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Learn, Earn, and Game on: Integrated Reward Mechanism Between Educational and Recreational Games

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Abstract

Rewards play a key role in gamifying education, especially when learners perceive them as valuable. However, in many educational games, rewards often lack a meaningful impact or long-term appeal, which limits their ability to motivate user performance effectively. This study introduces a novel integrated reward system designed to increase the perceived value of educational rewards by allowing them to be used in a separate recreational game. The system was implemented using two Android-based applications: EduGym, a microlearning quiz-based educational game, and EduShooter, a top-down action shooter recreational game. Coins earned in EduGym quizzes can be used to upgrade characters and unlock content in EduShooter, forming a cross-game incentive. A user study involving 48 participants demonstrated that those with access to the integrated system responded more positively to EduGym's reward mechanism and rated their overall game experience favorably. The reward system also enhanced learners' perception of their educational achievements by linking them to meaningful in-game benefits. These findings suggest that integrating educational and entertainment games through a cross-game currency system can significantly strengthen the motivational appeal and perceived value of rewards in these games.

Keywords: educational games; game development; education technology; human-computer interaction

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1. Introduction

In games, extrinsic rewards refer to incentives given to players to encourage certain behaviors and achievements. It is rooted in the work of behavioral psychologist B. F. Skinner (Skinner, 1965), who showed how reinforcement and punishment affect behaviors. According to the motivational dualism theory, psychologists classify motivation into two categories: intrinsic and extrinsic (Reiss, 2012). Intrinsic motivation refers to an individual's internal drive to participate in activities that they find inherently enjoyable and satisfying. Several factors can contribute to the development of intrinsic motivation in educational games, such as challenge, fantasy, and curiosity (Laine & Lindberg, 2020). In contrast, extrinsic rewards are mostly implemented in the form of points, badges, and leaderboards (PBL). The point system provides immediate feedback and measures progress. Badges signify achievements and milestones, and leaderboards enhance social value and encourage friendly competition among players. Several studies have shown that users are more likely

to have better engagement when a properly designed extrinsic reward is present (Balci et al., 2022; Follert et al., 2019; Huang & Hew, 2015). Nevertheless, some studies question whether extrinsic rewards are an effective method in the long run and whether they undermine intrinsic motivation to study (Bates, 1979; Eikmeier, 2018; Tyni et al., 2022).

Our research focuses on enhancing extrinsic motivation in educational games by introducing a cross-game currency system that links reward mechanisms between educational and recreational games. In this approach, the two types of games remain distinct, allowing each to concentrate on its core objective: the educational game focuses on learning outcomes, while the recreational game emphasizes enjoyment and play. Players earn rewards through their progress in the educational game, which can then be used as currency in the recreational game. This integration was developed as a mechanism for testing whether such a reward system can make the learning process more engaging by providing incentives that are meaningful to players. We argue that connecting educational and recreational games in this way can enhance the perceived value of rewards, making in-game achievements more desirable. Moreover, the distinct mechanics of educational and recreational games introduce variety, offering a refreshing change in pace that helps prevent burnout from prolonged educational activities. This balance between learning and entertainment encourages continuous participation and enhances motivation. In line with this objective, we formulated the following research questions:

RQ1: Does the integrated cross-game currency system influence user activity in the educational game (EduGym)?
RQ2: Does the integrated system enhance the perceived value of rewards and improve overall user perception of the educational game?

1.1. Educational Game

Educational games are a type of game specifically designed to teach or reinforce specific knowledge or skills while engaging users through gameplay. It combines educational content with gameplay elements to create an engaging and interactive learning experience. Previous research has shown that educational games are an effective approach to support the learning process. For example, educational games have taught mathematics (Hui & Mahmud, 2023; Pan & Ke, 2023), science (Filippas & Xinogalos, 2023), language skills (Alyaz & Genc, 2016; Costagliola et al., 2012; Müller et al., 2018), history (Zhang et al., 2023), programming (Djelil & Sanchez, 2023; Teng & Chung, 2025), and more. Additionally, digital educational games can increase accessibility to quality education, which is usually a challenge for children in rural and remote areas (Uchidiuno et al., 2018) or during a pandemic, where traditional classes are an issue (Arias-Calderón et al., 2022; Udeozor et al., 2023; Xu et al., 2023).

Designing educational games presents significant challenges because of the fundamental differences between entertainment games and educational processes. Educational processes often rely on explicit, sometimes mandatory, information delivery to ensure knowledge acquisition and skill mastery. This information is frequently reinforced through repetitive tasks, as repetition is a widely recognized strategy for effective learning and for memory retention. In contrast, entertainment games typically employ just-in-time (JIT) information delivery, providing players with the necessary knowledge only when it becomes relevant to the gameplay or narrative context (Gee, 2003). Additionally, while some entertainment games incorporate repetition to facilitate progression, they are generally designed to minimize redundancy by offering players non-linear gameplay and opportunities for customization. These elements allow players to experiment with various strategies, modify in-game components, and explore alternate paths to overcome challenges, thereby maintaining their engagement and preventing monotony. These contrasting design prin-

ciples create significant obstacles for educational games, as they must balance effective learning strategies with engaging mechanics. Consequently, achieving the same level of user engagement as entertainment games remains a critical challenge in educational game design (Adipat et al., 2021; Marklund et al., 2014).

Despite being primarily designed for entertainment, several studies have demonstrated that certain entertainment games are capable of delivering educational content to their users. For instance, some games incorporate historically accurate material and have been recognized for their potential to educate players about cultural heritage (Camuñas-García et al., 2024). Some games are also designed with scientific principles in mind, making them an effective medium for users to simulate and engage with scientific concepts (Rosenthal & Ratan, 2022; Rüth & Kaspar, 2021). Another study explored how various triple-A strategy games can foster perspective-taking skills and address social issues by embedding multiperspectivity within their game design (Budke et al., 2025). However, these studies agree that the educational impact of such games is inherently limited by the constraints of the game design and gameplay mechanics. As a result, these games cannot be fully relied upon as standalone tools for comprehensive educational instruction.

