

Secure Learning Management System (LMS) with Blockchain Technologies

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Abstract

Learning Management Systems (LMS) are essential in digital for managing and delivering online content. However, they face challenges in ensuring document security and integrity, particularly in preventing unauthorized access and maintaining data authenticity. This research aims to enhance LMS security by integrating blockchain technology, especially Ethereum-based smart contracts, which enable decentralized and tamper-proof document management. The proposed framework allows instructors and students to upload and verify academic documents, with all actions recorded immutably on the blockchain, ensuring transparency and traceability. The methodology involves the design and deployment of a smart contract that enforces role-based permissions, enabling only authorized users to perform uploads and verifications. Data collected through blockchain transactions (gas usage, transaction time, and cost ETH) was analyzed to evaluate the system's performance. Results show that document uploads consumed an average of 121,061 gas units and 49.5ms, while verifications required 50,564 gas units and 44ms confirming the framework's efficiency for real-time LMS operations. Although the framework incurs transaction costs, it significantly enhances data security by preventing unauthorized tempering through hash-based validation. In conclusion, the research demonstrates that blockchain technology offers a robust solution for securing academic documents in LMS platforms. However, the scalability of the framework is limited by Ethereum's gas fees, which may affect adoption in large-scale deployments. Future research should explore alternative blockchain platforms to address these cost challenges and enhance scalability.

Keywords: *Blockchain, Smart Contracts, LMS Security, Document Integrity, Ethereum*