

EduNetChain: A Review on Blockchain-Based Approaches for Secure Student Profile Verification and Alumni Interaction

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Abstract: *This paper presents a conceptual framework and literature review for EduNetChain, an innovative platform designed to enhance student–alumni interaction while ensuring the authenticity of academic profiles through blockchain simulation. The study reviews existing blockchain-based credential verification and alumni networking systems to identify current challenges in combining secure verification with interactive engagement. Based on these insights, the EduNetChain architecture is proposed, integrating conventional web technologies with blockchain simulation (using Hardhat) to enable tamper-resistant and verifiable student data management. The framework outlines modules for job postings, mentorship, and secure communication within a trusted academic network. This conceptual study serves as a foundation for future implementation and evaluation toward fully decentralized deployments.*

Keywords: Blockchain-based authentication, student profile verification, alumni interaction, conceptual framework, blockchain simulation, Hardhat environment, academic data integrity, secure academic records, decentralized verification, alumni networking

1. Introduction

In today's digital age, building meaningful connections between students and alumni is essential for academic and professional development. Alumni networks enable mentorship, job opportunities, and continuous knowledge sharing, thereby enriching the educational ecosystem. However, a critical challenge persists: ensuring the authenticity of student profiles and credentials within these networks to promote trust and transparency.

Traditional academic verification systems rely on centralized databases that are prone to forgery, tampering, and manual validation delays. These issues undermine the credibility of credentials, posing risks to both students and alumni who seek reliable information. The introduction of blockchain technology has provided promising solutions to these challenges. Blockchain's inherent features of decentralization, immutability, and transparency offer a robust alternative for secure academic credential verification. [1] [2]

Despite advances such as DIUcerts, which provide transparent certificate issuance and verification on the blockchain, current platforms largely focus on validating individual certificates. They often lack support for comprehensive student profiles and do not integrate engaging student-alumni interaction features such as job postings, secure communication, and mentorship programs. Meanwhile, interactive alumni portals emphasize networking but typically do not guarantee data authenticity, leaving a gap between secure verification and active engagement. [1] [3]

This study surveys the existing literature on blockchain-based academic credentialing and studentalumni platforms to

identify this gap. Based on these insights, EduNetChain is proposed as a novel system that combines blockchain-secured comprehensive student profile verification using blockchain simulation with a feature-rich alumni-student interaction portal. This project aims to enhance trust, improve career prospects, and foster a vibrant academic community through integrated verification and communication tools.

The scope of this study includes an extensive literature review, gap analysis, and design of a conceptual architecture that addresses unmet needs in current academic verification and networking systems. The main objectives are to construct a trustworthy system model that supports both secure verification and dynamic engagement between students and alumni.

2. Literature Review

The validation and verification of academic credentials have increasingly incorporated blockchain technology to resolve the inefficiencies and vulnerabilities found in traditional centralized systems. Conventional verification mechanisms remain slow, prone to manipulation, and dependent on centralized authorities, leading to risks such as forgery and single points of system failure.

Gayathiri et al. introduced a blockchain-based certificate validation method that leverages cryptographic hashing and immutable ledger structures to secure educational credentials. While effective in preventing tampering, this approach focuses solely on individual certificates and does not support broader academic profiles or continuous student engagement [2].

Shawon et al. developed the DIUcerts platform, enabling

academic institutions to issue verifiable digital certificates on the Ethereum blockchain using smart contracts. This decentralized approach strengthens transparency and tamper resistance, although it lacks features that support long-term student–alumni engagement or holistic academic profile management [1].

Similarly, Singh et al. proposed a blockchain-based system for verifying both educational and professional certificates. Their solution demonstrates enhanced reliability in credential authentication but remains restricted to discrete certificate verification without integrating interactive networking or identity management features [3].

Rahman et al. introduced Verifi-Chain, which integrates blockchain with the InterPlanetary File System (IPFS) to provide scalable and cost-efficient credential storage. This hybrid architecture significantly improves storage capacity and verification efficiency. However, Verifi-Chain does not extend its functionality to alumni–student interactions or community-building features [4].

On the engagement side, Patil et al. presented AlmaHub, a platform that promotes supportive alumni–student interactions through job postings, mentorship, and communication features. Although AlmaHub effectively fosters engagement, it does not use blockchain for credential verification, potentially compromising data authenticity on the platform [5].