1.2. Game Reward

Rewards are a fundamental component of games and gamification. Aside from the enjoyment of the game itself, rewards are a very effective tool for maintaining the user's interest. Several studies on human behavior in games indicate that rewards positively influence users' enjoyment, motivation, and effort (Cruz et al., 2017). Based on its type, the video game reward taxonomy is shown in Table 1 (Phillips et al., 2015; Tyni et al., 2023).

Table 1. Game reward taxonomy.

Type of Reward	Definition	Example
Access	Unlocked game content that used to be inaccessible	New and higher level is unlocked when the current level is defeated
Facility	Increasing players' performance or new ability	Ability to use a better weapon upon reaching a new level
Sustenance	Diminishing burden to prolong game session	Increasing players' health when achieving higher levels.
Glory	Measurable game components such as points, badges, and leaderboards	Player receives 100 credits when finishing a mission
Praise	Flattering the player via game systems	Animated "Good Job" text when answering 5 consecutive questions correctly
Sensory Feedback	Aesthetic feedback promoting positive affect in the player	Confetti animation followed by vibration upon finishing a level as the first winner in mobile games

Similar reward types are used in educational games to increase the engagement of users. Numerous studies have examined how extrinsic rewards/incentives positively impact the learning process (Eikmeier, 2018; Y.-L. Lin et al., 2024). Tyni et al. performed a review on the use of rewards in mobile educational games. Based on this review, the research shows that the most common type of reward is sensory feedback, followed closely by glory and access (Tyni et al., 2023).

1.3. In-Game Currency Reward Mechanism

In-game currency refers to a virtual form of currency used within a game's ecosystem. This currency can be used to purchase various items such as new characters, contents, and items. Typically, the implementation of in-game currency acts as an extension of points/rewards that can be achieved by completing tasks or winning challenges. The motivation behind in-game currency is to enhance player engagement by providing an ability to purchase in a controlled economy. This method has been proven effective to extend the purpose of the reward mechanism and enhance user engagement (Zourmpakis et al., 2023).

Some studies have focused on integrating learning and games using in-game currency. A study by Park et al. developed an integrated learning and game reward system (Park et al., 2019). The system consisted of two consecutive parts: English vocabulary for the education part and simple archery game for the entertainment part. Upon completing the English Vocabulary test, the player will be given a chance to play arrow shooting, and based on their performance in the educational game, the player will be rewarded with a different (and better) type of arrow. The study demonstrated promising outcomes, indicating improvements in both learning and motivation outcomes from the data gathered from 64 participants. Similarly, (Dicheva et al., 2023) examined the use of virtual currency in gamified education. While the study found no significant improvements in students' intrinsic motivation or academic performance, it did report a positive effect on student engagement.

Another similar study focusing on currency as an extrinsic reward in educational games was conducted by (Rahimi et al., 2021). This research evaluates the use of tangible rewards where students can earn money by watching educational videos, but must pay to watch the solution during the test in an educational game. Similarly, Bai et al. observed that tangible rewards in the form of assignment samples may increase learning performance (Bai et al., 2021). Both studies show that tangible extrinsic rewards increase learning performance and outcomes.

However, there are notable differences between the previous studies and the system proposed in this paper. First, in those studies, the game component was tightly integrated into the educational process, with players only able to access the game after completing specific learning tasks. In contrast, our system features a standalone recreational game that operates independently from the educational application, allowing players to access it at any time. Second, the reward mechanisms differ significantly. The earlier studies employed a fixed and straightforward reward structure, while our system introduces a cross-game currency that can be used across multiple recreational games. This approach gives players greater autonomy, enabling them to choose how and where to spend their rewards based on their individual gameplay preferences.

2. System Design

Our primary objective was to evaluate whether developing and implementing a cross-game currency reward system increases user engagement and perceived reward value in educational games. Educational games traditionally use points (or coins) as incentives to motivate players. However, our approach enhances the perceived value of this coin system by allowing it to be used as a currency in a separate recreational game. We treat the coins earned in the educational game as a cross-game currency that can be used to increase players' performance in the recreational game. Furthermore, by separating educational and recreational games, the design and development of each application can be tailored to its intended purpose. This separation ensures that the educational game focuses on education, while the recreational game can be fully designed for fun, engaging, and highly

replayable entertainment games utilizing established game design principles (Adams, 2014; Monedero March, 2019; Yang & Sun, 2020). Ultimately, this integration aims to elevate the perceived value of educational rewards by enabling players to use them in meaningful and recreational contexts.

2.1. EduProject

The EduProject is a research initiative aimed at developing an ecosystem where multiple games (and applications in general) can benefit from cross-game currencies. This research is a pilot project of an initiative aimed at simulating integrated rewards between educational and recreational games. The interconnected currency system allows players to earn rewards in the educational game and redeem them within the entertainment game, seamlessly linking the two experiences. The system consists of two Android-based applications: EduGym, a microlearning-based educational game, and EduShooter, an entertainment game designed for fast-paced and engaging play. Through this project, we aim to demonstrate the potential benefits of integrating educational games with entertainment games, thereby creating a mutually beneficial relationship between learning and play.

EduGym can be defined as a microlearning game, an instructional approach that delivers small and easy-to-understand educational content, which is typically designed for quick consumption. It employs pedagogical strategies such as spaced repetition and active recall through timed quizzes. It was intentionally structured to balance accessibility with progressive challenge, with the early levels presenting simple tasks (e.g., basic arithmetic or short word completions) as warm-up exercises and higher levels incorporating increasingly complex content such as multi-step arithmetic, vocabulary requiring contextual knowledge, and sentence arrangement tasks with greater syntactic complexity.

