Research on how to increase user engagement of Korean AI tutoring service using token economy

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Abstract

While AI tutoring has strengths in personalization, it is limited by a lack of emotional and social interaction to keep learners engaged. To address this issue, this research proposes a new model that fuses AI tutoring with blockchain-based "token economy" and "gamification". The token economy provides rewards for learning activities and community contributions (extrinsic motivation), while gamification provides the fun and sense of accomplishment of the learning process itself (intrinsic motivation). The synergy of these two elements aims to build a sustainable learning ecosystem by transforming learning into a "value-creating activity" rather than a mere obligation.

1. Introduction

1.1 Background and Need for the Study

With the advancement of digital technology, artificial intelligence (AI) is emerging as a key driver in education to provide personalized learning. AI tutoring services are becoming ubiquitous in education with advantages such as personalized learning and real-time feedback, but they have clear limitations in keeping users engaged.

The biggest problem is that AI cannot provide the same emotional support or interaction as a human tutor, making it difficult to maintain motivation to learn. In fact, the initial dropout rate for online education platforms in South Korea is as high as 36.7%, suggesting that technological advancements alone cannot guarantee learners' continued engagement. These limitations are analyzed because of AI tutoring focusing only on learning efficiency and failing to fully consider learners' psychological and social motivation.

As an alternative, this study proposes a combination of blockchain-based 'token economy' and 'gamification'.

Token economy is a sophisticated reward system based on behavioral psychology that gives learners a sense of ownership and transparency to increase extrinsic motivation and engagement. Gamification stimulates intrinsic motivation by applying game elements such as fun and immersion to the learning process. While current AI tutoring leverages piecemeal game elements, the synergy between the two can maximize learning through a balance of extrinsic rewards (tokens) and intrinsic enjoyment (gamification). This presents a new paradigm that transforms learning into a value-creating activity with rewards rather than a passive duty.

Therefore, this study aims to design an innovative model that combines token economy and gamification to solve the inherent problems of user engagement and churn in Korean AI tutoring services and explore how to build a sustainable learning ecosystem.

[Table 1] AI Key limitations of AI tutoring services and applicability of token economy/gamification

Key limitations of AI tutoring services	Token economy applicability	Gamification applicability
Lack of emotional interaction	Community contribution rewards, peer tutoring incentives	Collaborative quests, group challenges, social NFTs
The Challenges of Training Creative Thinking	Content creation rewards, problem-solving challenge rewards	Creative quests, storytelling-based learning
High dropout rates and learning persistence issues	Reward completion of learning activities, incentivize long-term engagement	Leveling up, badges, leaderboards, continuous learning rewards
Lack of instructor/student interaction	Community activity rewards, governance participation rights	Team-based learning, peer review, social enhancements

1.2 Research objectives

This study aims to propose a new service model that fuses blockchain-based token economy and gamification elements to solve the problems of user engagement and learning persistence in Korean AI tutoring services. The specific research objectives are as follows

First, we analyze the status of Korean AI tutoring services and the factors that hinder user engagement.

Second, we analyze prior research on token economy and gamification and their success/failure cases to draw implications for application in the education field.

Third, we design a token economy-based Korean AI tutoring service model to enhance learning motivation and social interaction and propose a specific token design and operation plan.

Fourth, we present the system architecture and main function implementation of the proposed model and propose evaluation methods for future empirical studies.

1.3 Organization of the Thesis

This thesis is organized into five chapters. Chapter 1, Introduction, presents the background and necessity of the study, explains the purpose of the study and the organization of the thesis.

Chapter 2, Related Research, provides an in-depth review of previous research on Korean AI tutoring services, token economy, and gamification.

Chapter 3, the proposed token economy-based AI tutoring service model, presents the service overview, token design and operation plan, and user engagement strategy in detail.

Chapter 4, System Implementation and Evaluation, describes the system architecture of the proposed model, how the main functions are implemented, and the experimental design and data analysis methods for evaluation.

Finally, Chapter 5, Conclusions and Future Research, summarizes the main contents of this research and presents the limitations and future research directions.

2. Related Research

2.1 Korean AI Tutoring Service

AI tutors are powerful learning tools that analyze an individual's learning data to provide customized materials and instant feedback. While their core strength is personalization, which improves learning efficiency and provides learning opportunities without time and space constraints, they face clear limitations.

