Enhancing Financial Literacy and Decision-Making through Gamified Learning: An Empirical Investigation of User Engagement, Effectiveness, and Feedback

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ABSTRACT

This paper presents a comprehensive exploration of gamified financial education's impact on decision-making skills and financial literacy [5]. The introduction contextualizes the significance of effective financial decision-making in a complex economy [4]. The methodology outlines the creation of a gamified financial simulation and the design of an external feedback survey [6]. Two experiments were conducted: the first demonstrated improved decision-making skills through active engagement in the simulation, while the second garnered external perspectives on the program's effectiveness, highlighting increased financial awareness and engagement [7]. Results indicated enhanced post-assessment scores and practical application of financial strategies. External feedback emphasized moderate enjoyment and identified areas for improvement, particularly in investment clarity and realism. Collectively, these findings underline the potential of gamified approaches for financial education, suggesting avenues for refinement to optimize user experience and learning outcomes [8].

KEYWORDS

Decision Making, Education, Risk Management, Experiential Learning

1. INTRODUCTION

In an interconnected global economy, adept financial decision-making is crucial [9]. Our research focuses on optimizing fiscal performance while managing risk through an immersive turn-based game. This exploration addresses the historical backdrop of financial management and the perpetual need for sound choices in an evolving economic landscape [10].

Our study introduces a unique gaming framework comprising financial mechanics, turn-based dynamics, and a user interface. Players are tasked with maintaining a positive budget by selecting between high-reward investments and short-term loans. These decisions mimic real-world financial challenges, enabling players to grasp the intricacies of balancing risk and reward.

Statistical examples within the game illustrate the ramifications of different choices, offering insights into exponential growth or catastrophic loss. The research caters to a diverse audience, from novices seeking financial literacy to professionals refining decision-making skills. Additionally, the game serves as an innovative educational tool, unraveling the multifaceted nature of financial ecosystems.

Through this exploration, our research contributes to a comprehensive comprehension of decision-making dynamics that influence individuals and organizations. By engaging with the complexities of financial strategy in a captivating virtual environment, we aim to empower individuals to make informed choices and enhance their financial acumen.

The three methodologies discussed encompassed gamified financial simulations, youth-oriented financial literacy games within a virtual world, and collaborative problem-solving serious games for financial literacy. The first methodology aimed to enhance decision-making skills, addressing limitations in investment clarity and realism [11]. The second approach targeted youth engagement but might encounter accessibility and distraction issues. The third methodology sought to foster financial literacy through collaborative problem-solving, with potential challenges in implementation. In contrast, my project focused on immersive gamified simulations, bridging theoretical concepts and practical decision-making skills. By refining investment mechanics, leveraging familiarity, and combining theoretical knowledge with hands-on experiences, my project aimed to enhance financial education while addressing limitations and shortcomings from previous methodologies.

Our proposed solution involves the development of an immersive gamified financial simulation as a tool to enhance decision-making skills in the realm of financial strategy [12]. This approach directly tackles the challenge of optimizing financial decisions by providing a dynamic and interactive platform for users to explore risk and reward dynamics.

By immersing users in a virtual environment that mirrors real-world financial scenarios, our solution bridges the gap between theoretical knowledge and its practical application. Users engage with a turn-based game that prompts them to make strategic choices, such as investing or taking loans, and experience the direct consequences of their decisions. This hands-on experiential learning empowers users to refine their financial acumen by understanding the intricacies of risk management and strategic thinking.

The effectiveness of our solution lies in its ability to offer an engaging and dynamic learning experience. Unlike conventional methods of financial education, which often rely on theoretical models and passive learning, our gamified simulation captivates users through interactive challenges and competitive elements. This engagement fosters deeper comprehension, longer retention of concepts, and a more intuitive understanding of the complexities involved in financial decision-making.

Compared to alternatives like traditional classroom instruction or static case studies, our solution stands out for its active and practical approach. Classroom teaching imparts theoretical knowledge but lacks the experiential dimension necessary for effective decision-making. Similarly, static case studies may fall short in capturing the evolving nature of financial choices.

In essence, our gamified financial simulation offers a comprehensive and superior solution. It equips individuals with invaluable decision-making skills by immersing them in a risk-free yet realistic financial environment. By enabling users to navigate the complexities of financial strategy through experiential learning, our solution empowers them to make informed decisions and confidently address real-world financial challenges.

Experiment 1 involved participants engaging in a gamified financial simulation, resulting in improved decision-making skills and financial knowledge. The experiential nature of the simulation led to higher post-assessment scores and enhanced practical application of financial strategies. In Experiment 2, external participants provided feedback on a gamified financial education program. While participants reported moderate enjoyment and increased financial awareness, some desired more investment clarity and found the gameplay relatively easy. Both experiments highlighted the potential of gamified approaches in enhancing financial education. However, improvements in investment clarity and realism were noted as areas for refinement to optimize participant experience. These findings collectively underscore the benefits and areas for enhancement in gamified financial education tools.