The primary target audience consists of teenagers and young adults (ages 15–30), including both formal learners and casual users seeking cognitive training. The app contains various quiz-based activities that cover Math quizzes that aim to reinforce arithmetic reasoning and number sense, Science quizzes that focus on factual knowledge and conceptual understanding, and English quizzes that aim to develop vocabulary, grammar, and sentence construction. The game also contains a leveling system that starts from level 1 and goes up to level 5. Each session lasted 30 s, during which the user was asked ten random questions. If the user answers all ten questions correctly, their level increases. However, if the user answers three questions incorrectly, their level is lowered. Figure 1 shows various screenshots of EduGym gameplay.

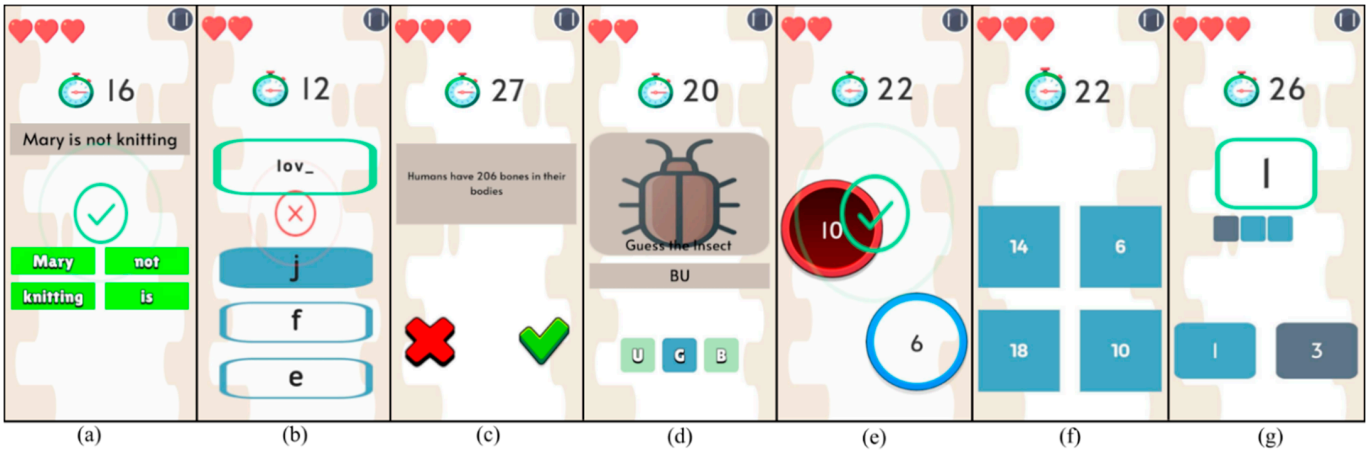

Figure 1. The screenshots of EduGym gameplay: (**a**) Scramble, (**b**) Fill Me, (**c**) Guess Me, (**d**) Who Am I, (**e**) Pop One, (**f**) Order Up, and (**g**) Zero Quest.

In its current version, there are nine quiz-based activities in EduGym:

1. Pop One (Math): Given two options, the player must choose the one with the larger value. At the first level, the options contained integers. At the later level, the options contained basic arithmetic operations (addition and subtraction) and larger numbers.
2. Zero Quest(Math): Given four options, the player must choose two options that, when added, have the same quantity as the two options not chosen. Similarly to Pick Me, the game starts with integer options at the first level and progresses to options with arithmetic operations.
3. Order Up! (Math): Given four options, the player must choose, in order, the smallest to largest option.
4. Truth or Lie (Science): Given a science-related statement, the player must choose whether the statement is true or false.
5. Who Am I? (Science): Given a science-related image, the player must guess the name (or term) of that image.
6. Scramble (English): Given a set of words, the player must select the options sequentially to form a correct sentence.
7. Guess Me (English): Given an image, the player must select the correct option that describes or is related to it.
8. Fill Me (English): given an image and options of the letter, the player has to sequentially pick the letter to form the correct word for the image.

EduShooter is a top-down action shooter game. In each session, players must survive three waves of increasingly challenging enemy attacks. After each wave, players can choose a minor upgrade to help them survive the next wave. Currently, there are seven maps, each with a different theme. Players control their characters from a top-down perspective using an on-screen, dual-stick virtual gamepad. The left joystick controls the movement, whereas the right joystick controls the shooting direction. Additionally, a dedicated button on the right side allows players to dash, enabling them to jump over thin obstacles such as fences and walls. To increase unpredictability, EduShooter employs a random spawn mechanism in which enemies appear at random positions (relative to the player's current location to avoid being spawn-camped). This design ensures that players cannot anticipate the enemy's position, thereby maintaining an element of surprise in the game.

EduShooter features difficulty levels ranging from 1 to 10, with each level presenting increasingly challenging adversaries to the player. At higher levels, the enemies are stronger, with greater health and damage capabilities. Players can select the difficulty level before starting a new game session, with higher levels offering more gems as rewards. Figure 2 shows various screenshots of the gameplay. To survive higher levels, users can upgrade their characters' statistics. Five properties can be upgraded: health, attack damage, speed, explosion damage, and reload time reduction (for both weapon and dash ability). This upgrade can be purchased using coins earned from the EduGym. Additionally, the game allows for customization. Players can use different weapons that fit their playstyle by purchasing them using gems. Players can also change the character's skin by purchasing the body and head using gems.

In addition to gems and other rewards, EduShooter employs conventional features to keep users engaged. The game includes a leaderboard and a daily login reward system. The leaderboard shows the top ten players based on their performance, which is calculated by aggregating the highest difficulty across all maps. Daily login rewards provide players with incentives to log in and play the game daily. Figure 3 illustrates these features of EduShooter.