The biggest challenge is sustaining user engagement. AI can't provide the emotional support or empathy of a human tutor, nor can it foster creative thinking. This, coupled with the lack of interaction common to online learning environments, leads to low learning motivation and high dropout rates. In fact, one training platform reduced its churn rate from 36.7% to 10.9% by increasing interaction with administrators and fellow learners, suggesting that social and emotional factors beyond technical personalization are crucial to learning persistence.

In conclusion, “personalized learning” by AI tutors increases the cognitive efficiency of learning but does not satisfy the emotional and social aspects of learning and does not ensure the continuity of the learning “experience.” Therefore, it is essential to introduce systematic motivation and social interaction mechanisms to compensate for the technical limitations of AI.

2.2 Token Economy

Token economy is a methodology for designing the economic system of a blockchain ecosystem, based on the principle of “reinforcement” in behavioral psychology, which is based on rewarding certain behaviors with tokens to drive engagement, and can be effectively used in education to motivate learning.

Successful examples such as ODEM, BitDegree, and Korea's Santatoic Coin have shown the potential of the Learn-to-Earn (L2E) model to engage students by tying cryptocurrency rewards to learning activities. On the other hand, the Terra/Luna debacle has taught us that token economies that rely on unstable mechanisms and excessive rewards are doomed to failure. This means that sustainability and transparent governance of the token design are crucial.

The most important principle for designing token economies in education is to focus on learning outcomes, not speculation. If users are only focused on “earning”, they will easily abandon when the value of the token drops, so the value of the token should be directly linked to learning outcomes and have real utility on the platform, such as unlocking learning content and accessing features. In other words, the token should not be an investment, but a reinforcement of the learning journey to encourage long-term engagement.

2.3 Gamification

Gamification is a strategy that applies the fun elements and mechanics of games to non-gaming contexts to engage and immerse users. In education, it is effectively used to increase learning and motivation.

One of the main theoretical backgrounds behind gamification is Self-Determination Theory (SDT). This theory emphasizes three core psychological needs that drive intrinsic human motivation: competence, autonomy, and relatedness.

Competence can be promoted by tracking learning progress and providing a sense of accomplishment through reward systems (points, level-ups, badges, trophies). Completing quests of appropriate difficulty is also important for a sense of competence.

Autonomy can be enhanced by giving learners the experience of making their own choices and pursuing their own goals in a game.

Cooperative play and social interactions with other gamers can foster a sense of belonging, which can lead to a sense of connection. However, gamification that relies solely on extrinsic rewards such as points or badges can easily lose momentum once the "novelty effect" wears off. Therefore, a design that continuously reinforces intrinsic motivation is essential to drive long-term engagement.

In the context of this research, gamification plays two key roles

A. The role of designing meaningful rewards requires combining token economics (extrinsic rewards) with self-determination theory, i.e., making tokens not just rewards, but meaningful symbols, such as proof of learning achievement (competence), content choice (autonomy), and recognition of community contributions (relatedness). This will help learners feel satisfaction in the act of earning rewards and keep them enthusiastic.

B. The role of promoting social interaction: Gamification should be used to address the inherent lack of interaction and learner isolation in AI tutoring. By linking token rewards to collaborative activities such as peer learning and group study, it is possible to fulfill the need for relationality and strengthen the sense of community through cooperation rather than competition, thereby increasing learning persistence.

[Table 2] Gamification elements and motivational effects to boost user engagement

Reformulation Factors	Self-Determination Theory Elements	Intrinsic Motivation Effects	Extrinsic Motivational Effects
Points, Experience	Sense of competence	Visualize learning progress to promote a sense of accomplishment	Instant rewards, the basis for earning tokens
Badges, Trophies	Sense of competence, connection	Recognition of learning achievements, boosting self-esteem	Tangible rewards, social recognition
Leveling Up	Sense of competence	Feeling of continuous growth, stimulating the desire to improve	Unlock new features/content, grant privileges
Leaderboards	A sense of competence, connection	Encourage healthy competition, motivate through performance comparisons	Additional rewards and honors for top rankers
Quests, Challenges	Sense of competence, autonomy	Fun, problem-solving, and goal achievement	Reward tokens/items for completing quests
Storytelling	Autonomy	Engage, excite, and inspire learning	
Avatar customization	Autonomy	Fulfill the need for self-expression, promote a sense of ownership	
Teamwork, collaborative activities	Relatedness, competence	Fostering a sense of belonging, accomplishing common goals	Communal token rewards for meeting team goals
Peer tutoring	Sense of competence, connection	The satisfaction of sharing knowledge, the reward of helping others	Incentivize knowledge sharing with token rewards

