A Blockchain Based Framework for Transforming Teachers Evaluation and Certification

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Abstract
Teachers play a pivotal role in shaping individual growth and societal progress by fostering students' academic, social, and emotional development. They impart knowledge, encourage critical thinking, and equip students with essential life skills. Given the importance of teachers, regular and effective assessment is crucial. However, evaluating educa- tors presents challenges due to their diverse responsibilities, subjective evaluation methods, and limited feedback mechanisms. To address these challenges, we have developed a comprehensive framework that allows students to assess teachers on a scale of 1 to 5 using customized evaluation questions. This framework gathers detailed feedback, computes average ratings, and visualizes both individual and overall teacher performance. Additionally, a Generative Pre-trained Transformer (GPT) API is utilized to generate summarized feedback for each teacher, offering insightful reflections on their performance. Upon course completion, teachers are awarded digital certificates embedded with QR codes for easy validation, with blockchain technology employed to ensure the security and authenticity of these credentials. This approach streamlines the teacher evaluation process, improves teaching quality, promotes student success, and supports professional development, all while ensuring institutional accountability.

Keywords: Blockchain, Feedback, Teachers Evaluation, Performance Visualization.

Introduction
Teachers play a pivotal role in shaping the future of individuals and society by fostering knowledge, skills, and values in learners. Their influence extends beyond academics, contributing to students' emotional and social development, critical thinking abilities, and lifelong learning [2]. Given their vital role, assessing and certifying teachers is essential to ensure they meet professional standards, maintain the quality of education, and build trust in their expertise. However, evaluating teacher performance is a complex and multifaceted process, involving both measurable outcomes, such as student achievement, and intangible factors like classroom management, creativity, and the ability to inspire learners [1]. These challenges make it difficult to design standardized and equitable evaluation methods, emphasizing the need for regular and reliable assessments to identify areas for improvement and enhance teaching effectiveness.

Blockchain technology presents an innovative solution to transform the teacher certification process. As a decentralized and distributed ledger, blockchain records data securely, transparently, and immutably across multiple nodes. Each piece of information is linked to the previous one, forming a secure "chain" that is collectively maintained by a network of participants. This technology eliminates the need for intermediaries, enhances transparency, and enables automated processes through smart contracts [10, 7]. By leveraging blockchain, it is possible to create a secure, efficient, and trustworthy system for teacher evaluation and certification.

2 Related Works
The previous work focused on teacher evaluation, various studies have explored methods and systems for assessing the performance of Teaching Assistants (TAs) with the goal of enhancing self-efficacy and improving teaching quality [5]. One key approach involves using wearable devices to track and analyze TA actions during classroom sessions, allowing for the identification of successful teaching behaviors. These successful experiences are then used for reflective practice, with the goal of boosting the TA's confidence and teaching effectiveness [3]. Despite some promising results, the impact of reflection on self-efficacy has shown mixed outcomes, with no significant difference observed between groups that engage in reflection and those that do not [9,6]. Additionally, some studies have highlighted the use of decision tree algorithms to analyze teacher assistant datasets, providing valuable insights into the performance of TAs by calculating information gain and evaluating different dimensions of their actions [4,8]. The previous work focused on teacher evaluation and did not focus on the visualization of data, formative evaluation

or certification systems, which, while beneficial in terms of verification and tracking, are outside the scope of improving reflective practices and self-efficacy through direct evaluation methods.

3 Blockchain Based Framework

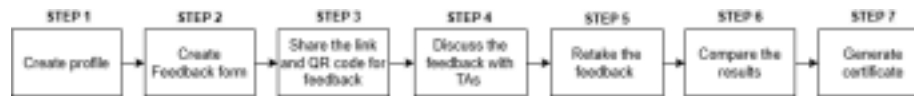The blockchain based framework for transforming teacher evaluation and certification is designed to provide a secure, transparent, and efficient mechanism for assessing teacher performance and issuing verifiable credentials. The following sections detail the framework's key procedure steps (see figure1), illustrating how it can be effectively utilized to enhance the credibility and scalability of teacher evaluation and certification systems.