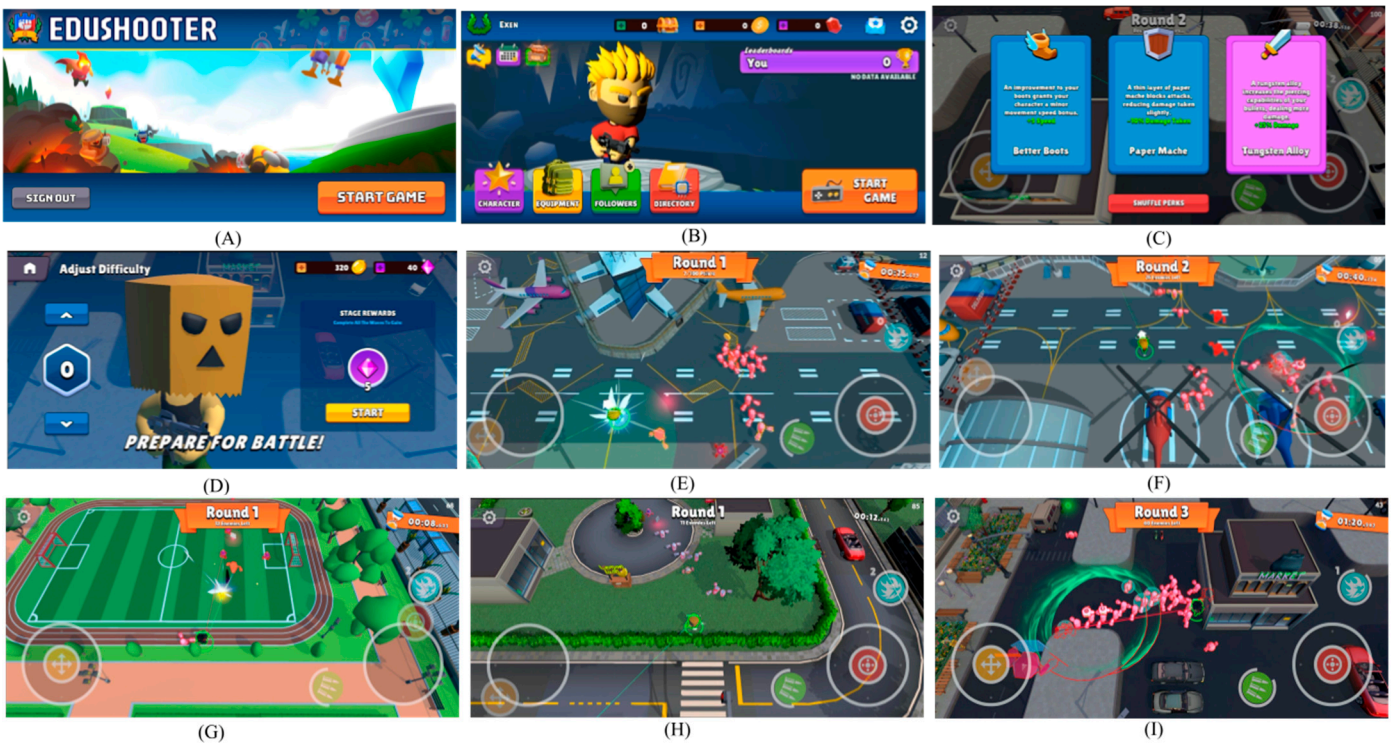

Figure 2. Screenshots of EduShooter: Splash Screen (**A**), Main Menu (**B**), Perk Upgrade Between Waves (**C**), Level Selection (**D**), and various gameplay screenshots (**E**–**I**).

Figure 3. Additional Features in EduShooter: Main Menu with reward notifications (**A**), Daily Login Reward (**B**), and Leaderboard (**C**).

2.2. Incentive System and Cross-Game Currency

The proposed method in this study is to integrate the EduGym and EduShooter incentive systems using a cross-game currency. We developed an integrated incentive system between EduGym and EduShooter. We implemented two currencies in the game: coins and gems. Coins can be used to upgrade a player's in-game character statistics, which are necessary for the player to survive at higher levels of the game. Gems can be used to change the player's in-game character cosmetics, which is useful for increasing replayability (L. Lin et al., 2017). Coins act as a cross-game currency between EduGym and EduShooter.

The overall concept of the incentive system is shown in Figure 4. Players can gain coins by playing the EduGym quiz (A). Upon finishing a quiz, players receive coins based on their performance and quiz level (B). The higher the level, the more coins the player receives. Players can use this coin to upgrade their character statistics in EduShooter (C). Later, they can use the upgraded character to tackle higher levels, which can be set in the game menu (D). EduShooter also contains an additional reward system presented as gems. Players receive gems upon completing the game (E). A higher level yields more gems than a lower level. These gems can be used to purchase content for character customization (F).

