Proceedings of ICMRED 2026 Symposium: Financial Innovation, Risk Governance, and the Dynamics of Global Capital Flows
DOI: 10.54254/2754-1169/2026.BL34558

Blockchain-Based Tuition Escrow and Trust Framework for Prepaid Education Services

Yaning Yang

Shanghai University, Shanghai, China
Yangyaning510@sina.com

Abstract. The prepaid model is widely used in private education and training markets, where parents or students are often required to pay the full tuition fee before instruction begins. Although this arrangement helps institutions secure cash flow, it also exposes consumers to substantial risks when promised courses are delayed, reduced in quality, or never delivered. This paper proposes a blockchain-based tuition escrow and trust framework for prepaid education services. The study adopts a design-oriented research approach and develops a Solidity smart contract prototype to demonstrate the core payment logic. In the proposed framework, tuition is deposited into a smart contract, released gradually as classes are completed, and refunded when the service relationship breaks down before completion. The framework also integrates an on-chain reputation module and a certificate-recording mechanism to strengthen transparency and post-service accountability. The analysis shows that blockchain can transform prepaid tuition from a high-trust, high-risk arrangement into an auditable and partially automated contractual process. At the same time, the paper finds that technological solutions alone cannot fully solve disputes over teaching quality, identity verification, and legal compliance.

Keywords: Blockchain, smart contract, education services, tuition escrow, decentralized trust

1. Introduction

The prepaid payment model is common in tutoring centers, language schools, and other forms of private education, where families pay for a package of classes in advance while services are delivered over time [1]. Existing research on blockchain in education has mainly focused on credentials, learning records, and decentralized academic administration, while also highlighting wider concerns about trust, institutional accountability, and data transparency in education systems [2, 3]. These concerns are directly relevant to prepaid education because the value promised to consumers lies in future performance rather than immediate delivery.

The central problem of prepaid tuition is the unequal allocation of risk. Institutions receive payment upfront, whereas consumers bear uncertainty regarding service continuity and institutional stability. This issue extends beyond intentional fraud, as operational failures such as poor management, teacher turnover, or sudden closures may also disrupt service delivery. Once tuition has been fully paid, consumers usually have limited bargaining power and limited visibility into

DOI: 10.54254/2754-1169/2026.BL34558

fund usage [1, 3]. Payment security, service verification, and institutional trust therefore become tightly connected.

Blockchain has been proposed as a useful infrastructure for situations in which multiple parties need a shared, tamper-resistant record without relying entirely on a central intermediary [2-5]. Smart contracts extend this idea by allowing predefined conditions to trigger the automatic execution of transactions [5, 6]. This paper explores how blockchain can be applied to improve trust, transparency, and payment security in prepaid education services. Specifically, the study develops a blockchain-based tuition escrow mechanism using Solidity, aligning payment release with service delivery milestones. In addition, reputation and certification modules are incorporated to strengthen accountability. By integrating system design and prototype implementation, this paper aims to demonstrate how blockchain can mitigate counterparty risk in prepaid education contexts.

2. The prepaid education model and its trust problems

2.1. The logic of prepaid tuition in education services

Prepaid tuition persists not only because it offers obvious advantages to providers—such as improved cash flow, simplified billing, and more predictable revenue—but also because it is often accepted by consumers due to bundled discounts and prevailing market practices. Yet the arrangement effectively asks consumers to finance the provider before the service is complete. In education, this risk is especially high because services are not provided at one moment but through repeated interactions over time [1, 2].

Education services differ fundamentally from standard product transactions. Their value is evaluated through attendance, teacher preparation, communication, and learning progress, all of which become visible only after the course begins. Although prepaid contracts typically specify the number of classes and total fees, they cannot fully capture all dimensions of instructional quality or service continuity. The longer the service period, the greater the uncertainty transferred to the consumer.

2.2. Financial exposure and information asymmetry

The most immediate risk in prepaid education is financial exposure. When the full fee is paid in advance, the consumer becomes dependent on the future behavior and financial condition of the institution. If the provider suspends classes, changes the service significantly, or ceases operations, the undelivered portion of tuition may be difficult to recover. From this perspective, the prepaid model transforms a service purchase into a high-risk advance transfer [1, 3].

Information asymmetry makes this risk worse. Institutions typically possess more information than consumers regarding enrollment pressure, staffing stability, and internal cash flow conditions. While parents may rely on marketing and informal reviews, they cannot easily verify operational resilience before payment. Research on digital transactions shows that where uncertainty and perceived risk are high, acceptance depends heavily on mechanisms that reduce vulnerability and make commitments credible [7, 8].