3. Proposed Token Economy-based AI Tutoring Service Model

3.1 Service Overview

The service proposed in this study aims to enhance both intrinsic and extrinsic motivation of learners and increase engagement by fusing token economy and gamification with the personalized learning capabilities of existing AI tutors. Learners will be engaged in learning through transparent rewards and fun elements, while taking ownership of their learning history.

The key features are summarized in four areas

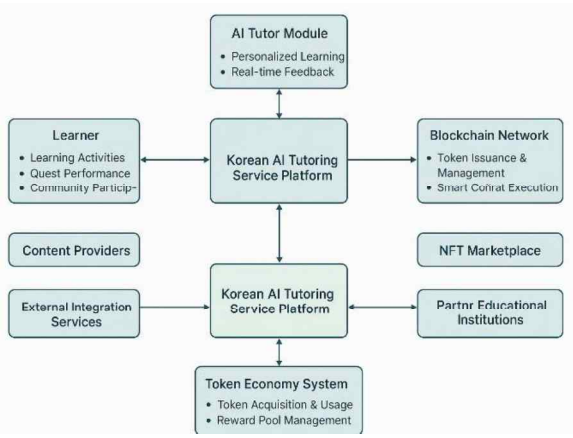
First, the AI-powered personalized learning feature provides personalized learning, including conversations with AI chatbots and vulnerability analysis.

Second, the Learning Reward System feature rewards all learning activities and achievements with tokens to create strong motivation.

Third, gamification elements add fun and engagement to the learning process through levels, quests, leaderboards, and more.

Fourth, the decentralized learning record feature permanently records learning history on the blockchain to ensure authenticity.

The service ecosystem consists of individual learners, AI tutor systems, content delivery experts, and a platform operator that manages the entire system.



[Figure 1] Token economy-based AI tutoring service model overview

The central structure of the AI tutoring service model is centered on the Korean AI tutoring service platform, which serves as the hub for all components. The service model has a virtuous cycle of learner activity → AI feedback → blockchain record → token reward → learning motivation. The main module-specific functions are personalized learning and real-time feedback in the AI tutor module, token management, smart contracts, and learning record storage in the blockchain network.

The token economy system operates token acquisition/use and reward pools, and learners participate in various learning activities and communities.

3.2 Token Design and Operation Plan

The proposed service uses a multi-layered token system to engage learners and activate the learning ecosystem.

The token types and roles can be defined as follows.

The role of the utility token (LER: Learn-to-Earn Reward Token) functions as a direct reward for learning activities. It is utilized to use various learning-related functions and contents within the service, and is the main token earned based on learning performance and participation. This is a similar concept to Boomco's LER token.

The role of the governance token (KAI: Korean AI Tutor Governance Token) grants the right to participate in platform operations and major decision-making and is issued to users who hold a certain amount of LER tokens or make high contributions to the platform, and promotes participation and ownership in the long-term direction of the platform, like Boomco's BOOM token.

Non-Fungible Tokens (NFTs) can be utilized as proof of learning achievements (digital degrees/certificates, badges), learning items (avatars, learning tools), and access to special content. They are unique and scarce and serve as a permanent record and proof of a learner's efforts and achievements. This is like the concept of Axies in Axie Infinity or bag NFTs in Boomco.

3.2.1 Token Earning Mechanism

The token earning mechanism is designed to engage learners by rewarding their various learning activities and contributions.

When completing learning activities, LER tokens are awarded when completing a set learning module (lesson, chapter) within the Korean AI Tutoring Service according to the regular learning results.

Additional LER tokens are awarded for successfully completing tasks (writing, speaking exercises, quizzes) presented by the AI tutor and receiving AI feedback.

Clean-up/review wrong answer notes LER tokens are awarded for cleaning up wrong answer notes based on the learner's weaknesses analyzed by the AI, or for repeating certain concepts.