Fig.1: Our user study procedure consists of seven steps

Step 1— Create profile: Employers can sign up by providing their name, phone number, address, company, and position details as shown in figure2. Similarly, employees can create profiles to access and view their statistics. Once the sign-up process is complete, users will be redirected to the dashboard similar to figure 2b.

(a) Employer sign-up page (b) Employer dashboard
Fig.2: Profile creation page

Step2—Create feedback form: Upon entering the dashboard, employers need to setup questions for the feedback form. A few predefined questions are available, but they can be updated, and additional questions can be added or removed, ensuring complete flexibility. For each question, employers must provide five answer options, with the final option designated as "Not Applicable" for scenarios where a question doesn't apply to the teacher see figure 3a.

Once the questions are finalized, the employer can click the **Create** button to proceed. They can then add teachers' names along with their email addresses and specify the subject title for which the feedback form is being created as shown in figure 3b. After submitting the form, a QR code and a link for the feedback form are automatically generated for the subject.

Step 3— Share the link and QR code for feedback: In the third step, the generated

QR code and link can be shared with students via Google Classroom or WhatsApp groups to collect feedback about the teachers. Students can rate teachers on a scale of 1 to 5 and provide descriptive feedback if they wish. For questions that do not apply to a specific teacher, students can simply select the "Not Applicable" option to skip those questions.

After collecting feedback from students, the next step is to analyze the data. The framework offers multiple methods for analysis. It generates a performance summary using OpenAI's generative pre-trained API and calculates the average rating for each teacher.
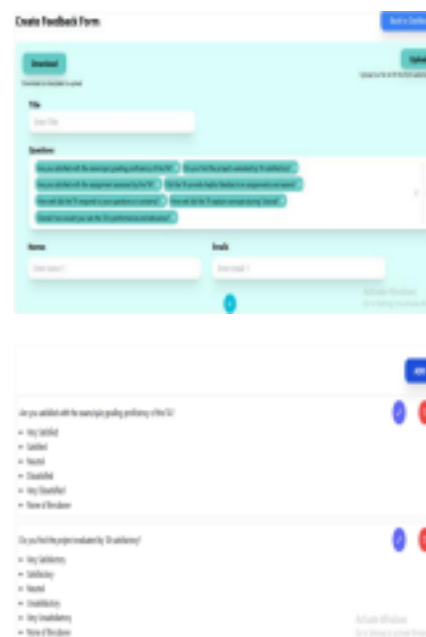

(a) Question setting page (b) Form creation page
Fig.3: Feedback from creation

Step 4— Discuss the feedback with teachers: After analyzing the student feedback performance from the various graphs and data as shown in figure 4, the employer should discuss the results and any concerns raised by students with the teachers. This collaborative discussion aims to address the identified issues and help teachers improve their performance.

Step 5— Retake the feedback: After a certain period, steps 2, 3, and 4 are repeated. This cycle involves collecting feedback

again, usually at the beginning, middle, and end of the course. These repeated assessments allow for formative evaluations of teachers, helping them to work on and improve their performance throughout the course. The final assessment, typically conducted at the end, provides a comprehensive analysis and final rating for certification purposes.
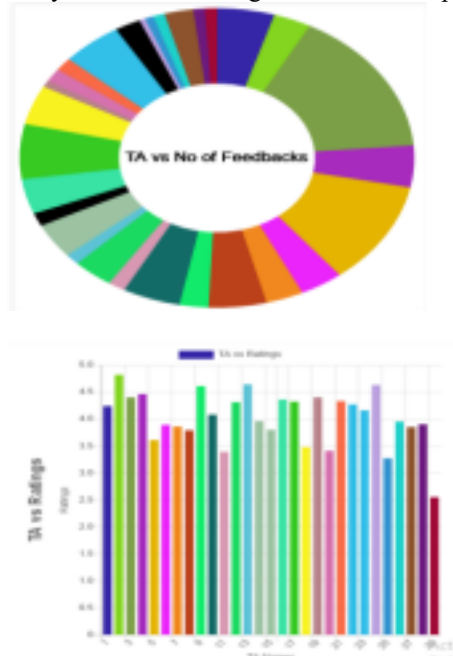
(a) Teacher with corresponding rating (b)Teacher with number of feedbacks Fig.4: Graphs for analysis.

