Journal DAO: User-Incentivized Autonomous Decentralized Scientific Publishing in Web3

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***Abstract*—The academic publishing industry is currently experiencing significant growth but also faces several challenges. Transparency in the peer review process is lacking, which undermines fairness and objectivity. The anonymity of reviewers and their feedback makes it difficult for authors to understand the reasoning behind decisions and address potential biases. Additionally, there is a need to protect the rights of authors. While authors are recognized as the creators of their articles, in many cases, ownership and control of data lie with publishers or electronic journal databases, leaving authors with limited control. Furthermore, the current system often restricts authors' ability to share or collaborate on data.**

The emergence of Web3.0 signifies a significant evolution in the internet landscape, emphasizing decentralization, openness, and user control over data. Key features of Web3.0, such as decentralized network architectures, smart contract applications, and data privacy protection, offer new perspectives for academic publishing. Leveraging the immutability and transparency of blockchain technology can enhance the authenticity, security, and traceability of academic article data, while providing novel approaches to ownership and governance. Through the framework of decentralized autonomous organizations(DAO), a more equitable, transparent, and open organizational structure can be achieved, fostering collaborative development in academia.

This paper proposes an innovative academic publishing model called Journal DAO, which applies blockchain, DAO, and other emerging technologies to address these challenges. Firstly, by recording articles on the blockchain, all operations are conducted on the chain rather than belonging to a specific database, ensuring data security and traceability. Secondly, through the DAO framework, tokens are distributed based on role contributions, protecting the rights of researchers. Lastly, effective incentive mechanisms are established to reward all participants and ensure the sustainability of the framework, enabling it to function autonomously.

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***Index Terms*—DAO, smart contract, decentralized autonomous organizations, decentralized funding, decentralized science, DeSci, parallel DeSci, Web3**

I. Introduction

ACADEMIC paper face several challenges recently, including peer review, authenticity, and copyright. Firstly, lack of complete transparency in the review process. The traditional peer review system, often conducted anonymously, may not always ensure fairness and impartiality. The identities of the reviewers and their feedback are typically kept confidential, making it difficult for authors to understand the rationale behind decisions and address any potential biases. This lack of transparency can undermine the credibility and integrity of the review proces. Secondly, While authors are credited with the authorship of a paper, they often lack control over the various data associated with it. In many cases, the ownership and control of data reside with the publishers or electronic journal databases. This poses a challenge to authors in terms of retaining their rights and having the ability to decide on data sharing, data transformation, or deriving benefits from their own research. This lack of control over their own data not only hampers their ability to fully utilize and leverage their research but also limits their potential for collaborations and further advancements in their field. Thirdly, Academic papers rely on data to support their findings and conclusions. However, the current system often restricts the ability of authors to share or collaborate on their data. The data associated with a paper is typically stored within electronic journal databases or controlled by publishers, limiting the author's autonomy to decide on sharing, collaboration, or commercialization opportunities. This restriction hampers the progress of research as it impedes the free flow of knowledge and inhibits potential collaborations among researchers. Additionally, it prevents authors from fully benefiting from their own research, restricting the potential for further discoveries and advancements that could benefit the scientific community as a whole. These challenges highlight the need for reforms in the academic publishing system to address issues related to transparency, author rights protection, and data sharing. Implementing new technologies, such as blockchain [1], could potentially provide solutions to these problems by ensuring transparency in the review process, protecting author rights, and facilitating data sharing and collaboration in a secure and decentralized manner [2].

Decentralized Autonomous Organization (DAO) have emerged as a disruptive and transformative innovation in the realm of organizational governance. Built on the foundation of blockchain technology and smart contracts, DAOs present a novel approach to decision-making, fund management, and community governance. Unlike traditional hierarchical structures, DAOs operate without the need for central authorities, relying on transparent and automated processes governed by code and consensus [3]. The concept of DAOs originated from the desire to create decentralized and trustless organizations that are not bound by geographical limitations or intermediaries [4]. DAOs leverage the decentralized nature of blockchain technology to establish a peer-to-peer network where every participant(authors, reviewers and readers...) can share research artilces resources. By utilizing smart contracts, DAOs can execute predefined rules, eliminating the need for intermediaries or third-party oversight and significantly reducing human intervention, thereby ensuring objectivity and efficiency in every step of the process. One of the key distinguishing features of DAOs is their ability to provide a transparent and auditable decision-making process [5]. By recording all transactions and actions on a blockchain, DAOs ensure that every participant has access to the same set of information, promoting transparency and accountability. This transparency also extends to the allocation and management of funds, as DAOs enable token holders to collectively govern and distribute resources based on predefined rules and consensus mechanisms.

blockchain-based smart contracts have received increasing attention in academic circles,Mainly distributed in security, privacy, software engineering, applications, performance, scalability, and other smart contract-related topics [6]. The current distribution and management processes in open journal systems are plagued by inadequate security, leading to issues such as unauthorized replication and dissemination of research papers. However, the implementation of blockchain technology has addressed these concerns by enhancing the security of electronic journal distribution and management. This approach brings significant benefits: Firstly, more precise and error-free distribution of e-journals within open journal systems. Secondly, improved reputation and increased trust in the open journal system. Lastly, safeguarding the management process of papers, protecting both soft and hard copies of journals from potential hacker threats. By utilizing blockchain technology, the security and efficiency of electronic journal distribution and management are significantly improved [7]. InterPlanetary File System (IPFS) and blockchain technology ensure the authenticity of online publications by storing them on a decentralized IPFS network and verifying their information through the blockchain, ensuring trust and reliability. This approach effectively addresses the challenges related to security and privacy in online publications [8]. The traditional scientific publishing system faces numerous challenges, including high publication costs, slow and biased peer review processes, copyright held by publishers, lack of rewards for contributors, and limited connectivity among researchers. By leveraging decentralized blockchain-based technology, creating a scientific publishing platform can address these issues. This platform utilizes Ethereum smart contracts to expedite the publication process, reduce biases in peer review, and lower publication costs. The model also enhances the quality of scientific research by incorporating new functionalities during the publishing process. The system increases the number of publishers, ensuring complete traceability throughout the publication process, and making scientific papers accessible to anyone for a nominal fee. Additionally, the system adopts a decentralized model for journals and integrates scientific papers with relevant data or datasets. Editors, reviewers, and cited authors are also rewarded [9]. The system is implemented using the Ethereum Virtual Machine (EVM), which includes frontend, middleware, and backend [10]. When an author submits a manuscript for evaluation, the system automatically identifies the most suitable editors and reviewers. After the publication process concludes, editors, reviewers, cited authors, and other contributors receive cryptocurrency rewards based on system tokens.

