LearnChain: Building the next-generation of the Knowledge-Based Economy

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Abstract. *This study addresses the challenges of the current knowledge economy, particularly in education, highlighting the limitations of centralized systems and monetization of educational Web systems. It introduces LearnChain, a blockchain-based solution promoting decentralization, transparency, incentivization, and privacy, aimed at offering equitable monetization for all stakeholders. The paper outlines the LearnChain architecture, unique features, and its blockchain foundation, concluding with its potential impacts and future research.*

1. Introduction

The concept of knowledge economy (KE) can be defined as a system of production and consumption that is based on knowledge-intensive activities, also comprehended as intellectual capital, rather than physical resources [Powell and Snellman 2004]. Among its characteristics, the KE is driven by rapid technological change, increasing global competition, and the growing importance of intangible assets such as intellectual property, brands, and human capital. One of the key technologies of KE is blockchain.

KE has gained significant momentum in recent years due to advancements in information and communication technologies. The Web plays a crucial role in KE, democratizing access to information and knowledge, promoting collaboration and innovation worldwide. However, current Web systems and monetization models face limitations and challenges [Švarc and Dabić 2015]. The existence of intermediaries controlling knowledge distribution and monetization limits opportunities for creators, educators, and learners to obtain fair recognition and compensation. Moreover, the lack of transparency, accountability, and unequal distribution of rewards among stakeholders are key issues needing resolution [Bonadio et al. 2022].

This context demands a paradigm shift leveraging blockchain to create a decentralized, transparent, and equitable platform for sharing and monetizing knowledge in a fairer way. This approach could benefit new markets ranging from education, research, content creation, consulting, training, and professional development, projected to generate upwards of US$325B globally by 2025[1].

Blockchain technology, foundational to cryptocurrencies like Bitcoin [Nakamoto 2008] and Ethereum [Buterin et al. 2013], delivers a robust framework for securely recording transactions and managing digital assets, eliminating the need

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[1]https://www.forbes.com/sites/tjmccue/2018/07/31/e-learning-climbing-to-325-billion-by-2025-uf-canvas-absorb-schoology-moodle/?sh=35e35c933b39

for intermediaries. This presents a compelling resolution to the previously outlined challenges, setting the stage for an equitable distribution of rewards and enhancing transparency across transactions.

In response to these needs, this work introduces LearnChain, a blockchain-based initiative aiming to contribute to the KE by providing a platform for content creators, educators, and learners to disseminate and financially benefit from their knowledge in a transparent and equitable manner. Leveraging blockchain capabilities for enhanced security, clear visibility, and straightforward transactions, LearnChain seeks to bridge the significant gap within existing frameworks for KE and revenue generation, with a focus on safeguarding user privacy and the intellectual property of content.

The following sections discuss the general background, related work, LearnChain architecture, features, underlying blockchain technology, challenges, opportunities, potential impacts on the knowledge economy, and future research directions.

2. Background and Related Work

The current state of knowledge sharing platforms encompasses various business models such as MOOCs (Massive Open Online Courses), e-learning portals, content creation platforms like YouTube and Medium, and social networking sites like LinkedIn and Facebook.[2] These platforms have surged in popularity due to a rising demand for online education, the flexibility of remote work, and the consumption of digital content [Pang et al. 2020]. Predominantly centralized and proprietary, these platforms operate under the Web 2.0 paradigm, marked by user-generated content, social networking, and collaborative efforts [França et al. 2021].

While transforming the KE into a lucrative model, these platforms have also centralized data under tech giants, consolidating power and introducing vulnerabilities such as privacy breaches, data misuse, and monopolistic practices including censorship and commercial exploitation of personal information [Bojić 2022]. Additionally, their monetization strategies, relying on advertising, subscriptions, or freemium models are often opaque and inequitable, obscuring revenue sharing and inadequately valuing creator contributions, thus misaligning reward distribution [O'Reilly et al. 2024].

Beyond its roots in cryptocurrencies, blockchain has been applied across sectors like supply chain, healthcare, finance, and education, enabling secure, democratic information access and transactions. It underpins the creation of decentralized applications (dApps), supporting peer-to-peer exchanges, smart contracts, and tokenized rewards, thus enhancing the knowledge economy and advancing Web3 [Ducrée 2020].

