed to motivate users to query the author and seek clarifications on points of interest or doubt. As an additional incentive, users have the option to tip the author for comprehensive and insightful answers, thereby creating a dynamic academic exchange that enriches the learning process and increases the inherent value of the scholarly work.

## B. Technical Implementation (fig. 1)

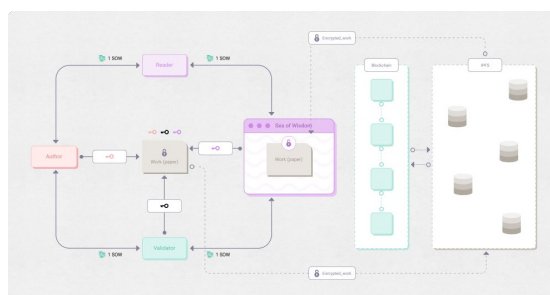


Figure 1: Diagrammatic Representation of the Decentralized Scholarly Publishing Platform, Grounded in Blockchain Technology.

**Blockchain:** The Blockchain serves as the unalterable digital ledger of this platform, housing all smart contract codes and transaction data. It provides a chronological record of transactions, including payments for paper access and rewards distributed to authors and reviewers.

**Frontend** (not shown in Fig. 1): The user interface is developed using HTML, CSS, and TypeScript, heavily relying on JavaScript libraries web3.js and ethers.js. The web3.js module is instrumental in enabling seamless interaction between the EVM-compatible blockchain and frontend elements. Authors, reviewers, and readers can interact

with the underlying blockchain and IPFS infrastructure through this intuitive browser interface.

*Interplanetary File System (IPFS)*: Upon an author's submission of a paper, the frontend oversees the transfer of the paper's content, along with its metadata, to IPFS. This action triggers the generation of a unique hash for the uploaded file, which is then recorded on the blockchain. This approach leverages IPFS to offset the exorbitant costs linked with storing files directly on the blockchain, while the unique hash functions as a permanent and unalterable link to the paper, ensuring reliable, decentralized access regardless of network conditions.

*Native token (SOW)*: The platform employs a native token, constructed on the Ethereum blockchain conforming to the ERC-20 standard. OpenZeppelin, a library for secure smart contract development, is used to ensure the security and reliability of the token. Readers use this token to gain access to scholarly papers, while authors and reviewers receive tokens as incentives for their respective contributions.

*Scientific Paper Token (SPT)*: In our quest to create an equitable, transparent, and decentralized academic publishing landscape, we introduce the Scientific Paper Token (SPT), a novel token standard inspired by Ethereum's ERC-721 protocol, a de facto standard for Non-Fungible Tokens (NFTs). Conceptualized and implemented as a smart contract on the Ethereum blockchain, the SPT operates at the intersection of technology, economics, and scholarly communication, presenting an innovative solution to long-standing problems in the publishing industry. At a high level, each instance of the SPT embodies a unique scholarly paper within our platform, ensuring the indivisibility and distinctiveness of the intellectual property it represents. It serves as a multi-faceted digital asset encapsulating vital attributes and operations pertinent to the lifecycle of an academic paper, including authorship, review, ownership, access, and remuneration. In addition to the common features of an ERC-721 token, the SPT incorporates several key enhancements catering specifically to the needs of the academic publishing ecosystem: *Ownership and Authorship*: The SPT is intrinsically tied to the original authors of the academic work it represents. The token is minted by the authors and, as such, establishes undeniable proof of authorship. It can also be transferred or sold, enabling the potential for a dynamic market in academic publishing rights; *Review and Approval Status*: Each token stores a mutable status field, indicating the approval status of the corresponding paper. This feature facilitates a transparent peer-review process; *Access and Expiry*: The SPT introduces a mechanism to control access rights to the associated scholarly work. It employs a mapping structure to store the access rights of individual users, alongside an expiry timestamp dictating the duration of this access; *Economic*

*Incentives*: The SPT holds an immutable initial price, setting a precedent for a fair, demand-based compensation model for authors and reviewers. In a broader perspective, the SPT serves as a foundational building block in our endeavor to restructure academic publishing. It fosters the much-needed transparency, and fairness, and by leveraging the power of the blockchain, enables a decentralized and democratized scientific community.

*Backend* (not shown in Fig. 1):: The infrastructure of the platform is developed in Golang adopting a microservice architecture, which enables a robust, modular backend. Each microservice is specialized for a specific task, including optical character recognition for uploaded papers, anti-plagiarism detection, and paper formatting, among others. These specialized services communicate seamlessly via the gRPC protocol, providing efficient service-to-service interaction. The services are also accessible as RESTful APIs, predominantly for internal use. However, future development plans include public API access, expanding the platform's capabilities to third-party developers, thereby fostering a comprehensive scholarly ecosystem.

#### 4. Operational Flow

This section provides an elaborate discourse on the operative schema of the proposed platform, encapsulating pivotal elements into business logic (Fig. 2):

- As an author, the user is enabled to upload their scholarly manuscript to the platform via the web interface, furnishing requisite metadata like the author's name, title of the paper, abstract, keywords, among others. Subsequent to this upload, the system mints a unique ERC721 token (Non-Fungible Token or NFT) on the Ethereum blockchain, symbolizing the author's proprietary rights over the uploaded manuscript.
- The manuscript, once uploaded to the InterPlanetary File System (IPFS), generates a distinctive hash that functions as a permanent locator to the manuscript. Leveraging the web3.js library, the web interface triggers a smart contract to inscribe the IPFS hash onto the EVM-compatible blockchain.
- Upon accruing two affirmative reviews, the manuscript is officially disseminated on the platform, thereby rendering it accessible for public acquisition.
- Readers inclined to access the manuscript remunerate the platform's native ERC-20 tokens, which are directly transferred from the reader's wallet to the author's wallet.

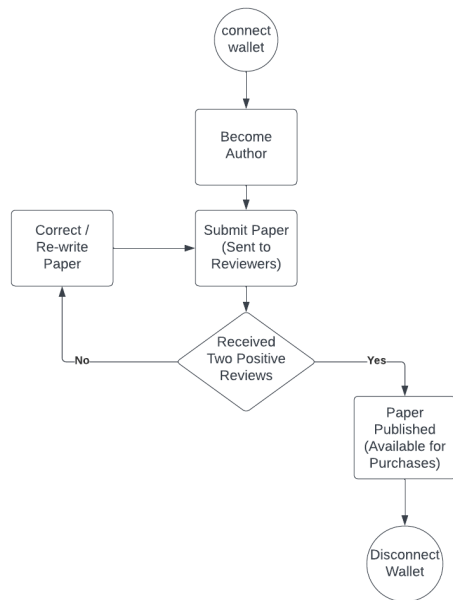


Figure 2: Illustration of the Scholarly Manuscript's Lifecycle, from Initial Submission to Final Publication on the Platform.

## 5. Conclusion

This research underscores the transformative potential of blockchain technology in academic publishing, aiming to bridge the chasm between theoretical propositions and pragmatic application. By developing a blockchain-centric platform, we have created a solution that tackles key issues in traditional scholarly publishing, including peer-review opacity, unfair remuneration, and restricted paper access.

However, we understand that technological progression comes with its unique set of challenges. Major constraints like mass adoption and plagiarism detection, albeit daunting, are surmountable through intuitive user interfaces, digital wallet tools like UniPass [14], and anti-plagiarism mechanisms [15].

In conclusion, our research is a decisive stride towards a more open, fair, and rewarding academic publishing ecosystem, despite recognizing that the path ahead demands continuous innovation, adaptation, and resilience.

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