The application of blockchain technology in intelligent journal has the potential to revolutionize data transparency and ensure its authenticity. By leveraging smart contracts, the reliability of data can be guaranteed, eliminating the need for third-party oversight. The framework of a DAO offers a higher level of scalability and addresses not only individual functionalities but the system as a whole. Recent research has demonstrated the feasibility of DAO applications in automating the peer review process and providing incentives to authors, reviewers, and cited authors, thereby fostering a self-sustaining publication ecosystem. While the adoption of DAO and other blockchain applications has become widespread, many implementations have remained largely theoretical, focusing on the concept of self-governance. However, to truly realize the potential of DAOs, an appropriate and robust incentive mechanism is crucial. Without it, the token issuance within the organization would lack practical significance. This paper aims to explore the incentive mechanisms of DAOs, specifically from the perspective of journal readers, in order to achieve a fully autonomous and economically sustainable DAO ecosystem [11]. By examining the reader's role in the DAO ecosystem, we can delve deeper into the design and implementation of effective incentive mechanisms. This research strives to contribute to the understanding of DAOs and their potential to transform the publication industry, enabling a seamless integration of blockchain technology and fostering a self-governing and economically viable ecosystem.

Section II, this paper begins by providing an in-depth introduction to the framework of Journal DAO, including its concepts, operational processes, and a comparative analysis with traditional approaches. Section III, it delves into the design and implementation of the incentive mechanism within Journal DAO. This section explores the various factors considered in designing the incentive structure, such as rewarding authors, reviewers, and cited authors based on their contributions to the publication process. Additionally, it discusses the integration of token-based incentives to foster motivation and participation among stakeholders. Section IV, subsequently, it presents experimental results to validate the effectiveness of the implemented incentive mechanism in Journal DAO.

Through a rigorous evaluation and analysis, the outcomes highlight the impact of the incentive structure on the overall performance, efficiency, and engagement of participants within the system. Section V, the paper concludes with a conclusion and outlook.

II. Framework of Journal DAO

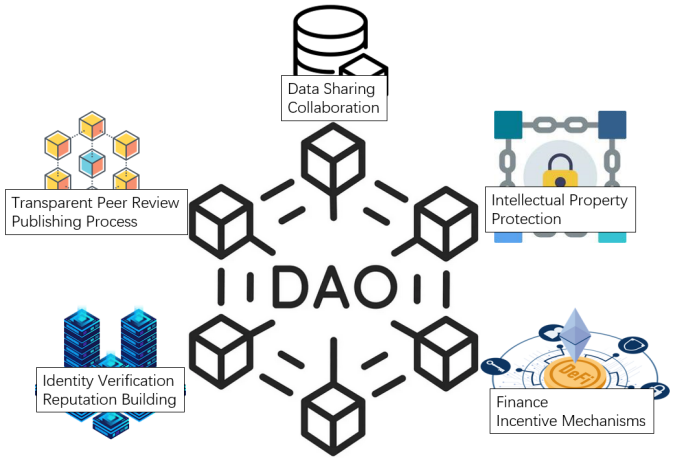

Fig. 1: Application of DAO in Article and Journal

According to the development of district DAO, related blockchain technology, the following DAO to Decentralized Scientific (DeSci) framework can be summarized as shown in the figure 1.It aims to establish a decentralized scientific publishing platform using blockchain and smart contract technology, enabling fair, transparent, and efficient scientific research dissemination [12].

- **Transparent Peer Review and Publishing Process:** Blockchain can be used to create a transparent academic publishing platform, ensuring transparency throughout the peer-review and publishing processes. [13] Smart contracts can manage review, publication, and payment procedures, ensuring traceability and fairness.
- **Protection of Intellectual Property:** Blockchain and smart contracts can safeguard authors' intellectual property, ensuring their works are not copied or distributed without permission [14].
- **Identity Verification and Reputation Building:** Blockchain can be employed to establish scholars' identities and reputations [15]. Smart contracts can automate the validation of scholars' achievements, storing them on the blockchain.
- **Data Sharing and Collaboration:** Blockchain and smart contracts can facilitate data sharing and collaboration among scholars, ensuring data integrity and traceability [16].
- **Finance and Incentive Mechanisms:** DAO and cryptocurrencies can be used to support research finance and incentive mechanisms.Funds can be allocated according to token weights [17].

These application examples highlight the potential value of blockchain, smart contracts, and DAO technology in academic publishing and journal management. They enhance transparency, protect intellectual property, verify identity, automate processes, and encourage collaboration. As these technologies continue to evolve, they hold promise for further innovation and efficiency in academia [18].

A. Web3-Based Journal DAO Framework

In the traditional landscape of Web 2.0, the ownership of articles remains with the creators, yet the entirety of the associated data is ensconced within the databases of publishers, shrouded in a lack of transparency. This opaqueness extends to financial allocations, where, even if publishers express willingness to distribute funds, the absence of intermediary oversight poses challenges to ensuring fairness and accountability in the process. This paper delves into the transformative potential of Web 3.0 and blockchain technology within the DAO framework to rectify these issues, ushering in a new era of decentralized, transparent, and equitable financial distribution for content creators [19].

From a physical perspective, the data of articles is stored in the database of the journal website, as shown in Figure 2a. When regular users access the journal website, they can browse and download articles of interest. The interaction between users and the journal website typically involves the following steps. When an article is uploaded to a blockchain, as shown in Figure 2b, its content, timestamp, and relevant metadata are all recorded on the blockchain [20]. This means that anyone can verify the existence, content, and timestamp of the article. This provides a high level of assurance for the immutability and transparency of documents, particularly with potential significance in research, intellectual property protection, and copyright. Uploading articles to the blockchain also enables decentralized data storage, reducing reliance on centralized institutions. This offers a more open and trustworthy means of data sharing for the academic community and other domains.Uploading an article to a blockchain, as compared to storing it in a traditional database, provides the author with a clear and objective ownership of the article. In a traditional database, the ownership of the data and the integrity of the database are controlled by the entity or organization managing the database. Authors and other stakeholders may not have direct control or visibility into the ownership and usage of the data.

On the other hand, when an article is uploaded to a blockchain, the author can have greater confidence in their ownership and control over the article [21]. The blockchain's decentralized and immutable nature ensures that the ownership records are transparent, tamper-resistant, and not under the sole control of a centralized authority. This empowers authors to have a direct and verifiable claim to their work, which can be particularly important for intellectual property protection, copyright, and ensuring that the author's rights are respected.