In terms of user engagement and contributions, LER tokens are awarded for active interactions within the community, such as answering learning questions, sharing learning materials, tutoring fellow learners, and participating in group studies.

The token earning mechanism for content creation is that LER tokens and KAI tokens can be earned for creating quality Korean learning content (e.g., example sentences, exercises, cultural information) that is evaluated as useful by other users.

In the case of bug reports/suggestions for improvement, LER tokens are awarded for providing meaningful feedback that contributes to the improvement of the service.

Additional LER tokens and KAI tokens will be awarded for continuous learning over a certain period or achieving certain learning goals, depending on the results of long-term/continuous participation.

The NFT holding mechanism is designed to allow learners who hold certain NFTs (e.g., learning assistant NFTs) to increase their LER token earnings or receive bonus tokens for certain learning activities. This is based on Boomco's bag NFT example.

3.2.2 Token usage and reward system

The earned tokens provide various utilities within the service and are linked to a reward system that keeps learners motivated.

The in-service utilities act to unlock premium content/features, and LER tokens can be used to unlock advanced Korean learning content (advanced grammar, advanced conversation), special features of the AI tutor (in-depth correction, practice tests), or additional conversation time with the AI tutor. You can also purchase learning items in the form of NFTs, such as avatar customization items and virtual tools to help you learn (e.g., AI dictionary extensions).

Discounts/Course Passes: LER tokens can be used to purchase discounts on paid courses or passes for a specific period.

In terms of reward systems, the level system allows learners to level up based on their learning progress and token earnings and rewards them with special badge NFTs or additional LER/KAI tokens upon leveling up. The Badge/Achievement system recognizes learners' achievements by issuing Badge NFTs for various achievements, such as achieving specific learning goals (e.g., passing a TOPIK exam), reaching a certain number of consecutive study days, or contributing to the community. The Leaderboard system creates weekly/monthly leaderboards based on learning volume, token earnings, community contributions, etc. and rewards top rankers with additional tokens or special NFTs to encourage healthy competition. Challenge/Quest System: AI tutors will provide personalized or community-based learning challenges/quests and reward LER tokens and special rewards upon completion. The governance participation system allows KAI token holders to directly participate in the operation of the platform by voting on important platform decisions (e.g., adding new learning content, changing token economy policies).

The service's token economy is designed based on two core principles: “learning relevance” and “sophisticated rewards”.

First, the utility of the token is focused on enhancing the learning experience itself. The value of a token is not determined by external markets, but by how compelling its use is within the platform. Therefore, tokens should provide utility that is directly linked to learning outcomes, such as unlocking premium content or accessing advanced features of an AI tutor. This makes the token a “symbol of learning achievement” rather than just a currency, and the issuance of NFT-based digital certificates reinforces this.

Second, the mechanism for earning tokens must be sophisticated and fair. Rewards should be tied to the “quality contribution” of learning, not just the quantity of activity, and apply psychological principles such as “shaping,” which rewards progressively increasing difficulty, to encourage good learning habits. Furthermore, all reward rules should be transparently published through smart contracts and designed to avoid concentrating rewards in the hands of a few, thus ensuring user trust and system sustainability.

[Table 3] Proposed token types and acquisition/redemption mechanisms

Token Types	Definitions and roles	Earning Mechanism	Uses and reward system
LER (Utility Token)	Direct rewards for learning activities	Regular study/assignment completion, organizing/reviewing wrong notes, community activity	Unlock premium content/features, purchase learning items, purchase discounts/courses, level up/badge/leaderboard rewards
KAI (Governance Token)	Rights to participate in platform operations and major decisions	Hold a certain amount of LER, reward long-term/continuous participation, reward quality content creation	Voting rights for major platform decisions
NFT (non-fungible token)	Proof of learning, learning items, and access to special content	Increased LER earned for meeting certain learning goals, leveling up, purchasing learning items, and holding NFTs	Digital diplomas/certificates, own/trade learning items, access to special content, profile display and social recognition

3.3 User Engagement Strategies

3.3.1 Learning motivation factors

Learning motivation is designed based on Self-Determination Theory (SDT). SDT explains that intrinsic motivation is driven by the fulfillment of three psychological needs: competence, autonomy, and relatedness.