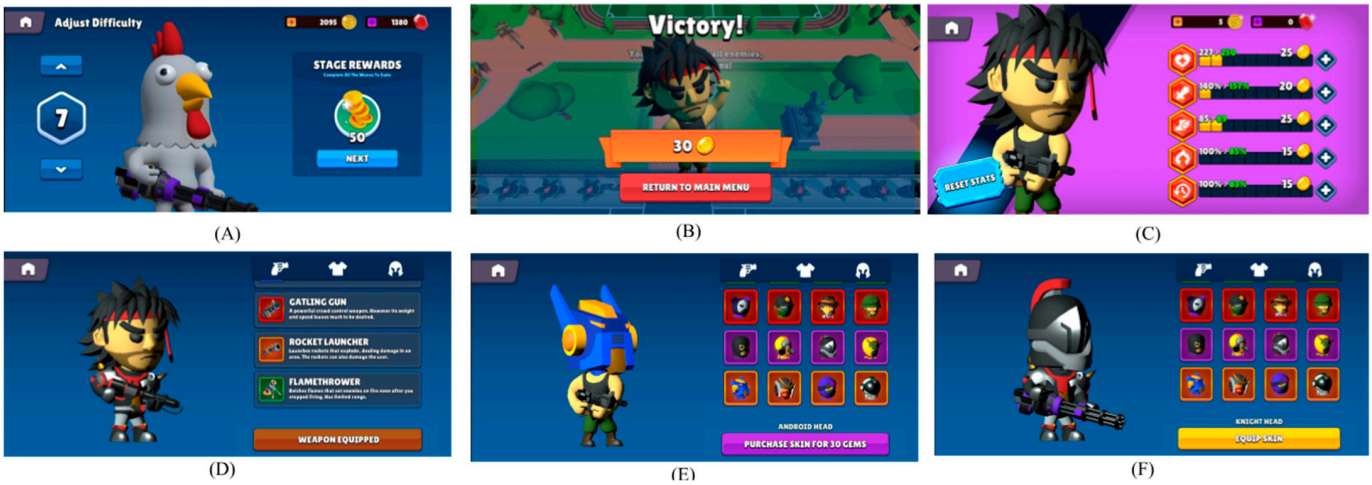

Figure 4. EduShooter Reward Mechanism: Level Selection (**A**), Coin Reward (**B**), Character and Weapon Upgrade (**C**,**D**), and Character Customisation (**E**,**F**).

One of the most crucial parts of the incentive system is to balance the reward based on the effort and progress made by players. This step is important for maintaining the engagement and satisfaction of players. Our objective in this step was to create a progressively challenging reward system that could provide a sense of accomplishment and motivation. However, the balancing process was an issue because the reward from EduGym was also used in EduShooter. Thus, balancing should consider how far the reward can boost the player during the game session.

There are two types of rewards in EduGym: badges and coins. Badges are extrinsic rewards aimed at recognizing achievements and milestones in the gamification process. Players can earn badges by leveling up a quiz, which can be done by obtaining a perfect score. The second type of reward is coins. Upon completing a quiz, players receive coins based on their performance. A higher level yields more coins, as shown in Table 2. Additionally, we established a few rules to prevent users from exploiting the incentive systems. Each type of Edugym reward can only be received once per quiz, per day. Because there are four types of quizzes, a user can receive success and perfect rewards four times.

Table 2. EduGym's Coin Reward Progression.

Performance	Level				
	1	**2**	**3**	**4**	**5**
Perfect	10	15	20	25	30
Success	5	8	10	12	15

Five statistics can be upgraded by the player: health point (HP), damage, speed, dash cooldown reduction, and reload duration reduction. The upgrade is designed progressively to provide early upgrades and avoid late upgrades that are too overpowered. We implemented the concept of diminishing returns, where the level of benefits at a point is less than the number of resources invested in it. This method is a common practice in designing character upgrades in games to maintain game balance, encourage diverse play styles and approaches, and prevent overpowered characters (Exponential Growth and Diminishing Returns, 2021).

Several approaches have been proposed to develop the concept of diminishing returns in upgrading. Some games use a specific formula that follows this pattern, such as logarithmic or exponential decay functions, to model this concept. Others simply build a series of

numbers based on trial and error. We use both methods to build our upgrade list, where we develop the base values using a logarithmic function and refine the list by testing the values in the game. Table 3 shows the statistical upgrade values for each level and the corresponding cost to upgrade to the next level.

Table 3. EduGym's Upgrade Cost Progression.

Stats	Level										
	Base	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**
HP	120	195	227	250	270	288	304	319	333	345	358
Damage (%)	100	150	171	187	200	212	223	233	242	250	259
Speed	70	86	93	98	102	106	109	112	115	118	120
Dash (%)	0	15	21	25	30	33	36	39	62	45	47
Reload (%)	0	15	24	30	35	39	42	46	49	52	55
Upgrade Cost	15	20	25	30	40	55	70	90	115	140	--

Figure 5 shows the visualization of the normalized value of Table 3 to see a better view of the diminishing return of the upgrade and compared to the exponential growth of the cost.

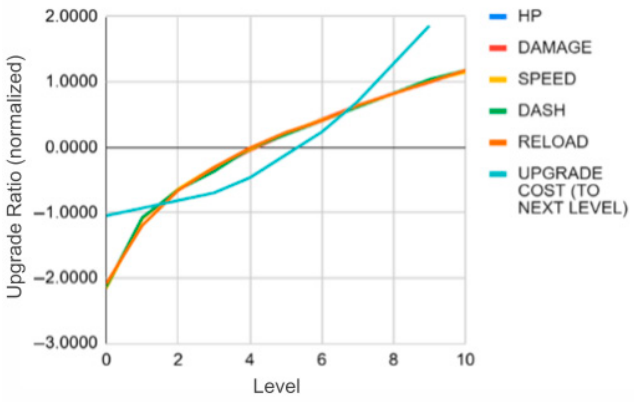

Figure 5. Upgrade Value and Upgrade Cost Progression in EduShooter.

3. Methods

This section presents the methods of our user study, designed to answer the research questions: (RQ1) whether the integrated system influenced user activity in EduGym, and (RQ2) whether it enhanced the perceived value of rewards and improved user perception of the educational application. To address these questions, we designed the test to collect both behavioral data and self-reported responses from two groups of users: those who experienced the cross-game currency system and those who did not.

3.1. Participants

In this test, the criteria for respondents were teenagers and young adults (ages 15–30) with experience in mobile gaming. We invited 48 people to participate in the study and divided them equally into two groups: the first group, the control group, had access only to EduGym. They received coins as rewards and were able to view their coins, but could not use them elsewhere. However, we briefly informed and encouraged the respondents to collect as many coins as possible, as this could be a good visual measurement of their achievements in the game. The second group, the intervention group, had access to the EduGym, EduShooter, and an integrated incentive system. Before the test, we briefly explained the integrated reward system using the cross-game currency to this group.

3.2. Procedures

The test was conducted over the course of one week. At the beginning of the test, respondents were randomly assigned to two groups. Participants in the control group were instructed to download only EduGym, while those in the intervention group had access to both EduGym and EduShooter with the integrated cross-game currency system enabled. Group assignments were managed by the researchers based on the usernames of each respondent. Participants were free to use their own devices and play the applications at their preferred time and pace throughout the one-week testing period. At the end of the test, all participants were asked to complete a digital questionnaire.