B. Advantages of Finance in Journal DAO

In the evolution of electronic journals, websites have become the primary medium for disseminating research papers. Although the content of users' papers remains the intellectual

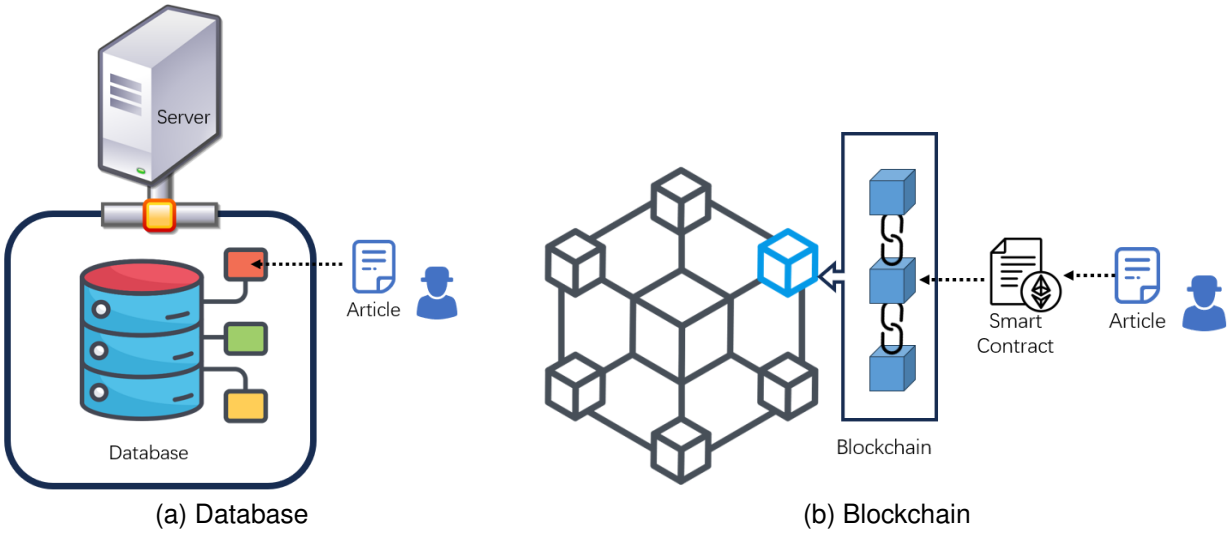

Fig. 2: Article in Database or Blockchain

property of the authors, the wealth generated by journals through these papers often belongs predominantly to the journals rather than the authors.In our hypothetical scenario, we contemplate a shift in this paradigm, envisioning a system where a certain proportion of the generated wealth is allocated back to the authors. Taking paid downloads as a simple example, this mechanism aims to provide authors with a more direct economic incentive. Such a transformation not only has the potential to enhance authors' motivation and creativity but also holds the promise of establishing a more equitable wealth distribution system. This envisioned change could contribute to fostering a sustainable and mutually beneficial development model in the realm of electronic journals, addressing the balance of interests between authors and journals more effectively.

Web2, also known as the social web, refers to the current state of the internet that we use today, which is primarily focused on social media, e-commerce, and other web-based applications that allow users to interact with each other and with content in various ways. In Web2, payment systems are typically centralized, meaning that they are controlled by a single entity or organization. As the Figure 3a shows. In the context of Web 2.0, the establishment of a platform for downloading articles entails several steps. Firstly, the creation of a functional website serves as the primary interface for users. This website acts as a centralized hub, hosting a database that stores a diverse range of articles across various disciplines.When a user decides to download a specific article, a payment system is in place to facilitate the transaction. The user pays a designated fee for the download, and the platform, acting as an intermediary, manages the distribution of funds. The allocation of funds may involve a proportional distribution to the authors, and this process is typically administered by the central entity running the website.This centralized model means that all user interactions, content storage, and payment transactions occur within the controlled environment of the website. Users depend on the centralized platform to oversee and coordinate all aspects of the transactional process, creating a reliance on a single authority for the entire operation [22].

Web3, also known as the decentralized web as shown in the Figure 3b, represents a shift toward a more open, decentralized, and secure internet that is built on blockchain technology

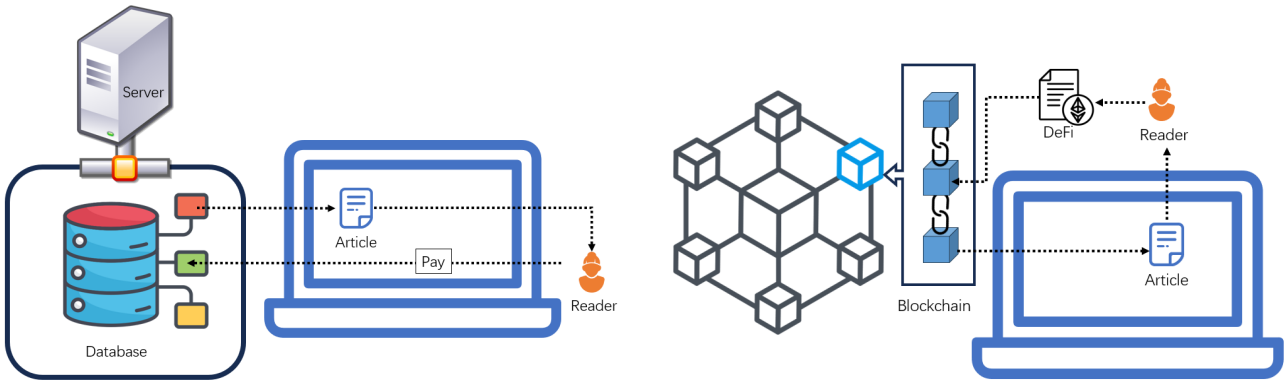

Fig. 3: Reader Pay for Download

[23]. In Web3, payment systems are decentralized, meaning that they are not controlled by a single entity or organization [24]. Instead, payments are made using cryptocurrency, which is a digital asset that is secured by cryptographic techniques and operates independently of central banks and other financial institutions. Cryptocurrency payments are processed directly between users without the need for intermediaries, which can result in lower transaction fees and faster processing times. In the realm of Web 3.0, we witness a fundamental transformation in the dissemination of academic articles. Unlike the traditional Web 2.0 model, it introduces a paradigm shift. In this innovative framework, the data entity of articles resides directly on the blockchain, with the website serving as a mere interface reflecting the blockchain data. When users make payments for downloads, the entire fund allocation process is automated through smart contracts, eliminating the need for manual intervention. This groundbreaking framework ensures complete transparency and traceability throughout the process. As users pay to download articles, funds are automatically distributed according to the rules set within the DAO framework, without any centralized oversight.In the Web 3.0 paradigm, this novel model signifies a departure from reliance on traditional intermediaries. Instead, it empowers users with the direct participation in DAO frameworks, utilizing smart contracts for automated and secure fund distribution. This shift not only achieves decentralization in the transaction process but also enhances the efficiency of academic article transactions.In the Web 3.0 environment, articles are directly uploaded to the blockchain. All operations, including payment processing and fund distribution, are seamlessly executed through smart contracts. This innovative framework ensures complete transparency and traceability throughout the entire process. When users pay to download articles, the funds are automatically allocated according to the rules established within the DAO framework, eliminating the need for any centralized oversight.

C. The Operation Process of the Journal DAO

In the practical implementation of the Journal DAO, this paper leveraged the Aragon framework to establish a decentralized and transparent infrastructure for academic publishing. The execution of the DAO involved several key steps to ensure a seamless and fair distribution of tokens among participants [25]. In a DAO, the concept of incentive mechanisms plays a crucial role in driving active participation and contributions. These mechanisms are designed to provide incentives and rewards to individuals or entities involved in the DAO's activities. By offering tangible benefits such as token rewards, governance rights, or recognition, participants are motivated to actively engage and contribute to the DAO's growth and development. Effective incentive mechanisms foster collaboration, maintain long-term motivation, and encourage innovation within the DAO community. The incentive design of journal dao promotes collaboration, maintains long-term incentives, and promotes innovation within the DAO community in the following aspects.