2.3. Trust deficits in long-term education services

Trust is crucial in markets where performance is delayed and quality is partly subjective. Reputation systems can help participants transact under uncertainty by aggregating information about past

DOI: 10.54254/2754-1169/2026.BL34558

behavior [9, 10]. However, online feedback mechanisms also suffer from manipulation, uneven participation, and selective disclosure, limiting their effectiveness in high-stakes service contexts such as education [11, 12].

In prepaid education, the trust problem is twofold. Parents require assurance that institutions will not appropriate funds without fulfilling their contractual obligations, and they also need evidence that classes have actually been delivered. Traditional systems usually separate these issues: payment is made first, while reviews appear only later. A stronger design would connect payment, delivery verification, and post-course reputation within one contractual structure.

3. Blockchain technology and smart contracts

3.1. Blockchain features relevant to prepaid education services

Blockchain became widely known through Bitcoin, which showed how a distributed ledger could record value transfers without a central intermediary [4]. Ethereum extended this idea by adding a programmable environment in which contractual logic could be embedded directly into the network [5]. For prepaid education, three features are particularly relevant: shared transaction records, resistance to unauthorized alteration, and programmable settlement rules [4, 5, 7].

These features do not mean that blockchain is suitable for all applications. Research has repeatedly noted concerns about scalability, privacy, and governance [9, 11]. Even so, blockchain is well suited to situations in which several parties need transparent, verifiable records and no single actor should unilaterally control the system. That is precisely the structural problem in prepaid education.

3.2. Smart contracts as automated escrow logic

The concept of smart contracts predates modern blockchains. Szabo described it as a digital protocol that formalizes and secures relationships over public networks [6]. Blockchain platforms made this concept operational by allowing code to execute automatically when predefined conditions are satisfied [5, 7]. Existing research suggests that their main value lies in reducing manual enforcement costs and making transactional rules more predictable, although coding errors and security flaws remain serious concerns [9].

For prepaid education, the most relevant application is escrow. Instead of sending all tuition directly to the institution, the parent deposits funds into a contract. The contract holds the balance and releases it in smaller units as service milestones are confirmed. This limits the provider's ability to access the entire payment prior to service completion while preserving the consumer's claim over undelivered services. The arrangement does not eliminate trust, but it redistributes it from unilateral discretion to verifiable rules.

3.3. Existing blockchain applications in education

A growing body of research has provided several examples of blockchain in education. Early work proposed blockchain-based systems for managing educational records, reputation, and rewards [13]. Subsequent studies developed models for credit transfer, lifelong learning portfolios, academic qualification verification, and broader education blockchain ecosystems [14-18]. In most cases, blockchain is used as infrastructure for immutable records and portable credentials.

DOI: 10.54254/2754-1169/2026.BL34558

While this literature provides valuable insights, it largely focuses on verifying learning outcomes after educational activities have been taken place. Much less attention has been paid to earlier payment stages, especially the governance of prepaid payments in commercial education settings. The proposed tuition escrow framework extends the education blockchain agenda from credential verification to payment governance.

4. Design of the blockchain-based tuition escrow system

4.1. Design goals and participants

The proposed system centers on three primary participants: the parent or student as payer, the education institution as service provider, and a blockchain-based smart contract as the escrow mechanism. In wider deployment, regulators or platform operators may act as observers or arbitrators; however, the core logic can be illustrated through the interaction between the two parties and the contract.

The system is designed to achieve four goals. First, payment security: undelivered tuition should remain protected. Second, transparency: key events such as deposit, class completion, release, refund, and rating should be recorded in a verifiable way. Third, accountability: historical service performance should contribute to future trust assessment. Fourth, completion traceability: once services are fulfilled, learners should receive a durable record of completion.

4.2. Tuition escrow and staged release

At the center of the framework is a staged settlement mechanism. Before the course begins, the parent deposits the full tuition amount into a smart contract rather than transferring it directly to the institution. The contract allocates payment proportionally across service units (e,g., individual classes). After each class, the institution submits a completion claim, which must be confirmed by the payer. Upon mutual confirmation, the contract releases the corresponding payment. This process continues iteratively until all service units are completed.

The logic balances commitment and protection. The institution gains assurance that total tuition has been reserved at the start of the relationship, while the parent retains protection over the undisbursed balance. If the course stops partway through, the remaining funds can be returned according to contract rules. This structure directly addresses the consumer's core concern: not whether to pay at all, but when payment becomes irrevocable. In trust terms, the design reduces perceived vulnerability by linking settlement to verified milestones [8].

4.3. Reputation system and certificate recording

Escrow alone addresses payment timing, but long-term trust depends on visible history. The framework therefore includes a reputation module. After successful completion, the parent can submit a rating, which is recorded on-chain and accumulates into a persistent performance signal. Such mechanisms can enhance trust when they make past behavior easier to observe [10], although their limits also need to be recognized [12].