3.3. Data Collection

Two types of data were collected in this study: telemetry data from both EduGym and EduShooter, and responses to a digital questionnaire completed after the playtest. The telemetry data were automatically recorded by the applications and transmitted to a secure server, while the questionnaire was administered online at the end of the one-week testing period. For analysis, independent samples t-tests (t) were used for continuous variables, Pearson's correlation coefficient (r) was applied to measure associations between EduGym and EduShooter sessions, and Mann–Whitney U (U) tests were employed for Likert-scale data. Statistical significance was set at $p < 0.05$. Table 4 summarizes the telemetry data collected.

Table 4. Telemetry Data Collected from User Activity.

No	Activity	Collected Data	Description
1	EduGym Quiz Activity	Quiz Type, Level, User's performance (Correct/Incorrect, Perfect/Success/Fail), Time Start, Duration, (Coin) Reward Received	Collects the user's quiz activity. The data is collected each time the user finishes a quiz session.
2	EduShooter Play Session	Level, Map, Duration, (Gem) Reward	Collects the user's Edushooter activity. The data is collected each time the user finishes a play session.
3	EduShooter Character Upgrade	Type, Level, Cost, Time	Collects the user's character upgrade activity that uses coins
4	EduShooter Character Customization	Body Part, Type, Cost, Time	Collects the user's character upgrade activity that uses gems

The questionnaire consists of Likert-scale and open-ended questions. The questionnaire was divided into four parts: respondent profile, EduGym experience, EduShooter experience, and Incentive System. The EduShooter and Incentive System sections were only applicable to participants in the intervention group. Each response was linked to the participant's username to enable matching with the corresponding telemetry data. Table 5 presents the questions provided to the respondents.

Table 5. Questionnaire for Usability Test.

Q	Question	Type	Description
	Respondent's Basic Profile		
1	Username	Short text	The username used in the application
2	Age	Short text	-

Table 5. *Cont.*

Q	Question	Type	Description
3	Occupation	Short Text	-
4	Average Daily Gaming Activity	Single-select Multiple Choice	Average gaming activity Non-gamer (Less than 1 h per week) Casual (Between 1 and 3 h per week) Core (More than 3 h per week)
5	Most Recent Game Played (maximum 5)	Short Text	The last 5 games played by the respondents
6	Most Used/Preferred Gaming Platform	Single-select Multiple Choice	The most preferred gaming platform/device Mobile/Handheld Console PC
7	Understanding of Reward System	Text	Open-Ended Question
	EduGym Experience		
1	The gameplay mechanic is interesting	Likert Scale	1 (Strongly Disagree) to 5 (Strongly Agree)
2	The educational questions are engaging	Likert Scale	
3	The educational content is educative	Likert Scale	
4	The educational content was well integrated into the gameplay	Likert Scale	
5	The reward system is effective in maintaining my engagement	Likert Scale	
6	I am challenged to earn more coins by playing the game	Likert Scale	
7	Describe the most interesting factor you found in the game.	Text	Open-ended question.
8	Describe your main issue during the EduGym gameplay session	Text	
	EduShooter Experience		
1	The gameplay mechanic is interesting	Likert Scale	1 (Strongly Disagree) to 5 (Strongly Agree)
2	The gameplay is engaging	Likert Scale	
3	I am interested in replaying the game with increased difficulty	Likert Scale	
4	The character upgrade/modification is interesting	Likert Scale	
5	Describe the most interesting factor you found in the game.	Text	Open-ended question.
6	Describe your main issue during the EduShooter gameplay session!	Text	
	Incentive System		
1	Describe your understanding of the incentive system!	Text	Open-ended question.
2	The incentive system motivates me to perform in EduGym	Likert Scale	1 (Strongly Disagree) to 5 (Strongly Agree)
3	The quality of EduShooter affects my interest in playing EduGym	Likert Scale	
4	The incentive system and in-game economy are fair and balanced	Likert Scale	

4. Results

Table 6 presents the overall data collected from the control group respondents. Naturally, the only data available from this group pertained to EduGym, as the respondents only had access to it.

Table 6. Activity and Performance Data from The Control Group.

Data	Min	Max	Average	SD
EduGym Total Session	13	31	21.29	5.68
Coin Received	90	375	213.79	79.60

Table 7 shows the telemetry data from the intervention group. These data were collected from both EduGym (green background) and EduShooter (blue background).

Table 7. Activity and Performance Data from The Intervention Group.

Data	Min	Max	Average	SD
EduGym Total Session	7	31	20.45	7.75
Coin Received	50	482	214.7	112.39
EduShooter Total Session	5	14	9.33	3.14
Coin Spent	35	405	168.33	92.06
Percentage Coin Usage (%)	59	100	78	9

The performance results in EduGym were similar for both the groups. Although the control group had slightly more quiz sessions on average, the difference was minimal. However, the standard deviation values were significantly higher in Group 2, indicating greater variation in the EduGym sessions within this group. Looking through the raw data, there is a tendency for users with high EduShooter session counts to have low EduGym session counts. The data indicates a tendency for participants with higher activity in EduShooter to demonstrate lower activity in EduGym, suggesting an inverse usage pattern between the two applications. However, this does not imply that EduShooter discouraged the use of EduGym; rather, it reflects how participants, given a limited time to perform the task, distributed their time within the broader ecosystem based on their interests and gameplay preferences.

Most of our respondents were male, accounting for 70.8% of the total respondents. As for game time activity, our respondents were almost evenly distributed among all categories: 35.4% identified as non-gamers with less than 1 h per week, and 37.5% identified as casual gamers with 1–3 h per week on average. The other 27.0% identified themselves as core gamers, playing for more than 3 h per week. The most preferred platform, as expected, was mobile/smartphone, followed by personal computers (desktop/PC). Only two respondents chose a console as their preferred gaming device, as it is not popular in our region (Southeast Asia). The answers regarding the most recent game played were diverse. The respondents were also asked to list 3–5 of their most popular and recent games. Most respondents who prefer smartphones listed Mobile Legend, PUBG Mobile, and Genshin Impact, while for PC users, the games are Dota 2, Valorant, and PUBG.