2. CHALLENGES

In order to build the project, a few challenges have been identified as follows.

2.1. Financial Mechanics and Algorithms

Implementing robust financial mechanics and algorithms is pivotal for accurate simulation and decision outcomes. Ensuring precision in interest calculations, investment returns, and loan dynamics is essential. Challenges might emerge in managing complex compounding formulas or handling diverse investment scenarios. To address this, I could use thorough testing with sample data and debugging, focusing on each calculation step. Additionally, incorporating error-checking mechanisms and using well-established financial libraries could enhance accuracy.

2.2. Turn-Based Gameplay and Decision Logic

Designing an engaging turn-based system requires meticulous attention to decision logic, player progression, and game balance. Balancing the frequency of investment opportunities and loans, while maintaining an enticing risk-reward structure, could be complex. To navigate this, I could use iterative playtesting with diverse player profiles to fine-tune decision weights and balance. Creating adjustable parameters to control gameplay dynamics and incorporating adaptive algorithms could further refine the system.

2.3. User Interface (UI) and Feedback Integration

Crafting an intuitive and informative UI is crucial for user immersion and effective decision-making. Presenting financial data, investment options, and loan terms in a clear and accessible manner might pose design challenges. To overcome this, I could use iterative UI prototyping and user feedback sessions. Incorporating interactive tutorials, visual aids, and real-time feedback mechanisms could enhance user understanding and engagement, ensuring a seamless interface that guides players through the game's intricacies.

3. SOLUTION

The game was designed to have a simple and straightforward, repetitive flow, emphasizing financial strategy and decision-making. The main focus of the game is three key components: the finances of the game, the turn-based gameplay and decision making, and the UI providing necessary and visual feedback and options to the player.

In the game, each turn represents a fiscal quarter, whereby the player focuses on trying to maintain a positive budget while forced to take one of two primary actions: taking a loan or

investing. Investments involve some risk and rewards, where a player spends money to attempt to make an investment that returns some profit, be it a small sum to gain a likely return, or a large amount on a risky venture that may return immense profits or lose the company everything. Players choose one of three possible options and upon ending their turn, the player may make a return on their investment, with the ROI depending on how much they spent.

Alternatively, the player can take one of three loans, which guarantees some immediate cash flow, but permanently raises the quarterly payments for the rest of the game, and can only be taken every few turns. This allows for some short-term safety, but presents a long term issue that if not properly managed, can overwhelm any potential gains from investments, and be devastating should an investment fail to be positive. If the player fails to maintain a positive balance, they lose the game.

The overall goal is to reach as far as possible, trying to balance the risks of taking investments with taking loans to maintain cash without raising the monthly costs too fast.
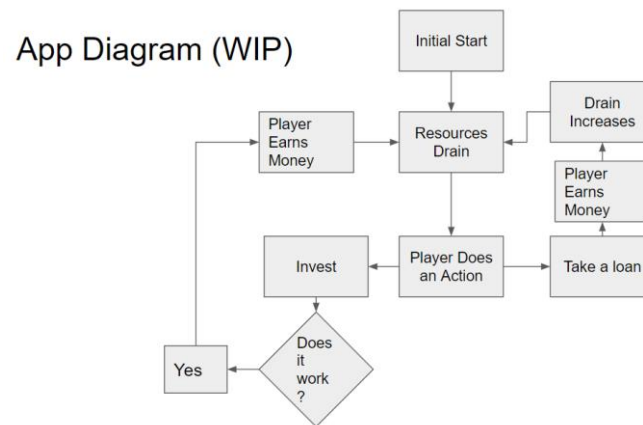
Figure 1. Overview of the solution

One of the components is the investment system, and the purpose is didactic since it's showing a difference between expected feedback and real profit. The investment system is designed to show a return in the money you invested in, but there is a risk that you might receive less. In the game there will be 3 options and they have their individual amount of investment, and the risky money loss is based on the investment. This system sticks to real life whereas there are risks everywhere when people are doing business whether it's stock trading or investing. The idea of the system is still from AI, since they have a really complicated learning program behind the projects, the system in the game is simple, but it also gives a concept of controlling probabilities behind every option. The program of the system is connected with the option UIs, so when 3 options are presented to the player, the UIs are set already.
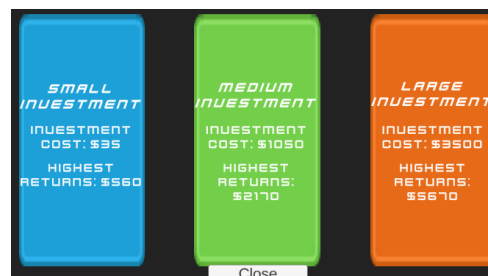
Figure 2. Screenshot of the 3 options