The system also includes a certificate-recording mechanism. When all classes have been confirmed, the contract marks the learner as having completed the course. This function does not replace a full transcript but creates a verifiable record that the agreed service cycle was fulfilled. By

DOI: 10.54254/2754-1169/2026.BL34558

linking payment completion with documentary outcomes, the design aligns with broader efforts to use blockchain for durable learning records [13-15].

4.4. Benefits and limitations of the design

The proposed system offers three main advantages. First, it reduces counterparty risk by ensuring that undelivered tuition remains recoverable. Second, it increases transparency because contract events are recorded through a shared ledger. Third, it strengthens accountability by combining completion records with post-course reputation signals.

However, important limitations remain. The system can verify that a class was marked and confirmed, but it cannot automatically assess pedagogical quality. A parent may confirm attendance even when teaching is weak or may withhold confirmation for unrelated reasons. The design also raises concerns about privacy, wallet usability, fees, and the legal recognition of blockchain records. In practice, a deployable system would require identity management, dispute resolution, and hybrid on-chain/off-chain governance.

5. Implementation of the smart contract prototype

5.1. Overview of the contract architecture

To test feasibility, a prototype smart contract was implemented in Solidity. The design models a bilateral relationship between a payer (parent) and a service provider (education institution). The implementation is intentionally simplified to highlight the core mechanisms of escrow, confirmation, refund, reputation, and certificate issuance, demonstrating how a prepaid education agreement can be translated into state-dependent blockchain operations.

The contract defines key participants and financial variables: parent, institution, totalClasses, pricePerClass, completedClasses, and totalAmount. These variables convert an abstract service package into measurable contractual units. By expressing tuition as a sequence of class-based payments, the implementation operationalizes staged settlement at the code level.

5.2. Variables, access control, and state machine design

A key strength of the prototype is its state-machine structure. The contract defines four states: Created, Funded, Completed, and Refunded. This prevents functions from being executed outside invalid phases of the contractual lifecycle. For example, tuition can only be deposited in the Created state, class completion can only be processed after funding, and the contract moves to Completed only after all classes are confirmed.

Role-based modifiers such as onlyParent, onlyInstitution, and inState further restrict access. This matters because payment disputes often arise from uncertainty about who is allowed to trigger financial events. By embedding role and state restrictions directly into the code, the prototype reduces ambiguity and strengthens procedural discipline.

5.3. Deposit, completion confirmation, and refund logic

The deposit() function requires the parent to transfer the total tuition amount into the contract. The institution can then call markClassCompleted() to signal delivery, but that signal alone does not release funds. Payment occurs only when the parent calls confirmClass(). At that point, the contract

DOI: 10.54254/2754-1169/2026.BL34558

increments the number of completed classes, transfers one class payment to the institution, resets the class marker, and checks whether the whole course has been finished.

The refund() function allows the parent to recover the remaining balance whenever the contract has not yet reached the "Completed" state. Conceptually, the code converts a lump-sum prepayment into a conditional stream of micro-payments backed by an automatically calculated residual claim. This is the clearest demonstration of how blockchain can change the risk profile of prepaid education.

5.4. Reputation and certificate modules

After completion, the rateInstitution() function allows the parent to submit a score from one to five. Ratings and rating counts are stored on chain, creating a basic reputation record. The issueCertificate() function, called internally when all classes are completed, marks that the learner has received a certificate. These modules show how payment control, service verification, and post-service trust data can be combined in one contract.

The prototype also reveals the limits of a first-stage design. It does not include external arbitration, decentralized identity, privacy-preserving storage, or oracle-based attendance checks. Refund authority is relatively simple and would need more sophisticated governance in production. Even so, the contract demonstrates the practical feasibility of a blockchain-based tuition escrow model.

6. Discussion

The prototype suggests that blockchain can reduce information asymmetry and improve the transparency of prepaid education contracts. However, technological feasibility alone does not guarantee adoption. A public blockchain offers openness, yet it may create user-experience and fee challenges for ordinary families. A consortium chain may be easier for schools and regulators to manage, although it reduces some decentralization benefits. A hybrid model may therefore be the most realistic path.

Legal and operational enforceability also remain key challenges. Smart contracts can automate agreed rules, but they do not automatically resolve disputes related to teaching quality, attendance exceptions, or emergency schedule changes.

7. Conclusion

The prepaid tuition model creates a structural trust challenge in education services, as payments are made upfront while service delivery is gradual and uncertain. Parents bear the risk of institutional failure, delayed delivery, and incomplete information, while conventional payment systems offer limited protection once money has been transferred. This paper addressed that problem by proposing a blockchain-based tuition escrow and trust framework for prepaid education services.

The analysis shows that blockchain is useful here not simply because it is decentralized but because it allows contractual logic to become transparent, auditable, and partially self-executing. By locking tuition into a smart contract and releasing payments class by class, the proposed framework reduces the mismatch between when money is paid and when value is delivered. The addition of a reputation module and completion certificate extends the system from payment protection to broader accountability.