We also performed additional analysis from the intervention group by categorizing the data based on the user's profile and comparing this data with telemetry data based on their activity. Based on this analysis, we can add the following information.

1. Respondents categorized as core gamers, who played more than three hours per week, had more total sessions in EduShooter. Their average session count was 12.3 compared to the overall average of 9.33. Additionally, this group spent a higher proportion of

their coins, with 85% of the total coins received in EduGym being spent in EduShooter. This finding indicates that EduShooter is more attractive to core gamers than to respondents from other categories. Furthermore, core gamers show greater interest in utilizing their coins to enhance their performance than casual gamers.

2. Despite having fewer total sessions in EduShooter, non-gamer and casual respondents had an average number of sessions in EduGym that was comparable to that of core gamers. Non-gamers had the highest number of total sessions in EduGym compared with the other groups. This result was expected because non-gamers, who had the lowest average sessions in EduShooter, had more time to spend in EduGym.
3. The overall performance in the EduGym was similar across all categories. No significant differences were found between non-gamers, casual gamers, and core gamers in terms of the win/lose ratio and coins received in EduGym.

Table 8 presents the overall results of the Likert-scale-based questions regarding the respondents' experiences playing EduGym. The data were divided into two groups: the control group included respondents without access to EduShooter (indicated by a blue background), and the intervention group included respondents with access to EduShooter (indicated by a green background). Consequently, since the control group was not given access to EduShooter, they were not able to access the proposed integrated incentive system using cross-game currency. They are still, however, able to see the amount of coins they have collected.

Table 8. User Feedback on EduGym Experience from The Control Group (blue) and The Intervention Group (green). The questions were shortened to fit the columns.

EduGym Experience														
Q	**Question**	**Control**							**Intervention**					
		1	**2**	**3**	**4**	**5**	**M**	**SD**	**1**	**2**	**3**	**4**	**5**	**M**	**SD**
1	Gameplay mechanic	0	0	4	10	10	4.25	0.72	0	0	3	8	13	4.4	0.7
2	Engaging Questions	0	0	7	14	3	3.83	0.62	0	0	5	14	5	4	0.64
3	Educative content	1	1	8	11	3	3.45	0.91	1	0	9	10	4	3.66	0.89
4	Well-integrated content	0	1	6	13	4	3.58	0.90	1	1	6	14	2	3.62	0.85
5	Effective reward system	0	1	7	11	5	3.83	0.67	0	0	6	8	10	4.16	0.79
6	Challenged to earn more coins	0	0	13	9	2	3.54	0.64	0	0	6	11	7	4.04	0.73

Based on the data above, all respondents responded positively to the game. Overall, the responses show that the educational game is interesting, engaging, and educational. However, a few users argued that the educational content was neither educational nor well-integrated into fun and engaging gameplay.

An important finding from these data is that the intervention group outperformed the control group. Responses from the intervention group were consistently higher, particularly regarding the reward system (Questions 5 and 6). Additionally, positive feedback from open-ended responses in the intervention group suggests that the cross-game currency effectively enhanced the perceived value of rewards. Several respondents from the intervention group made positive comments regarding the reward system.

Similarly to EduGym, the data (Table 9) indicate that respondents generally found the gameplay mechanics interesting, with a mean score of 3.70 on a 5-point Likert scale. The low standard deviation suggests a moderate level of agreement among the respondents, with some variation in opinions and suggestions in the open-ended questions. Respondents also generally agreed that the game was engaging and that the difficulty level was interesting. Furthermore, the data suggest that respondents find the character upgrade and modification aspect interesting, with a mean score of 4 on a 5-point scale. The low standard deviation

shows that most respondents agree that this feature adds significant appeal to the game and, based on the open-ended question, adds a significant replayability factor to the game.

Table 9. User Feedback on EduShooter Experience from The Intervention Group.

Edushooter Experience								
Q	**Questions**	**1**	**2**	**3**	**4**	**5**	**M**	**SD**
1	The gameplay mechanic is interesting	0	3	6	10	5	3.70	0.93
2	The gameplay is engaging	0	4	5	8	7	3.75	1.05
3	I am interested in replaying the game with increased difficulty	0	4	4	9	7	3.79	1.03
4	The character upgrade/modification is interesting	0	0	7	10	7	4.00	0.76

The third section of the questionnaire focused on assessing the proposed incentive method. It began with an open-ended question aimed at evaluating respondents' comprehension of this approach. Table 10 presents the results of the questionnaire on the proposed incentive method. Based on their answers, it can be concluded that all participants understood the concept of the proposed method, with some providing detailed descriptions. Most respondents either "agreed" or "strongly agreed" that the method enhanced the value of the Edugym reward system. They concurred that the proposed system offers a more effective mechanism for sustaining engagement than traditional point, badge, and leaderboard frameworks. However, many respondents emphasized that the quality of EduShooter as a game is critical for sustaining the effectiveness of the proposed approach. Furthermore, the in-game economy should be balanced and fair to sustain players' engagement. Further development is required to improve the overall quality of the game and ensure the method's continued impact.

Table 10. User Feedback on The Proposed Incentive Method from The Intervention Group.

Incentive System								
Q	**Questions**	**1**	**2**	**3**	**4**	**5**	**M**	**SD**
1	The incentive system motivates me to perform in EduGym	0	0	3	8	13	3.5	0.50
2	The incentive system adds value to the reward given in EduGym	0	0	5	14	5	3.7	0.45
3	The quality of EduShooter affects my interest in playing EduGym	1	0	9	10	4	3.4	0.49
4	The incentive system and in-game economy are fair and balanced	1	1	6	14	2	3.3	0.64

5. Discussion

This study investigated the impact of a cross-game incentive system on user engagement and reward perception in an educational gaming environment. Two research questions guided this study.