The adoption of blockchain in education offers innovative solutions to challenges of security and accessibility. Key studies by [Lam and Dongol 2020] and [R et al. 2023] highlight this potential, focusing on enhancing e-learning platforms and secure storage of educational materials. The table 1 below compares these studies, outlining the challenges, blockchain solutions, and their impacts on education.

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[2]MOOCs Example Platform - `https://www.coursera.org`, E-learning Portal - `https://www.udemy.com`, YouTube - `https://www.youtube.com`, Medium - `https://www.medium.com`, LinkedIn - `https://www.linkedin.com`, Facebook - `https://www.facebook.com`.

Table 1. Blockchain Applications in Enhancing E-Learning Platforms

Study	Challenges Addressed	Blockchain Solution	Impact/Potential
Lam & Dongol (2020)	Enhancing reliability and trust in online education	blockchain-based e-learning platform prototype: Automates assessments and personalizes curricula	Improves the reliability and trustworthiness of online education providers
Harsha et al. (2023)	Decentralized storage of educational materials to address access, security, and single points of failure	Use of blockchain and IPFS for decentralized storage	Creates a more inclusive and resilient educational ecosystem

3. LearnChain: Concept and Differentiation

The dApp landscape is heterogeneous, with a variety of projects focused on building decentralized solutions for different sectors, as illustrated by the Ethereum dApp Repository[3]. This repository is an example that encompasses developments from open marketplaces for digital assets to decentralized finance (DeFi) platforms, indicating that the blockchain ecosystem is rich with innovative projects with disruptive potential.

As previously discussed, the KE is a sector that already has been gaining some attention from blockchain developers and entrepreneurs, with projects like Audius, Likecoin, and Fleek platforms exploring decentralized content sharing and monetization models.[4] However, as much as these projects have helped advance the field, there is still a gap to be filled, mainly in terms of privacy.

Given the openness and auditability principles of blockchain, privacy hasn't been a priority in most projects and platforms, meaning that users data and transactions are often exposed to the public [Li et al. 2020] [Πλιτυ et al. 2021]. This is a critical issue, especially in the context of knowledge sharing platforms, where users intellectual property and personal information must be protected. LearnChain aims to address this gap by providing a privacy-first platform that ensures the security and confidentiality of user data while still leveraging the benefits of blockchain technology.

LearnChain is a decentralized platform that enables creators to share and monetize their knowledge, experience, and educational resources directly with interested consumers. The solution is based on the use of blockchain to ensure secure, transparent distribution and fair compensation for content creators. On the platform, creators will be able to publish courses, videos, e-books, podcasts, and other educational content formats that will be tokenized as decentralized learning object assets that can be purchased and reused by students and creators alike.

Smart contracts automate and guarantee instant payment to creators whenever their content is consumed or reused. This eliminates intermediaries and ensures that

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[3]https://ethereum.org/en/dapps/

[4]For more information on these platforms, see: Audius - `https://audius.co/`, Likecoin - `https://about.like.co/`, Fleek - `https://fleek.co/`.

creators receive their fair share of the value generated. Blockchain allows LearnChain proposal to be technically feasible and solves the inefficiencies of traditional content monetization models.

What sets LearnChain apart from other projects is its focus on privacy and data protection. The platform is designed to ensure that users' data is encrypted and stored securely on the blockchain, guaranteeing the confidentiality of their personal information and intellectual property. This is achieved using advanced encryption techniques and zero-knowledge proofs that allow users to interact with the platform without revealing sensitive information. By prioritizing privacy, LearnChain aims to create a safe and trusted environment for creators and students to share knowledge and learn from each other.

4. Architecture and Proof of Concept

LearnChain uses state-of-the-art privacy blockchain technology to ensure the security and confidentiality of user's data, enabling privacy-preserving transactions and interactions out of the box and by default. This approach goes beyond mere security, as it also empowers users and creators by ensuring their data and interactions remain private, fostering a trusted environment for learning, sharing, and monetizing knowledge. By prioritizing privacy, LearnChain aims to create a secure platform where personal and intellectual property risks are minimized, encouraging an equitable exchange of information.