1) Author Rewards:
   Authors receive tokens based on the evaluation provided by reviewers during the submission process. The more constructive and impactful the reviews, the higher the token allocation to the authors.
2) Reviewer Incentives:
   Reviewers are rewarded with tokens for their valuable contribution to the peer-review process. This includes providing insightful feedback and assisting in maintaining the quality of published work.
3) Publication and Download Rewards:
   Upon successful publication, both authors and users who download the papers are granted tokens. This encourages not only the creation of quality content but also its dissemination and accessibility.
4) Citation Bonuses:
   Authors receive additional tokens when their published work is cited by other researchers. This incentivizes the production of influential and impactful research that contributes to the academic community.

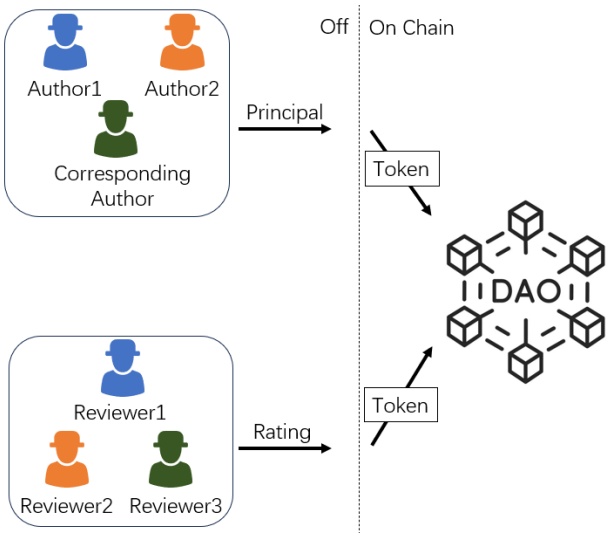

Fig. 4: Distribute Token by DAO

As Figure 4 shows, the process initiates with a user submitting a paper for publication. As the DAO initiates the coin minting process, specific rules govern the allocation of tokens. Authors are categorized based on their roles in the paper, including corresponding authors, first authors, second authors, and third authors, and so on, each receiving distinct token allocations.Simultaneously, reviewers play a pivotal role in the distribution of tokens. Their allocations are determined by their roles in the review process and the scores they assign to the submitted papers. This meticulous token distribution mechanism ensures that each contributor, whether an author or reviewer, is fairly rewarded according to their specific contributions and responsibilities.By implementing such a structured system, the DAO creates a transparent and equitable environment, aligning the incentives of authors and reviewers. This not only fosters a sense of fairness within the system but also encourages active and meaningful participation from all contributors. The workflow, guided by DAO principles, facilitates a seamless integration of various stakeholders, ensuring a well-functioning and self-sustaining ecosystem.

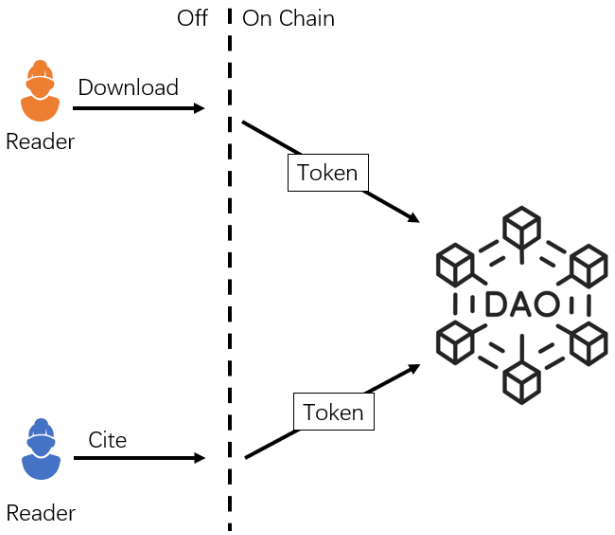

Fig. 5: Distribute Token while Download or cited

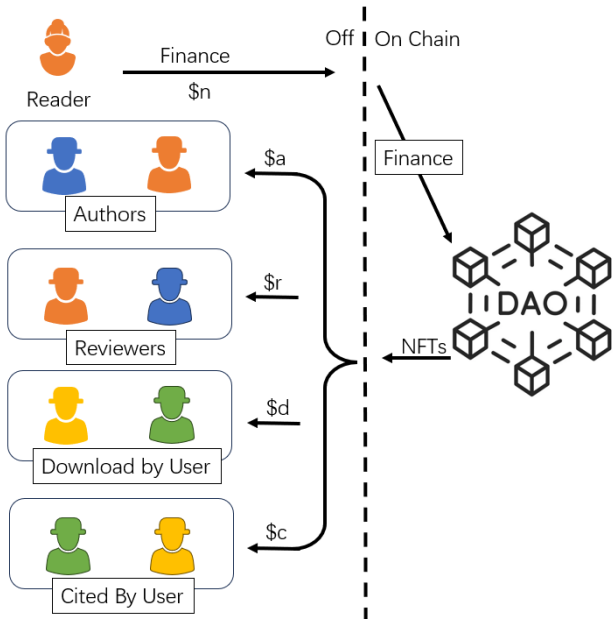

Fig. 6: Distribute Finance by NFTs

As Figure 5 shows, upon the download or citation of a paper, the DAO employs specific rules for the allocation of tokens to the downloader and the citers. This ensures that contributors beyond the authorship and reviewing process are also recognized and rewarded within the DAO framework.For downloaders, the token allocation is determined by the extent and impact of their engagement with the paper. High download counts result in increased token rewards, creating a dynamic and merit-based incentive system.Similarly, when a paper is cited, the citers receive token allocations based on the significance and reach of their citations. This encourages users to engage in scholarly discussions, contribute to the academic community, and actively participate in the dissemination of knowledge.These token allocation mechanisms not only acknowledge the efforts of those who contribute by downloading or citing papers but also foster a collaborative environment where users are motivated to interact with the content and contribute meaningfully to the scholarly ecosystem [26]. The DAO's commitment to recognizing various forms of contribution ensures a comprehensive and inclusive reward system, aligning incentives with the broader goals of the academic community.

Non-Fungible Tokens (NFTs) are a type of digital asset that represent ownership or proof of authenticity of a unique item or piece of content on the blockchain [27]. Unlike cryptocurrencies like Bitcoin or Ethereum, which are fungible and can be exchanged for one another, NFTs are unique and cannot be exchanged on a one-to-one basis. The finance generated within the Journal DAO is distributed based on the NFT model, where each token holder is entitled to a proportional share. This innovative approach ensures that the financial rewards align with the level of contribution and engagement at various stages of the academic process [28].