To provide clear learning goals and progress, the AI tutor sets personalized learning goals and tracks learning progress (progress rate, percentage correct, study time) in real-time, providing a visual representation. It reinforces a sense of competence by allowing learners to see their growth through level-ups, experience bars, and more. In addition to real-time feedback from AI tutors for instant feedback and achievement rewards, we also reinforce a sense of accomplishment by offering instant rewards such as LER tokens for completing learning activities, badge NFTs for completing quests, and level-ups for achieving certain difficulties. The AI analyzes the learner's level and achievements to present challenges that are “not too easy, not too hard,” so that learners experience a sense of competence without frustration through appropriate difficulty adjustments.

In addition to AI-recommended learning paths, the desire to promote autonomy gives learners the option to choose a personalized learning path, where they can freely select learning modules, content, and challenges based on their interests and goals. Avatar and profile customization, where learners can create their own avatars and decorate them with tokens or NFTs, gives them a sense of ownership and autonomy. By offering flexibility in when and how they learn, we provide a flexible learning environment that gives learners the freedom to learn on their own schedule.

The core of our motivation strategy is to create a synergy between intrinsic motivation (the enjoyment of learning itself) and extrinsic motivation (tangible rewards).

To prevent the “process-per-course effect” where extrinsic rewards (tokens) can undermine intrinsic motivation, the principle is to link token rewards to the “process” and ‘effort’ rather than the final “result” of learning.

The goal is to use tokens as an extrinsic reward as a tool to reinforce the three core elements of self-determination theory: competence, autonomy, and relatedness.

Competence is designed to provide immediate recognition of learners' achievements, autonomy is designed to give learners a sense of control by allowing them to choose how to spend their earned tokens, and relatedness is designed to promote a sense of belonging by rewarding social activities such as community contributions.

This design allows learners to perceive tokens as meaningful indicators that symbolize their learning journey and growth, rather than just currency, which motivates continued participation.

3.3.2 Social interaction elements

To compensate for the limitations of AI tutors and enhance learning continuity, we actively introduce social interaction elements.

First, for social interaction through community-based learning, we provide an online community space where learners can ask questions, share answers, and support each other's learning progress through ‘Enabling Learning Community’. To encourage voluntary participation by linking token rewards to active activity within the community, LER tokens are awarded to learners who are proficient in a specific learning topic to help or tutor other learners, and a “Peer Tutoring and Mentoring” feature is provided to promote voluntary knowledge sharing. It also provides team-based learning quests through group challenges/collaborative learning to encourage learners to work together to solve problems and achieve goals. Token rewards are awarded to all team members for meeting team goals. Leaderboards and ranking system drive healthy competition by maintaining individual and group learning performance leaderboards, with additional rewards and honors for top rankers.

Secondly, for social interaction through social NFTs and digital identities, the learning achievement NFT sharing function is designed to allow learners to display and share earned badge NFTs or proof of learning achievement NFTs on social media or on their profiles on the platform to promote learner pride and social recognition. Self-expression through avatars and profiles, allowing learners to express themselves and connect with other learners through avatars and profiles that reflect their learning styles, interests, achievements, etc.

Finally, through offline connectivity activities, the service goes beyond online community activities to connect online and offline learning experiences by incentivizing offline study groups among learners in specific regions or Korean cultural experience activities with tokens.

To address the limitations of AI tutors' emotional interaction and the inherent isolation of online learning, the service takes as its core strategy the creation of a ‘social learning environment’. To do so, it leverages the token economy to actively incentivize peer-to-peer (P2P) interactions between learners. This is done by rewarding tokens for any activity that helps each other, such as answering a peer's question, participating in a study group, or sharing useful learning materials.

This design encourages learners to act as “assistant tutors” and “emotional supporters” for each other. As a result, learning extends beyond an isolated individual activity to a “communal experience,” which compensates for the technical limitations of AI tutors and dramatically increases learning persistence.

4. System Implementation and Evaluation

4.1 System Architecture

The system architecture of the proposed service model is designed to seamlessly integrate AI tutoring, blockchain-based token economy, and gamification elements to provide users with a seamless learning experience.

The main components of the system architecture are as follows.