The platform's architecture is designed in a 3-layer model, a Data Layer, a Blockchain Layer, and an Application Layer, each serving a unique purpose in the ecosystem. At the foundation of LearnChain architecture is the Data Layer, leveraging the InterPlanetary File System (IPFS)[5] and the InterPlanetary Linked Data (IPLD)[6] protocols.

IPFS offers a decentralized storage solution, ensuring that educational content, be it courses, videos, e-books, or podcasts, is stored in a peer-to-peer network, thus eliminating single points of failure and enhancing data availability. IPLD further extends these capabilities by enabling more efficient, interoperable data structures to be built over IPFS. This ensures that all content stored on LearnChain is not only decentralized but also optimally organized for efficient access and retrieval, preserving the integrity and availability of data across the network.

Central to LearnChain privacy-focused ethos is the integration with the Secret Network[7], a blockchain designed specifically for privacy-preserving smart contracts. This layer utilizes encrypted smart contracts to automate transactions and interactions on the platform, ensuring that creators are compensated fairly and instantly for the use of their content while maintaining the confidentiality of user data. The Secret Network's unique approach to privacy enhances LearnChain ability to protect user information and intellectual property through secure, encrypted transactions that shield sensitive data from public view.

The Application Layer is where users interact with LearnChain through a user-friendly interface. Powered by Abakhus[8], a dApp framework, this layer facilitates se-

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[5] InterPlanetary File System (IPFS) - https://ipfs.tech/
[6] InterPlanetary Linked Data (IPLD) - https://ipld.io/
[7] Secret Network - https://scrt.network/
[8] Abakhus Protocol - https://abakhus.io/

cure and private connections to the blockchain. Abakhus is a suite of privacy-preserving protocols and tools, initially designed for health and life sciences data. It enables the tokenization of personal records and services using private smart contracts, ensuring that only token owners can access their private metadata. This unique capability simplifies the process for LearnChain to provide a secure environment for content, especially by allowing users to securely control and share their data.

Through Abakhus, LearnChain integrates advanced encryption techniques and zero-knowledge proofs to enable users to engage with the platform without exposing sensitive information. This not only ensures the privacy of transactions but also secures the identity and data of all participants within the ecosystem. It also encompasses front-end state-of-the-art technologies like NextJS[9] and Tailwind CSS[10] to provide a seamless user experience.

5. Key Challenges and Opportunities

LearnChain presents several challenges and opportunities that need to be addressed to ensure the success and sustainability of the platform. One of the key challenges is the integration of privacy-preserving technologies into the platform without compromising performance or usability. Privacy is a fundamental aspect of LearnChain value proposition, and it is essential to implement robust encryption and data protection mechanisms that do not hinder the user experience or scalability of the platform. This requires a careful balance between security, privacy, and performance to create a seamless and efficient user experience.

Another challenge is platform adoption and scalability. While blockchain offers numerous benefits for dApps, it can also present challenges in terms of user onboarding, transaction costs, and network congestion. Fully decentralized platforms for hosting the computational requirements of the application itself are still in active development and testing, which can limit the full scope of the project.

On the other hand, LearnChain also presents significant opportunities for innovation and impact in the web3 ecosystem. Alongside its novel privacy-first approach, some of the main features of the platform includes incentivized learning and sharing, through tokenomics and gamification, automated revenue distribution through smart contracts, and a decentralized governance model that empowers users to participate in the decision-making process.

6. Conclusion and Future Directions

LearnChain project represents a significant advancement in the field of knowledge sharing platforms, offering a decentralized privacy-first solution that addresses the limitations of existing centralized models. Its architecture, features, and integration with privacy-preserving technologies make it a unique and innovative platform that has great potential to impact the knowledge economy positively. Developed for teachers and students, it carries the experience of different learning perspectives, proving to be a valuable tool for the educational community.

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[9]NextJS Framework - https://nextjs.org/
[10]Tailwind CSS Framework - https://tailwindcss.com/

The development of LearnChain is currently in its early phases. Researchers and developers with expertise in blockchain, privacy, and education are collaboratively building a comprehensive solution that is technically solid and socially impactful. The project is actively participating in various blockchain bootcamps and seeking funding to expedite its development and increase its visibility within the community.

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