As Figure 6 shows, in this system, authors, reviewers, download users, and reference users all possess a specific quantity of tokens. These tokens are considered as NFTs due to their unique nature. Once finance is generated, such as when a user pays to download a paper, the system allocates this finance based on the number of tokens held by the respective parties.This design ensures objectivity, fairness, and transparency within the system. Each participant's contribution is reflected in a specific number of tokens, and the allocation mechanism operates according to the quantity of these tokens. Such a design not only enhances the fairness of the incentive mechanism but also makes the entire system more transparent, allowing participants to clearly understand the relationship between their contributions and rewards.This NFT-based token system provides tangible and verifiable returns for contributors while establishing an effective and operable incentive mechanism for the entire ecosystem [29]. This fair and transparent allocation method is expected to drive collaboration and development in the academic community, creating a mutually beneficial environment for all stakeholders.

D. Summary of Journal DAO

Overall, the main difference in payment systems between Web2 and Web3 is the degree of centralization. Web2 payment systems are centralized, while Web3 payment systems are decentralized. While Web3 is still in its early stages, it has the potential to revolutionize the way we think about payments, transactions, and financial systems. In the current era of digitization, the act of anchoring a paper on the blockchain signifies the author's complete ownership of the work, opening up boundless possibilities. The introduction of blockchain technology empowers authors with more rights and limitless potential. Once a paper is inscribed on the immutable blockchain, authors not only possess intellectual property rights but also gain absolute control over their creations. This shift in ownership implies that authors can explore innovation more freely, facilitate transparent data sharing, and attain fairer returns from the wealth generated by their works [30]. The immutability and transparency afforded by blockchain provide robust protection for the rights of paper owners, ushering in

new possibilities for academic research and knowledge sharing. This profound ownership transformation elevates a paper beyond being merely a conduit for academic dissemination; it becomes a symbol of the unique wealth created by the author, sparking a profound revolution in the relationship between academia and authors.

III. Mechanism Design of Journal DAO

This paper combines the fundamental concepts of DAO to establish a framework for implementing DAO in academic journals. The framework begins with the issuance of tokens, which are allocated to all participants involved in the publication process, including reviewers, authors, and readers, through a specified mechanism. These tokens serve as a means to determine the weightage of proposals, and the framework utilizes the token distribution to allocate financial resources accordingly. By integrating token-based incentives and governance mechanisms, this framework ensures a fair and transparent distribution of resources within the DAO-operated journal ecosystem. Participants holding tokens can actively participate in the processes of all aspects of the article publication, such as send articles, review articles, and download articles, thereby influencing the allocation of financial resources based on their token holdings. Through this framework, the DAO-operated journal can foster an inclusive and democratic environment, empowering participants to shape the direction and priorities of the journal based on their token weightage.

$$\begin{bmatrix} A_t \\ E_t \\ P_t \\ R_t \end{bmatrix} = \omega_{t-1} \begin{bmatrix} A_{t-1} \\ E_{t-1} \\ P_{t-1} \\ R_{t-1} \end{bmatrix} + \omega_{t-2} \begin{bmatrix} A_{t-2} \\ E_{t-2} \\ p_{t-2} \\ R_{t-2} \end{bmatrix} + \cdot + \omega_n \begin{bmatrix} A_n \\ E_n \\ P_n \\ R_n \end{bmatrix} \quad (1)$$

By applying the DAO framework to academic journals in accordance with the proposed Equation 1, each action taken within the system has the potential to alter future benefits. Through a well-structured incentive mechanism, the entire DAO ecosystem can achieve a state of perfect autonomy. This means that the actions and decisions made by participants, including authors, reviewers, and readers, have a direct impact on the overall functioning and success of the journal. With the right incentives in place, the DAO-operated journal can foster a self-sustaining and self-regulating environment, where participants are motivated to actively engage, contribute their expertise, and collectively drive the advancement of scholarly knowledge.

A. First Mint Token

In the DAO framework, tokens are minted during key events such as article publication, downloads, and citations, and then distributed to participants according to predetermined proportions. All these processes are executed through smart contracts, ensuring transparency and traceability. Having a well-designed token allocation mechanism forms the foundation of the entire framework, enabling a self-sustaining and self-regulating environment. With a fair token distribution mechanism, the DAO framework can create a system where participants are incentivized to contribute and engage actively. The allocation of tokens based on specific events fosters a sense of fairness and encourages collaboration among authors, readers, reviewers, and publishers. The transparent and traceable nature of the smart contract-based processes ensures that the token distribution is open to scrutiny and can be verified by all participants. In this self-regulating environment, the DAO framework can adapt and adjust dynamically based on the actions and contributions of its participants. The token allocation mechanism serves as a means to reward and recognize the efforts of contributors, fostering a sustainable ecosystem where knowledge sharing and collaboration thrive.

$$\begin{aligned} D_0 &= \sum_{i=1}^{m} x_i \\ 1 &= \alpha_1 + \alpha_2 + \alpha_3 \\ A_0 &= \alpha_1 D_0 \quad (A = \{a_0, a_1, a_2, a_3, \cdots a_n\}) \\ E_0 &= \alpha_2 D_0 \quad (E = \{e_1, e_2, e_3, \cdots e_m\}) \\ P_0 &= \alpha_3 D_0 \quad (P = \{p\}) \end{aligned} \quad (2)$$

Upon publication of an article, a DAO specific to that particular article is established, and tokens are minted and distributed among the authors, reviewers, and the publisher. The total number of tokens minted after this process, denoted as D_0, is determined based on Equation 2, taking into account the distribution proportions among the three parties: α_1, α_2, and α_3. Consequently, the allocation of tokens is as follows: the authors receive $A_0 = \alpha_1 D_0$, the reviewers receive $E_0 = \alpha_2 D_0$, and the publisher receives $P_0 = \alpha_3 D_0$.

$$\begin{aligned} 1 &= \beta_0 + \beta_1 + \beta_2 + \beta_3 + \cdots + \beta_n (\beta_1 \geq \beta_2 \geq \beta_3 \cdots \geq \beta_n) \\ a_i &= \beta_i A \quad (a \in A) \\ a_{i0} &= \beta_i A_0 \quad (a_0 \in A_0) \end{aligned} \quad (3)$$

In the case of having a total of n authors, the allocation of tokens for each author is determined by the proportions specified in Equation 3. In this equation, β_0 represents the token allocation for the corresponding author, β_1 represents the token allocation for the first author, β_2 represents the token allocation for the second author, and so on. The total number of tokens allocated to all authors is denoted as A, and each author a_i receives a portion of tokens distributed according to the respective β ratio.When the article is published, tokens are minted and distributed to all authors. The total number of tokens allocated to the authors is denoted as A_0, and each author a_{i0} receives tokens distributed in the same proportions as determined by the β ratios.

$$\begin{aligned} 1 &= \gamma_1 + \gamma_2 + \gamma_3 + \cdots + \gamma_m \\ e_i &= \gamma_i E \quad (e \in E) \\ e_{i0} &= \gamma_i E_0 \quad (e_0 \in E_0) \end{aligned} \quad (4)$$

The number of reviewers is denoted as m, the allocation of tokens for each reviewer follows the proportions specified in Equation 4. In this equation, the token allocation for each reviewer e_i is determined by the respective γ ratio. The proportions for the reviewers may be determined based on

other factors, such as the role the reviewers. The total number of tokens allocated to all reviewers is denoted as E.When the article is published, tokens are minted and distributed to all reviewers. The total number of tokens allocated to the reviewers is denoted as E_0, and each reviewer e_{i0} receives tokens distributed in the same proportions as determined by the γ ratios. The distribution mechanism remains consistent with that of the authors.