The first research question evaluated the influence of the proposed system on user activity in EduGym. Telemetry data in Tables 5 and 6 showed minimal differences in session counts between the control and intervention groups, with the latter recording slightly fewer sessions. An independent samples t-test confirmed that this difference was not statistically significant ($t(46) = 0.42,\ p = 0.67$), indicating that the proposed system did not significantly affect session frequency. This outcome is expected, as participants in the intervention group also invested their time in EduShooter. Overall, respondents in the intervention group devoted more time to the ecosystem as a whole than those in the control group. Combined with the high rate of coin utilization in EduShooter, this indicates that the cross-game currency contributed to engagement with the broader EduProject ecosystem.

Interestingly, an inverse usage pattern was observed: participants who engaged more frequently with EduShooter tended to have fewer sessions in EduGym ($r = -0.55$,

$p = 0.004$). While this could suggest a trade-off in attention between the two games, it is more appropriately interpreted as a redistribution of playtime within the ecosystem rather than displacement of educational engagement. Players naturally allocate time based on perceived value and interest. It is also possible that this behavior reflects individual play styles, including a preference for recreational gameplay, or in some cases, compulsive gaming tendencies. The key insight is that motivation to earn coins in EduGym may shift from intrinsic gameplay enjoyment to extrinsically driven goal completion—a pattern further supported by the higher motivational ratings reported by the intervention group in the questionnaire results. Triangulation of telemetry data with self-reported perceptions strengthens the conclusion that the integrated reward system meaningfully shaped player behavior.

The second research question examined whether the integrated system enhanced the perceived value of rewards in EduGym and improved the overall user perception of the educational app. The Likert-scale questionnaire results showed consistently higher mean scores across all items in the intervention group compared with the control group. In particular, Question 5 (Effective reward system) indicated higher perceived value in the intervention group ($mean = 4.17, SD = 0.76$) than in the control group ($mean = 3.83$, $SD = 0.96$). Although the difference was not statistically significant ($U = 226.0, p = 0.1784$), the positive trend favors the intervention. In contrast, Question 6 ("I am challenged to earn more coins by playing the game") showed a statistically significant difference, with the intervention group reporting a higher mean score (4.04) than the control group (3.54), confirmed by a Mann–Whitney U test ($U = 183.5, p = 0.0207$). Supporting this, telemetry data revealed a modest but positive correlation between coin usage and EduGym session count ($r = 0.21, p = 0.32$). Together, these findings suggest that while behavioral changes were modest, participants perceived the reward system as more motivating and valuable when integrated across both games.

Based on the findings, we conclude that our results align with previous studies on extrinsic rewards in education, such as tangible incentives (Rahimi et al., 2021), virtual currency (Dicheva et al., 2023), and currency systems in recreational games (Park et al., 2019), all of which have been shown to enhance motivation. The cross-game currency in our study extends these insights by allowing rewards earned in the educational game to function as currency in a recreational game, giving players broader utility for their achievements. This not only increased the perceived value of rewards but also strengthened participants' engagement with the educational game. Taken together, the results suggest that connecting educational and recreational contexts through a shared currency can create a more sustainable and engaging reward system for learners.

While the findings of this study suggest promising outcomes for integrated cross-game incentive systems, several limitations should be acknowledged. First, the study did not employ a factorial design, as the cross-game reward mechanism was treated as a unified system rather than separable components. Second, the focus of this study was on player engagement and reward perception, not direct learning outcomes. While we argue that the system has potential educational benefits, learning gains were not measured and remain an area for future work. Finally, although the values of Cronbach's alpha were low, this result is expected given the small sample size, short item scales, and the multidimensional nature of the questionnaire sections, which captured different aspects of gameplay, reward, and motivation. Future studies should refine the questionnaire into unidimensional subscales, apply them to larger samples, and validate their reliability.

6. Conclusions

This study introduced an innovative reward mechanism that integrates an educational game and a recreational game through a cross-game currency system. Unlike prior studies

that focus on single-game reward mechanisms, our study highlights the redistribution of engagement across educational and recreational ecosystems through an integrated reward system. By allowing players to transfer rewards earned from educational activities into a separate entertainment game, the proposed approach enhances the perceived value of learning achievements. This decoupled yet connected structure enables each game to focus on its primary purpose—education in one, enjoyment in the other—while maintaining a meaningful incentive link that strengthens motivation and engagement.

The results also highlight varied behavioral patterns based on player types, suggesting that the appeal and use of the cross-game currency system differ according to gaming experience and preferences. This opens opportunities for adaptive gamification strategies tailored to diverse user profiles. Overall, the cross-game currency model offers a novel direction in educational game design by demonstrating how meaningful integration with recreational gameplay can sustain motivation and transform digital rewards into more valuable, context-bridging experiences.

For future work, in addition to refining the applications based on respondents' feedback, we have identified several promising directions for further exploring the potential of the proposed method. While this study focused on engagement and perceived reward value, future research is needed to assess how the system affects actual learning outcomes, such as retention and knowledge transfer. Additionally, we plan to conduct longer testing periods to better understand how a shared currency influences sustained engagement and usage patterns over time, providing insights into the long-term player motivation. There is also an ongoing effort to expand the project by integrating multiple educational and recreational games into a unified ecosystem that utilizes a cross-game currency. This interconnected framework is designed to enhance cross-game interactions, enabling players to seamlessly earn and spend currency across diverse gaming platforms.

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Informed Consent Statement: Informed consent was obtained from all subjects involved in the study.

Data Availability Statement: The data utilized in this study, including telemetry data from respondents' devices and questionnaire responses, contains information provided by respondents with consent for use solely in this research. To ensure privacy and address ethical considerations, the data used and analyzed during the study are restricted and can only be accessed upon reasonable request, subject to the approval of the institution of the corresponding author.

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