First, the User Interface Layer. It consists of web and mobile applications through which learners interact with the service, and provides an intuitive and user-friendly UI/UX, including a learning dashboard, AI tutor chat interface, learning content viewer, token wallet, community board, leaderboard, and NFT gallery.

Second, there is the AI Tutoring Engine. This is the core module that understands Korean questions, generates responses, and provides grammar correction, vocabulary explanation, pronunciation feedback, etc. in real-time through the Natural Language Processing (NLP) module. The Learning Analytics module collects and analyzes learning data (progress, correct answer rate, study time, wrong answer patterns) in real time to identify learners' strengths and weaknesses. The Personalization Recommendation module recommends personalized content and quests optimized for learners' levels and weaknesses based on learning analytics results.

An optional emotion recognition module can include the ability to detect learner focus, frustration, etc. through facial expression and voice tone analysis, and adjust the learning experience accordingly.

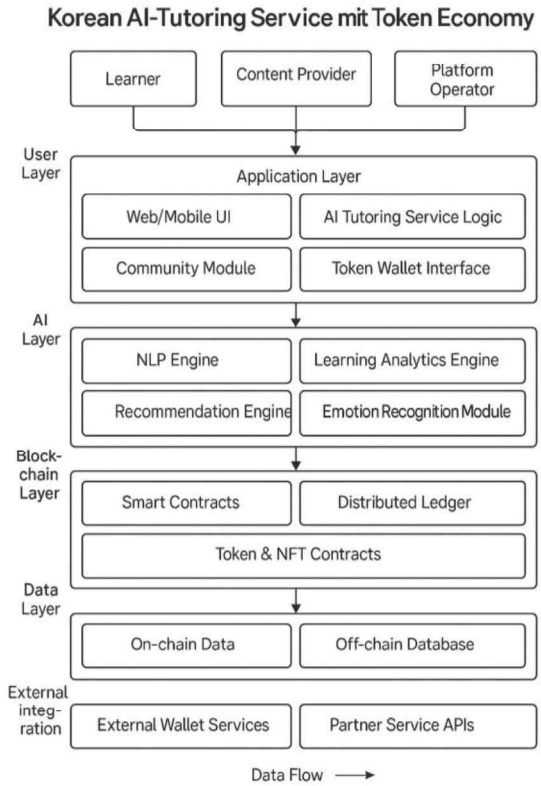
Blockchain Network is an optional consideration, and the appropriate platform can be a public blockchain (e.g., Ethereum, Klaytn) or a private/consortium blockchain (e.g., Hyperledger), depending on transaction processing speed, scalability, fees, ease of development, etc. Transparency and immutability of learning records, issuance and transfer of tokens. Smart Contracts are programs that automate the rules for issuing, earning, and redeeming tokens. They are implemented to automatically award LER tokens when certain conditions are met, such as completing learning, fulfilling quests, and contributing to the community, and are responsible for NFT issuance and ownership management, governance voting logic, etc. The Distributed Ledger will immutably store all learning activity records, token

transactions, NFT ownership information, etc. to ensure data integrity and reliability.

Third, the Token Economy Management System manages the total supply, issuance cycle, and distribution pool of LER and KAI tokens, and operates token pools for learning rewards, community contribution rewards, etc. It also manages the creation and burning of learning achievement NFTs, item NFTs, etc.

Fourth, the database stores a large amount of data that is not directly stored on the blockchain, such as learning content, user profiles, and AI model training data.

Fifth, the API Gateway serves as an interface for secure and efficient communication between each module.



[Figure 2] System architecture

The layered architecture is organized into six distinct layers, clearly separating the roles and responsibilities of each technology stack. The components of each layer are: the User Layer, consisting of learners, content providers, and platform operators; the Application Layer, consisting of UI/UX and service logic; the AI Layer, consisting of core AI functions (NLP, learning analytics, recommendations, emotion recognition); the Blockchain Layer, which ensures token economy and trustworthiness; the Data Layer, which manages on-chain and off-chain data; and the External Integration Layer, which integrates external services for scalability.

4.2 Implementing key features

The main functional implementation of the proposed service model is as follows.