B. Token Distributement while User Download or Cite Article

Unlike the singular issuance of tokens associated with article publication, the act of downloading articles by users as readers is a recurring event that perpetually exists within the DAO framework. The act of downloading an article not only represents recognition of the article itself but also serves as recognition of the article's author. Therefore, tokens need to be allocated to the authors, with the primary author and corresponding author, who contribute the most, receiving a larger share. Furthermore, readers who download articles both recognize the value of the article and also receive tokens as a result. This dual recognition mechanism ensures that both authors and readers are rewarded within the DAO framework. By allocating tokens to authors and readers, the system fosters a sense of acknowledgment and incentivizes active participation from all stakeholders involved in the publication and consumption of articles.

$$\begin{aligned} D_1 &= D_{1a} + D_{1r} \\ A_1 &= D_{1a} \\ \Sigma_1^A &= A_0 + A_1 \\ E_1 &= 0 \\ P_1 &= 0 \\ R_1 &= D_{1r} \end{aligned} \tag{5}$$

After the publication of the article, when users read and download the article, additional token minting occurs according to the formula specified in Equation 5. The purpose of this additional token minting is to incentivize authors and provide benefits to readers. In this process, new tokens are allocated to both authors and readers, while the token allocations for reviewers and the publisher remain unchanged.

$$\begin{aligned} 1 &= \beta_{1,0} + \beta_{1,1} + \beta_{1,2} \\ a_{1,0} &= A_1\beta_{1,0} \\ a_{1,1} &= A_1\beta_{1,1} \\ a_{1,2} &= A_1\beta_{1,2} \end{aligned} \tag{6}$$

According to Equation 6, the tokens generated through the user's download behavior will be allocated to the corresponding author, first author, and second author in certain proportions. However, the token allocations for other authors remain unchanged.

$$\begin{aligned} D_2 &= D_{2a} + D_{2r} \\ A_2 &= D_{2a} \\ \Sigma_2^A &= A_0 + A_1 + A_2 \\ E_2 &= 0 \\ P_2 &= 0 \\ R_2 &= D_{2r} \\ \Sigma_{r1} &= R_1 + R_2 \quad if \quad R_1 = R_2 \quad (r_1 \in R) \end{aligned} \tag{7}$$

According to Equation 7, if a user cites a previously downloaded article in their own article, it triggers token minting. The tokens generated in this case are allocated to both the authors of the cited article and the user who made the citation.

C. Finance by Token

By employing token allocation based on NFT principles, the framework ensures a fair distribution of rewards among token holders. Through transparent smart contracts, the DAO framework establishes a self-regulating environment that incentivizes active participation and contribution. The implementation of this token-based distribution mechanism requires tracking token ownership and automated distribution of finance.

$$\begin{aligned} 1 &= \frac{A}{D} + \frac{E}{D} + \frac{P}{D} + \frac{R}{D} = \alpha_1 + \alpha_2 + \alpha_3 + \alpha_4 \\ F &= finance \\ F_A &= \alpha_1 F \quad (A = \{a_0, a_1, a_2, a_3, \cdots a_n\}) \\ F_E &= \alpha_2 F \quad (E = \{e_1, e_2, e_3, \cdots e_m\}) \\ F_P &= \alpha_3 F \quad (P = \{p\}) \\ F_R &= \alpha_4 F \quad (R = \{r_1, r_2, r_3, \cdots r_i\}) \end{aligned} \tag{8}$$

According to Equation 8, the token allocation ratios for authors, reviewers, publisher, and readers are denoted as α_1, α_2, α_3, and α_4, respectively. Once finance is generated, it is distributed to all token holders based on these ratios. To respect intellectual property rights, many publishers require users to pay for downloading articles. In such cases, finance enters the DAO and is distributed to all authors, reviewers, publisher, and readers according to their token ratios. Articles typically attract a significant number of downloads, with exceptional ones garnering even more. Importantly, this distribution mechanism enables sustained earnings, thereby incentivizing authors to produce higher quality articles. While users initially act as consumers when downloading articles, they also become partial owners of the downloaded articles. As a result, they are eligible to receive a portion of the generated finance based on their token ratios. Motivating readers is crucial as it encourages them to willingly pay for article downloads, ultimately creating more finance and fostering a real automated organization. By implementing this approach, all participants receive fair allocations for their contributions. The autonomous nature of the framework drives authors to produce outstanding articles and incentivizes readers to pay for downloads, thereby generating more finance and establishing a virtuous cycle within the system.

D. Decentralized Governance

DAO, adopting a decentralized governance model, allows token holders to participate in the decision-making process. This ensures community involvement in platform development, creating a democratic and inclusive environment. With robust incentives in place, token holders have made outstanding contributions while also receiving greater rewards. This positive feedback loop forms a self-sustaining ecosystem of active governance. DAOs leverage blockchain technology to provide transparency and trust, recording all proposals, votes, and transactions on the blockchain for public verification. Incentives motivate token holders to actively engage in the governance process, while DAOs offer a meritocratic approach that values expertise. The flexibility and adaptability of DAOs allow them to evolve and respond to the needs of the community. However, challenges such as active participation, governance gridlocks, and power concentration need to be addressed through clear rules and mechanisms. Overall, DAOs empower token holders, foster community involvement, and create a democratic and inclusive environment.

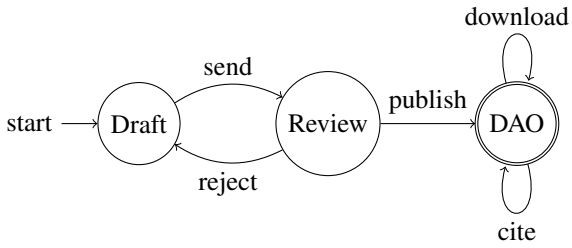

Fig. 7: Events of Article in Framework

The implementation of the Journal DAO (Figure 7) has yielded positive results in terms of increased engagement, quality submissions, and a more inclusive academic ecosystem. The transparent and automated token distribution mechanisms have effectively addressed issues of ownership and reward distribution, fostering a collaborative and fair scholarly environment. In conclusion, The detailed execution of the Journal DAO demonstrates the viability of blockchain and DAO principles in reshaping academic publishing. The emphasis on decentralized governance, token incentives, and transparent finance distribution has the potential to revolutionize the scholarly landscape, making it more accessible, collaborative, and equitable for all participants.