Penugonda et al. proposed Unibridge, an engagement-focused platform that enhances alumni–student interactions using modern communication features. However, like AlmaHub, it lacks blockchain-based verification, creating a gap in ensuring secure academic credential management within interactive ecosystems [6].

Suktam et al. discussed the transformative potential of blockchain in education, highlighting its capabilities in credentialing, academic data management, and secure learning ecosystems. Their study emphasizes transparency and tamper resistance but mainly provides a broad conceptual overview rather than a fully integrated verification-engagement solution [7].

Ahmed et al. conducted a comprehensive survey on blockchain-based identity management and self-sovereign identity (SSI) ecosystems. Their work highlights the importance of decentralized identifiers (DIDs) and verifiable credentials for privacy-preserving user identity control. However, the study focuses on identity systems rather than combining verification with academic engagement use cases [8].

Turkanović et al. introduced EduCTX, a blockchain-driven academic credit system aimed at standardizing and decentralizing credit transfer mechanisms across institutions. While EduCTX expands beyond single certificates to academic credits, it lacks social features and alumni–student interaction capabilities [9].

Blockcerts, developed by MIT Media Lab and Learning Machine, is one of the earliest practical blockchain-based

digital certificate frameworks. It provides a standard for issuing tamper-proof digital certificates but does not integrate interactive or community-driven functionalities for users [10]. The Blockchain for Education (B4E) framework presents a private blockchain model to authenticate lifelong learning records. Although it offers comprehensive credential management, the system does not incorporate networking, mentorship, or interactivity components [11].

Pu's multi-case study on blockchain-based digital certificates supports the practicality and benefits of blockchain credentialing. However, the study identifies challenges such as interoperability, institutional adoption, and lack of integrated social features within verification platforms [12]. Across existing solutions, a clear pattern emerges: blockchain systems excel at securing and verifying certificates, while engagement platforms excel at interaction but lack secure verification. None provide a unified solution combining **comprehensive blockchain-enabled academic credential verification with sustained student–alumni engagement**. **EduNetChain seeks to bridge this critical gap** by providing a blockchain-secured academic profile verification system integrated with interactive alumni–student networking features. This hybrid approach ensures both the integrity of student credentials and the development of meaningful academic communities essential for career growth, mentorship, and professional development.

3. Problem Statement

In the contemporary educational landscape, the reliability of student profiles and academic credentials is a pressing concern. Traditional verification methods, which depend on centralized authorities and manual processes, are often slow, prone to manipulation, and vulnerable to fraud. These challenges diminish trust among students, alumni, employers, and educational institutions. Within this context, the role of an administrative authority (admin) is crucial to oversee user registrations, verify submitted profiles, review updates, and control access. However, reliance on manual admin verification also introduces bottlenecks, inconsistency, and potential human error, further complicating the verification process.

Blockchain technology presents an immutable and decentralized alternative for credential verification, as implemented in platforms like DIUcerts that utilize smart contracts to securely authenticate certificates. Despite this progress, existing blockchain-based solutions primarily focus on validating individual certificates, overlooking comprehensive student profiles that include skills, projects, and extracurricular activities. Moreover, current alumni–student engagement platforms emphasize networking and communication but lack robust mechanisms for verifying the integrity of shared student data, risking misinformation and reduced confidence within academic communities. [1] [3]

To address these intertwined issues, this study proposes a unified solution that integrates blockchain simulation with a role-based administrative framework. This approach ensures secure, tamper-proof verification of complete student profiles, while retaining human oversight to manage exceptions and maintain data quality. Concurrently, it enables

dynamic alumni-student interactions through features such as job postings, mentorship programs, and real-time communication. Bridging the gap between secure automated verification and effective human administration is essential for fostering a trustworthy and supportive academic ecosystem.

4. Proposed Solution

To address the challenges of unreliable academic data verification and disconnected alumnistudent engagement, EduNetChain proposes a comprehensive, role-integrated platform. This system uniquely combines blockchain simulation technology with administrative oversight to deliver secure, transparent, and tamper-proof verification of complete student profiles.

The platform leverages cryptographic hashing and blockchain simulation to anchor verifiable snapshots of student profiles, including academic records, skills, and extracurricular achievements. Unlike existing systems limited to verifying discrete certificates, EduNetChain's holistic approach ensures authenticity across a broad spectrum of student information.