The AI tutoring feature implementation plan implements a chatbot that utilizes Korean natural language processing (NLP) technology to understand learners' questions and provide grammar correction, vocabulary explanation, pronunciation feedback, etc. in real time through the implementation of an interactive learning interface. It also designs/implements personalized learning paths to identify learners' strengths, weaknesses, and learning speed through an AI learning analysis module, and dynamically adjusts the learning content and difficulty level to optimize for them. The correction and feedback system provides AI-based correction and specific improvement feedback on learners' writing and speaking exercises to maximize learning effectiveness.

The token economy feature implementation plan will use smart contracts to implement an automated token payment system that will automatically disburse LER tokens to learners' wallets when certain conditions are met, such as completing learning modules, succeeding in quests, and contributing to the community. In addition, we will develop a token usage linkage system that uses LER tokens to unlock premium content, purchase learning items, apply discounts, and other utilities within the service. We will also implement an NFT issuance and management system for the NFT Gallery feature that allows learners to issue NFTs such as learning achievement badges, digital degrees/certificates, and special learning items, and manage and display them. For gamification and engagement features, visualize learners' levels, experience points, earned badges, leaderboard rankings, etc. in an intuitive UI/UX to motivate learning. Implement a quest/challenge system that allows AI to generate individual or group learning quests, and clearly present quest objectives, progress, and rewards. Community interaction tools enable social interaction and foster relationships among learners by providing learner-to-learner chat, message boards, group study creation, peer review, and more.

Finally, to ensure security and reliability, we leverage the data integrity and transparency properties of blockchain to prevent tampering with learning records. Apply measures to minimize security vulnerabilities in blockchain-based services, such as securing user wallets and auditing smart contracts.

4.3 Experimental Design and Data Analysis

The experimental design and data analysis method to verify the effectiveness of the proposed token economy-based Korean AI tutoring service model is as follows.

A. Experimental design

The ‘research subjects’ of the experimental design are a group of users of a certain age group or learning level who wish to learn Korean. It is necessary to set up an experimental group and a control group, where the ‘experimental group’ uses the Korean AI tutoring service with the proposed token economy and gamification elements, and the ‘control group’ uses the existing AI tutoring service (without token economy and gamification elements). 'Experiment period' means a sufficient period of at least one semester to verify the long-term motivational effect. Measurement points: pre-measurement, periodic

interim measurements, and post-measurement to capture learner change at multiple points. 'Data Collection Method' is used to collect quantitative data such as learning time, learning module completion rate, quest completion rate, token acquisition and usage, community activity frequency, learning achievement (quiz score, practice test score), dropout rate, and retention rate through system logs, and qualitative data is used to understand learners' subjective experiences and perceptions through surveys (learning motivation, satisfaction, usefulness, usability, self-efficacy, relationship) and in-depth interviews (learning experience, perception of token economy, improvement points).

B. Key Performance Indicators (KPIs)

The 'User Engagement' metric measures the number of daily/weekly active users (DAU/WAU), learning module completion rate, quest completion rate, community posts/comments, peer tutoring participation rate, etc. Learning persistence metrics utilize key metrics such as weekly/monthly study time, churn rate, revisit rate, and retention rate. The 'Learning Achievement' metric measures learning effectiveness through changes in quiz/test scores within AI tutoring and external standardized Korean proficiency test (TOPIK) scores. The 'Motivation' metric evaluates changes in intrinsic and extrinsic motivation levels based on self-determination theory through surveys. The 'Satisfaction' metric measures user satisfaction with the overall service.

C. Data analysis methods

'Quantitative analysis' methods use statistical hypothesis testing (t-test, ANOVA), regression analysis, time series analysis, etc. to verify significant differences between the experimental and control groups. The 'Qualitative Analysis' method uses Content Analysis, Topic Modeling, etc. to derive the main trends and in-depth meaning of user feedback. The 'Blockchain Data Analysis' method analyzes token transaction data, NFT issuance and transaction records, etc. to analyze the degree of activation of the token economy and user behavior patterns.

It is important to deeply understand the "motivation mechanism" through the fusion analysis of quantitative indicators and qualitative feedback. The fact that the churn prediction function has a 95% accuracy rate and can utilize churn prediction data on a per-customer basis shows the sophistication of quantitative data analysis. Gamification research shows the largest effect size for "motivation" and suggests that integrating features that increase "intrinsic motivation" is important. Quantitative metrics such as churn rate or learning completion rate alone do not capture the underlying "motivation" behind why users engage and disengage, so experimental designs must combine quantitative data (token acquisition/spending, learning time, and persistence) with qualitative data from surveys and in-depth interviews (learning motivation, satisfaction, self-efficacy, and relationships).