IV. Model Performance

In addition to the theoretical framework, there need conducted simulations to evaluate the effectiveness of the proposed DAO system [31]. Table I presents results from 20 simulated downloads, illustrating the distribution of finance among holders. This simulation provides a comprehensive overview of how finance is allocated to holders based on their token holdings. Within the DAO framework, authors, as the owners of the articles, experience an increase in their tokens and ownership ratio when their articles are downloaded or cited, leading to higher profits. Reviewers, as participants in the article review process, initially receive tokens that do not increase over time. Although their ownership ratio gradually decreases, their profits continue to increase. The accuracy of their ratings directly benefits themselves. Readers, during the process of downloading and citing, also receive tokens, albeit in smaller quantities and with lower ownership ratios. However, as the articles are downloaded or cited, their overall profits increase. Additionally, the profit margin gradually decreases, meaning that readers who download and cite the articles in the early stages will benefit from higher profits, thus incentivizing the early identification of outstanding articles.

A. Proportion of Trend

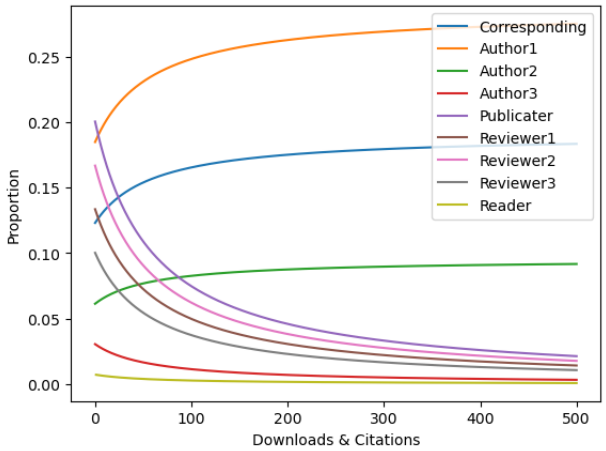

Fig. 8: Proportion of All.

Integrating DAO technology into the realm of academic journals holds immense potential for benefiting authors, reviewers, and readers alike. Look at Figure 8. Authors, being the rightful owners of their published works, would reap the most substantial rewards from such a system. By leveraging the decentralized nature of DAOs, authors can secure a greater share of the financial gains associated with their articles. As time progresses, their earnings could potentially increase, providing a long-term incentive for continued contributions. Reviewers, as the gatekeepers and custodians of scholarly integrity, would also stand to gain from the implementation of DAOs in journals. Initially, they would hold a higher proportion of benefits, reflecting their crucial role in the early stages of article evaluation. However, as time progresses and articles are published, their share of benefits may gradually diminish, ensuring a fair distribution of rewards among all stakeholders. Readers, as active participants in the scholarly discourse, would also have the opportunity to benefit from DAO-operated journals. While their gains may be comparatively lower than authors and reviewers, early engagement with the DAO ecosystem could yield higher returns. By accessing articles and participating in the DAO's governance processes, readers can contribute to the growth and success of the journal, potentially increasing their benefits over time. The implementation of DAO mechanisms, such as token-based incentives, transparent governance structures, and decentralized decision-making processes, would enable a fair and equitable model for

TABLE I: Finance for DAO.

	Authors				Reviewers			Readers	
index	**Corresponding**	**Author1**	**Author2**	**Author3**	**reviewer1**	**reviewer2**	**reviewer3**	**cite**	**download**
0	0.128171	0.128171	0.051068	0.025367	0.222296	0.278037	0.166889	0.000000	0.000000
1	0.128605	0.128605	0.051044	0.025191	0.220749	0.276102	0.165728	0.000000	0.003977
2	0.129032	0.129032	0.051020	0.025016	0.219223	0.274194	0.164582	0.000000	0.003950
3	0.129454	0.129454	0.050997	0.024845	0.217718	0.272311	0.163452	0.000000	0.003923
4	0.129870	0.129870	0.050974	0.024675	0.216234	0.270455	0.162338	0.000000	0.003896
5	0.130281	0.130281	0.050951	0.024508	0.214769	0.268623	0.161238	0.000000	0.003870
6	0.130685	0.130685	0.050929	0.024343	0.213325	0.266816	0.160154	0.000000	0.003844
7	0.130982	0.130982	0.050693	0.023929	0.209698	0.262280	0.157431	0.007557	0.003778
8	0.131373	0.131373	0.050673	0.023772	0.208320	0.260557	0.156397	0.007507	0.003754
9	0.131759	0.131759	0.050653	0.023617	0.206961	0.258856	0.155376	0.007458	0.003729
10	0.132140	0.132140	0.050633	0.023464	0.205619	0.257178	0.154369	0.007410	0.003705
11	0.132515	0.132515	0.050613	0.023313	0.204294	0.255521	0.153374	0.007362	0.003681
12	0.132886	0.132886	0.050594	0.023164	0.202987	0.253886	0.152393	0.007315	0.003657
13	0.133253	0.133253	0.050575	0.023016	0.201696	0.252271	0.151423	0.007268	0.003634
14	0.133614	0.133614	0.050557	0.022871	0.200421	0.250677	0.150466	0.007222	0.003611
15	0.133971	0.133971	0.050538	0.022727	0.199163	0.249103	0.149522	0.007177	0.003589
16	0.134324	0.134324	0.050520	0.022585	0.197920	0.247548	0.148588	0.007132	0.003566
17	0.134672	0.134672	0.050502	0.022445	0.196692	0.246013	0.147667	0.007088	0.003544
18	0.135016	0.135016	0.050484	0.022307	0.195480	0.244497	0.146757	0.007044	0.003522
19	0.135356	0.135356	0.050467	0.022170	0.194282	0.242999	0.145858	0.007001	0.003501
20	0.135692	0.135692	0.050449	0.022035	0.193099	0.241519	0.144970	0.006959	0.003479
Total	2.773651	2.773651	1.064935	0.495363	4.340948	5.429444	3.258970	0.101500	0.074210

academic journals. This model fosters a sense of ownership, rewards active participation, and ensures the sustainability and long-term viability of the journal ecosystem.

B. Break Even of User Download

Indeed, allowing users to offset their expenses or even earn profits through downloading articles can effectively stimulate user participation. While individual reader earnings may be modest, readers constitute the largest group within the DAO framework, making them a critical factor for the system's autonomy. By providing readers with the opportunity to offset their expenses or earn profits, the DAO framework can incentivize their active engagement. Despite individual earnings being relatively small, the cumulative impact of a large number of readers participating in the ecosystem contributes significantly to the overall success and sustainability of the DAO. As a result, readers play a crucial role in driving the self-governing nature of the DAO framework.

The total revenue for downloading users is depicted in Figure 9. As readers who own the downloaded articles, their total revenue increases with a growing number of users downloading the articles. However, as more readers download the article and become owners, the individual token proportion naturally decreases. Consequently, the per-download revenue gradually declines. To simulate the distribution ratios, let's consider the following scenario: the first reader who downloads the article breaks even when the article is downloaded 559 times; the tenth reader breaks even when the article reaches 651 downloads; and the one hundredth reader breaks even at a staggering 1579 downloads. This incentive mechanism aims to encourage readers to discover exceptional articles earlier rather than following the crowd since owning the article no longer yields significant returns. This approach incentivizes readers to identify outstanding articles sooner, as the potential for substantial earnings diminishes once an article has already demonstrated its quality.