Step6—Analyse the results: In the penultimate step, the employer conducts a comprehensive analysis of the teacher's performance throughout the course. This includes comparing current ratings with previous ones to determine whether the teacher has shown improvement or decline and assessing whether they have addressed the issues raised by students earlier.

(a) Certificate with QR code, date (b) Etherscan And time.
Fig.5: Certificate and Etherscan

Step 7— Generate certificate: In the final step, the employer generates a certificate for the teacher by providing essential details such as the teacher's name, course duration, and a one-word feedback summary. The generated certificate includes a QR code for verification, ensuring its authenticity. The certificates also have real-time date and time information as shown in figure 5a. Teachers can also share the certificate link wherever needed. To ensure security, certificates are secured using Ethereum blockchain technology, making them error free, fraud-resistant, and highly transparent. Employers can view the blockchain node transactions on Etherscan for added verification a sample etherscan is shown in figure 5b.

4 Discussions
Our tool features a user-friendly interface, making it convenient and flexible to use for both employers and employees. It offers a variety of visual analysis options, including detailed graphs, to enhance data interpretation as shown in figure 4. Recognizing the importance and challenges of conducting formative assessments for teachers, this tool provides an efficient and effective solution to support continuous performance improvement.

Both employers and employees can benefit from using the tool. Employees can access their certificates to showcase their skills and performance, using them as verifiable proof when applying for new opportunities or advancing in their careers. For employers, the tool offers a wide range of uses. It can be employed for formative evaluations of teachers, helping identify areas for improvement and providing targeted feedback. Additionally, it can assist in resolving student grievances by offering clear, accessible performance records. Employers can also track employee performance overtime, making it easier to assess long-term progress and inform decisions related to promotions, professional development, or even recruitment of new staff. Furthermore, the tool enables employers to conduct in-depth analyses of employee performance, offering valuable insights for decision-making and talent management.

Ethereum blockchain technology is used to certify teachers' performance. Ethereum is a decentralized platform known for its robust security features and transparent, tamper-proof record-keeping capabilities. Using Ethereum, our tool ensures that every certification is securely stored and verifiable, offering an immutable record of teacher performance.

Additionally, our tool integrates Etherscan, a powerful blockchain explorer, which allows users to view the node formation and transaction history of the blockchain certificates. This provides full transparency and the ability to track and verify each certification in real-time as shown in figure 5. The combination of Ethereum's blockchain technology and Etherscan's visibility offers several key benefits, some of which are outlined below:
* *Enhanced Security and Fraud Prevention:* Blockchain ensures certificates are tamper-proof and cannot be forged, guaranteeing their authenticity.
* *Transparency and Immutability:* The decentralized ledger records all trans actions permanently, allowing verifiable, unalterable data tracking.

* *Global Accessibility and Decentralized Verification:* Certificates can be easily shared and verified worldwide through platforms like Etherscan, eliminating reliance on third parties.

* *Efficiency and Automation:* Blockchain streamlines certificate issuance and verification, reducing administrative tasks and speeding up the process.

5 Conclusions

Blockchain based framework for teacher evaluation and certification, utilizing Ethereum's decentralized platform to ensure secure, transparent, and efficient assessments. By integrating Etherscan for real-time verification, the tool provides immutable, tamper-proof certificates, enhancing the credibility and scalability of performance evaluations. The multi-step process enables continuous formative assessments, constructive feedback, and professional development for teachers, while offering employers valuable insights for decision-making and talent management. The use of blockchain eliminates administrative inefficiencies, ensuring secure, verifiable, and easily accessible certificates. This system addresses key challenges in traditional evaluation methods, offering a scalable, global solution for improving teacher performance and education quality.

7

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