This will give you a deeper understanding of how the token economy and gamification elements affect learners' "extrinsic behavior" as well as their "intrinsic motivation". For example, we can verify the actual "motivation mechanism" of the proposed model by understanding whether learners who earned a lot of tokens were simply motivated by extrinsic rewards, or whether earning tokens made them feel competent and engaged in learning itself. This will provide crucial insights for future model improvement and optimization.

4.4 Evaluation Results and Analysis

The hypothesized outcome is that the proposed token economy-based service group will show significantly higher user engagement rates, learning persistence, learning achievement, and motivation levels compared to the control group. There will be a significant increase in the rate of participation in community activities and peer tutoring, suggesting a positive impact on satisfying learners' relational needs. Analysis of token acquisition and usage patterns will reveal that certain learner behaviors (e.g., taking on difficult tasks, long-term learning) are effectively reinforced by the token economy.

In the direction of analysis, we will test for statistical significance between the experimental and control groups for each KPI. Qualitative data analysis will reveal qualitative aspects of the user experience, changes in learners' perceptions of the token economy and gamification elements, and recommendations for improvement. We will distinguish between successful and unsuccessful engagement strategies and further analyze the reasons behind them. Early signs of token economy sustainability and potential problems (e.g., token inflation, speculation) will be analyzed and countermeasures will be discussed.

5. Conclusion and Future Research

5.1 Conclusion

this study, we proposed a new service model that fuses blockchain-based token economy and gamification elements to solve the inherent user engagement and learning persistence problems of Korean AI tutoring services. We analyzed the technical limitations of existing AI tutoring (lack of emotional interaction) and the dropout rate of online learning in depth and examined the psychological basis and educational effects of token economy and gamification to secure the theoretical justification of the proposed model.

The proposed model provides a concrete way to maximize learning motivation and promote social interaction through a multi-layered token system using utility tokens (LER), governance tokens (KAI), and NFTs, and a gamification strategy that includes elements that promote competence, autonomy, and relationships based on self-determination theory. In addition, the system architecture, including the AI tutoring engine, blockchain network, and token economy management system, as well as the implementation plan for major functions, and the experimental design and evaluation metrics to verify the effectiveness of the proposed model were presented, laying the foundation for future empirical studies.

This study presents an innovative approach for enhancing user engagement in Korean AI tutoring services and contributes to the exploration of the positive impact that

digital assets and blockchain technology can have on the education sector.

5.2 Research limitations

Since this study focused on the conceptual design and theoretical validation of the proposed model, it is limited by the lack of actual system implementation and effectiveness verification through empirical user data. As the proposed model is premised on the convergence of various advanced technologies such as AI, blockchain, token economy, and gamification, unexpected challenges such as technical difficulties, scalability, security issues, and interoperability may arise in the actual implementation process.

The value of tokens can fluctuate depending on market conditions, which can have a positive or negative impact on learner motivation. This study could not fully analyze and address this market volatility in depth. As failures like Terra Luna have shown, instability in the token economy can be devastating to user trust and platform sustainability. Another limitation is the lack of in-depth discussion of additional strategies for maintaining long-term learning sustainability, given the potential for de-motivation due to the "freshness effect" of gamification.

5.3 Future Research Directions

Future research should proceed in four directions.

First, empirical effectiveness verification and optimization. The proposed model should be implemented into a real system, and the learning persistence and motivation effects should be quantitatively verified through user studies. In addition, we need to continuously optimize the token economy based on real data and research stabilization mechanisms to respond to market volatility.

Second, advanced AI-powered personalization. Develop models that allow AI to analyze learners' emotional states and learning styles to dynamically personalize rewards and gamification elements, such as offering special quests when they are frustrated.

Third, legal and regulatory responses. It is necessary to continuously monitor changes in domestic and foreign laws and regulations on token-based education services and study policy responses to them.

Fourth, securing technical scalability. It is essential to study how to secure system scalability and interoperability with other education platforms in preparation for a large influx of users in the future.

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