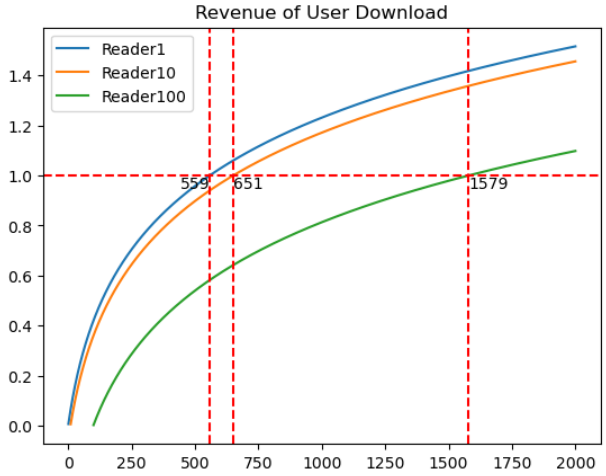

Fig. 9: Revenue of User Download.

C. Real Article simulation

Furthermore, we applied our DAO framework to a real-world case by analyzing a published paper with 2154 downloads and 42 citations. As shown in Table II. By simulating the income distribution within the current DAO structure, we observed that download users not only offset their initial payment but also gained additional earnings. The incentivized system encourages users to respect copyright and, more importantly, has achieved a level of autonomy.The provided tables and case study demonstrate the practical application and positive outcomes of our proposed DAO framework. By aligning incentives with user behaviors, the system not only offsets costs for downloaders but also significantly incentivizes engagement. This not only respects copyright but also establishes a self-sustainable and autonomous ecosystem, providing valuable insights for the future development of decentralized academic publishing.

TABLE II: Finance of Real Article for DAO.

	Authors				Reviewers			Readers	
index	**Corresponding**	**Author1**	**Author2**	**Author3**	**reviewer1**	**reviewer2**	**reviewer3**	**cite**	**download**
0	0.128171	0.128171	0.051068	0.025367	0.222296	0.278037	0.166889	0.000000	0.000000
1	0.128605	0.128605	0.051044	0.025191	0.220749	0.276102	0.165728	0.000000	0.003977
2	0.129032	0.129032	0.051020	0.025016	0.219223	0.274194	0.164582	0.000000	0.003950
3	0.129454	0.129454	0.050997	0.024845	0.217718	0.272311	0.163452	0.000000	0.003923
4	0.129870	0.129870	0.050974	0.024675	0.216234	0.270455	0.162338	0.000000	0.003896
...	...	...	...	...	...	...	...	...	...
2151	0.209045	0.209045	0.043698	0.001416	0.012405	0.015516	0.009313	0.000447	0.000224
2152	0.209049	0.209049	0.043698	0.001415	0.012400	0.015509	0.009309	0.000447	0.000223
2153	0.209052	0.209052	0.043698	0.001414	0.012395	0.015503	0.009305	0.000447	0.000223
2154	0.209056	0.209056	0.043697	0.001414	0.012389	0.015496	0.009301	0.000446	0.000223
Total	423.722713	423.722713	96.973407	9.477511	83.052922	103.878504	62.352043	2.672524	1.492444

After voluntarily making a payment, users' ability to participate contributes to a robust incentive mechanism, fostering a sense of autonomy within the entire framework. Through this design, users become direct contributors to financial activities, injecting new value into the framework and creating potential opportunities for self-reward. This decentralized autonomous model empowers users to engage directly in decision-making and contributions, shaping a more open, fair, and virtuous ecosystem. Overall, this autonomous framework cultivates a more positive and sustainable participation experience for users and the entire community. Through the detailed simulations and analyses, the incentive mechanisms within the DAO framework emerge as crucial drivers in shaping the dynamics of authorship and user participation. As downloads and citations increase, the token-driven rewards become a powerful motivator for authors, leading to an accumulation of influence and financial gains. This incentive structure not only acknowledges and rewards the contributions of authors but also establishes a direct correlation between their efforts and the benefits they accrue. Furthermore, users who engage with the system by downloading papers witness a direct impact on their influence and, subsequently, on their earnings. This creates a dual incentive structure, where authors and users are mutually motivated to contribute to and participate in the DAO environment. The concept of decentralized autonomy becomes evident as the system operates independently, fostering a self-sustaining loop of contributions, rewards, and governance. In this context, the DAO framework provides a powerful tool for aligning interests and promoting a fair distribution of rewards based on tangible contributions. The transparency and automation inherent in DAO contribute to a governance model that minimizes external intervention, allowing the ecosystem to evolve organically through the collective actions of its participants. This synergy of incentives and autonomy within DAO not only enhances the overall efficiency of the academic publishing model but also creates a robust and self-regulating environment for authors and users alike.

Once the paper is on the blockchain, it unequivocally belongs to the author, author is the real owner,that creating endless possibilities, especially in terms of financial activities. This means that the author not only owns their work but can also leverage blockchain technology to create various financial opportunities. Authors can receive rewards through financial activities, which may include paid downloads, knowledge exchanges, collaborative projects, and more. This decentralized framework provides authors with greater creative freedom and potential economic returns, enabling them to be more independent and influential in the academic domain. Overall, putting a paper on the blockchain opens up a new and forward-thinking path for authors.

V. Conclusion

This paper extensively explores the framework of DAO and provides a thorough analysis of its potential applications in the academic publishing domain. By placing papers on the blockchain, we have achieved transparency in ownership, allowing authors to have complete control over their works while also creating diverse financial opportunities. The autonomous nature of DAO enables users to directly participate in decision-making and contributions, constructing an ecosystem that is open, fair, and characterized by positive feedback loops.

Under this framework, users can not only pay for paper downloads but also receive rewards through participation in financial activities. This novel academic publishing model grants authors greater creative freedom while motivating users to actively engage, contribute, and share knowledge. The decentralized autonomous design brings a more open and fair publishing mechanism to academia, breaking away from the limitations of traditional academic publishing.

In summary, Decentralized Autonomous Organizations inject new vitality into academic publishing, creating a more equitable environment for both authors and readers. This innovative model holds promise for paving new paths in the development of academia, fostering the free dissemination and sharing of knowledge.

Once an article is recorded on the blockchain, it opens up endless possibilities for the future, and the application of DAOs is expected to become increasingly widespread. Starting with the initial use of tokens to govern proposals, the introduction of NFTs, and now the emergence of recursive inscriptions, we are witnessing the continuous development of new applications within the DAO ecosystem. These advancements indicate that the realm of DeSci can also benefit from these innovative applications. The integration of blockchain technology, NFTs, recursive inscriptions, and other emerging technologies within DeSci can revolutionize the way scientific research is conducted, incentivize collaboration, facilitate knowledge sharing, and enhance the overall efficiency and

transparency of the scientific process. As the technological landscape continues to evolve, we can expect to see even more novel applications that will further enhance the capabilities and impact of DeSci.

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