Complementing this automated verification, the system integrates an administrative role responsible for validating user registrations, approving profile submissions, and managing reverification tasks. This human oversight mitigates risks associated with blind automation and provides an additional trust layer, ensuring data integrity before blockchain anchoring.

Simultaneously, EduNetChain fosters community engagement by offering dynamic features such as job postings, mentorship programs, and encrypted messaging. This design encourages active collaboration within a secure environment where student data is trustworthy and interactions are meaningful.

By uniting advanced blockchain-based validation with essential human administration and rich engagement tools, EduNetChain aspires to create a trusted, efficient, and scalable academic ecosystem suited to modern educational and professional needs.

5. Proposed System Architecture

The EduNetChain platform integrates blockchain simulation technology with traditional web application components to deliver a secure, interactive, and scalable academic verification and alumni-student networking solution.

1) Blockchain Simulation Layer

Uses a blockchain simulation framework (e.g., Hardhat) to generate cryptographic hashes of student profiles, anchoring immutable and tamper-evident records without the costs of live blockchain deployment. Smart contracts manage profile registrations, verification statuses, and access controls.

2) Backend Server

Acts as the main data processing hub, handling user authentication, profile data, job postings, mentorship requests, messaging records, and administrative functions. It

interfaces with the blockchain simulation to create and validate cryptographic proofs of profile authenticity. The backend supports admin roles for verification, approval, and reverification workflows.

3) Admin Module

Provides dedicated tools and interfaces for administrators to review and verify user registrations before blockchain anchoring, validate submitted profiles, and manage reverification requests on profile updates. This human oversight layer mitigates risks of blind automation, ensuring data integrity and trustworthiness in the system.

4) Frontend Interface

An intuitive web platform for students, alumni, and administrators. It enables profile creation, management, viewing of verified credentials, job and mentorship posting, and secure communication.

5) Verification Module

Implements the core logic to hash profile data and anchor these hashes on the blockchain simulation. It validates user data against blockchain records during profile access to guarantee integrity.

6) Interaction Module

Supports job postings, mentorship program workflows, and encrypted chats with role based access control to protect privacy and secure communications.

This architecture balances the security and immutability of blockchain with essential human administration and efficient user engagement, producing a trustworthy and functional platform for academic profile validation and alumni collaboration.

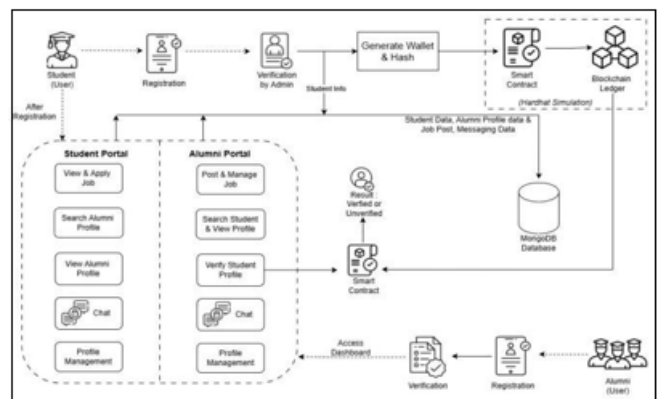


Figure 1: EduNetChain System Architecture

The figure illustrates the overall architecture of the EduNetChain platform, integrating blockchain simulation with traditional web technologies. The process begins with student and alumni registration, followed by admin verification. Once verified, profile data are hashed and anchored through smart contracts on a simulated blockchain using Hardhat, ensuring immutability and authenticity. Verified information and interaction data are securely stored in a MongoDB database. The system provides dedicated portals for students and alumni, supporting job postings, mentorship, chat communication, and profile management within a secure and tamper-resistant environment.

6. Conclusion

This study presents a comprehensive survey of blockchain-based academic credential verification systems and alumni engagement platforms, identifying a notable gap in integrating secure, holistic student profile verification with dynamic alumni-student interactions. The proposed EduNetChain framework addresses this issue by combining blockchain simulation for tamper-proof profile validation with interactive features such as job postings, mentorship, and secure messaging.

Integral to this design is the role of administrative oversight, which ensures data integrity by validating registrations and managing profile updates prior to blockchain anchoring. This unified approach promises to enhance trust and foster vibrant academic communities in the future. Future studies will explore real-world deployment challenges, scalability, and privacy concerns to fully realize its potential.

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