DOI: 10.54254/2754-1169/2026.BL34558

The Solidity prototype demonstrates that the main components of such a model are technically feasible. Variables for class count, class price, escrow balance, and participant roles can be combined with a clear state machine to manage deposit, confirmation, refund, rating, and certificate issuance. In this sense, the research question can be answered positively: blockchain can improve trust, transparency, and payment security in prepaid education services by converting a lump-sum prepayment into a staged and verifiable contractual process.

At the same time, the framework does not directly measure teaching quality, fully prevent strategic behavior, or replace consumer law and educational regulation. Future work should therefore focus on dispute resolution, privacy design, decentralized identity, and interoperable standards for education-service smart contracts. Even with these limits, the proposed model provides a practical foundation for rethinking how prepaid education transactions can be governed more fairly and securely.

References

[1] Park, J. (2021) Promises and challenges of blockchain in education. Smart Learning Environments, 8(1): 33. https: //doi.org/10.1186/s40561-021-00179-2
[2] Chen, G., Xu, B., Lu, M., et al. (2018) Exploring blockchain technology and its potential applications for education. Smart Learning Environments, 5(1): 1. https: //doi.org/10.1186/s40561-017-0050-x
[3] Grech, A., & Camilleri, A. F. (2017) Blockchain in education. Publications Office of the European Union. https: //doi.org/10.2760/60649
[4] Nakamoto, S. (2008) Bitcoin: A peer-to-peer electronic cash system. https: //bitcoin.org/bitcoin.pdf
[5] Buterin, V. (2014) A next-generation smart contract and decentralized application platform. Ethereum White Paper. https: //ethereum.org/whitepaper/
[6] Szabo, N. (1997). Formalizing and securing relationships on public networks. First Monday, 2(9). https: //doi.org/10.5210/fm.v2i9.548
[7] Christidis, K., & Devetsikiotis, M. (2016) Blockchains and smart contracts for the Internet of Things. IEEE Access, 4: 2292–2303. https: //doi.org/10.1109/ACCESS.2016.2566339
[8] Pavlou, P. A. (2003) Consumer acceptance of electronic commerce: Integrating trust and risk with the technology acceptance model. International Journal of Electronic Commerce, 7(3): 101–134. https: //doi.org/10.1080/10864415.2003.11044275
[9] Alharby, M., & van Moorsel, A. (2017) A systematic mapping study on current research topics in smart contracts. International Journal of Computer Science & Information Technology, 9(5): 151–164. https: //doi.org/10.5121/ijcsit.2017.9511
[10] Resnick, P., Zeckhauser, R., Friedman, E., et al. (2000) Reputation systems. Communications of the ACM, 43(12): 45–48. https: //doi.org/10.1145/355112.355122
[11] Yli-Huumo, J., Ko, D., Choi, S., et al. (2016) Where is current research on blockchain technology?—A systematic review. PLOS ONE, 11(10): e0163477. https: //doi.org/10.1371/journal.pone.0163477
[12] Dellarocas, C. (2003) The digitization of word of mouth: Promise and challenges of online feedback mechanisms. Management Science, 49(10): 1407–1424. https: //doi.org/10.1287/mnsc.49.10.1407.17308
[13] Sharples, M., & Domingue, J. (2016) The blockchain and kudos: A distributed system for educational record, reputation and reward. European conference on technology enhanced learning, 490-496. Cham: Springer International Publishing.
[14] Turkanović, M., Hölbl, M., Košič, K., et al. (2018) EduCTX: A blockchain-based higher education credit platform. IEEE Access, 6: 5112–5127. https: //doi.org/10.1109/ACCESS.2018.2789929
[15] Ocheja, P., Flanagan, B., Ueda, H., et al. (2019) Managing lifelong learning records through blockchain. Research and Practice in Technology Enhanced Learning, 14(1): 1-19.
[16] Mori, K., & Miwa, H. (2019) Digital university admission application system with study documents using smart contracts on blockchain. International Conference on Intelligent Networking and Collaborative Systems, 172-180. Cham: Springer International Publishing.
[17] Nousias, N., Tsakalidis, G., Michoulis, G., et al. (2022) A process-aware approach for blockchain-based verification of academic qualifications. Simulation Modelling Practice and Theory, 121: 102642.. https: //doi.org/10.1016/j.simpat.2022.102642

DOI: 10.54254/2754-1169/2026.BL34558

[18] Ocheja, P., Agbo, F. J., Oyelere, S. S., et al. (2022) Blockchain in education: A systematic review and practical case studies. IEEE Access, 10: 99525–99540. https: //doi.org/10.1109/ACCESS.2022.3206791