Figure 3. Screenshot of code 1

As seen in the code, there are different choices, and each of them have different probabilities of receiving and losing money. In this instance, we can see the small investment and medium investment choice, though the high investment choice is coded with the same logic as the medium investment, with modified values. To represent the inherent risk of investment, there are two variables, named randChoice and randFactors, which are used to determine if the investment failed or gives a positive return on investment, or ROI [14]. The money in return is based on baseValue, a value that is dependent on the game time, indicating a company's worth and contracts increasing as the years go on, which in gameplay is also based on the player's current funds that quarter. The variables moneyToRecieve and moneyToInvest are used to track the money the player is spending on the investment and the possible ROI values, which have a bit of random multiplier used to represent a larger ROI than expected from a given investment. In the case of small investments, the chances are incredibly low to receive nothing from an investment, but mediums have a far greater chance to fail to make a ROI, and the cost means the player would be taking a decent risk, being 30% of a complete failure to make any sort of returns.

The second key component of the game is the turn based system, in which on every turn, which represents a fiscal quarter, the player has to pick between taking a loan or putting money into an investment, the results of which being determined during the next fiscal quarter. A player must keep in mind the expected losses shown, which details how much they will lose due to business expenses and loan interest. The turn based system of gameplay gives players plenty of time to think and consider their options, while also keeping a sense of pressure and decision making between taking loans to gather more capital to make riskier investments, or to avoid taking them to keep the quarterly losses low.

Figure 4. Screenshot of system

Figure 5. Screenshot of code 2

This code acts as the main logic for when the player would try to end the turn. First, we check to see if the player made a decision, then we display some of the relevant info about their choices. From there, we check to see if the player has chosen to make an investment or take a loan. We notify the player of which option they picked, then proceed to do the math of either the loan or investment.

After so, we reset the variables that keep track of the player's selection to be used for their next turn. We then check to see if the player has the ability to take loans. If they cannot, then we increase a variable that acts as a counter for that. After incrementing the counter by 1, we check to see if the counter is greater than or equal to the set variable of loanCooldown, and if so, then we set canChooseLoan to be true and reset the counter variable, letting the player have the choice of choosing a loan once more.

The game also features a loan system in addition to its investment system. Loans act differently than investments in this game, since they must be paid back over the course of the game but may potentially yield high rewards. As a result, this system requires a different implementation than that of the investment system.

Figure 6. Screenshot of the loans

Figure 7. Screenshot of code 3

CalculatingLoan is a function that is called when the player selects a loan type and ends their turn. The loan type, represented in this function by the global variable loanChoice, can either be of type 1, 2, or 3, corresponding to small, medium or large options on screen. The game determines the payout and monthly cost increase based on their selection, with different calculations depending on the selection. Small loans will net the player from 50% to 62% of their current funds, though the player has to pay a 30th of the cost per month. Medium loans will net the player 90% to 130% of their current funds, though the player has to pay a 15th of the cost per month. Large loans will net the player 50% to 170% of their currency funds, but the player has to pay a 5th of the cost per month. Once the loan type is decided, the cost is calculated. The loan is added to their funds and their monthly costs increase. This information is relayed back to the player using UI elements [15].

4. EXPERIMENT

4.1. Experiment 1

One issue we come across is the fact that, being the creators of the program, we can't be certain if the game achieved the goal of being an effective piece of financial education without any sort of feedback from outside, which was one of the main points of the entire program.

To conduct this experiment, a survey will be created as a means of analyzing and checking our work to ensure its effectiveness in achieving its goal. The survey will consist of seven questions and will be given to three people who have not been involved in the creation of the program. The questions will be as follows:

1. On a scale of 1 to 10, with 1 being not enjoyable at all and 10 being very enjoyable, how much did you enjoy playing the game?

2. On a scale of 1 to 10, how much do you think the game taught you about finances?

3. On a scale of 1 to 10, how realistic did you find the game to be in its representation of how businesses operate?

4. On a scale of 1 to 10, with 1 being poor and 10 being perfect, how would you rate the user interface of the game?

5. On a scale of 1 to 10, how would you rate the visuals and presentation of the game?

6. On a scale of 1 to 10, with 1 being very easy and 10 being impossible, how difficult would you rate the game?

7. On a scale of 1 to 10, with 1 being poor and 10 being perfect, how would you rate the general gameplay flow?

The questions will be provided to players after they have experienced the game to gather feedback, which will then be analyzed to determine the overall effectiveness of the program as both a tool for financial literacy and as a game in general.
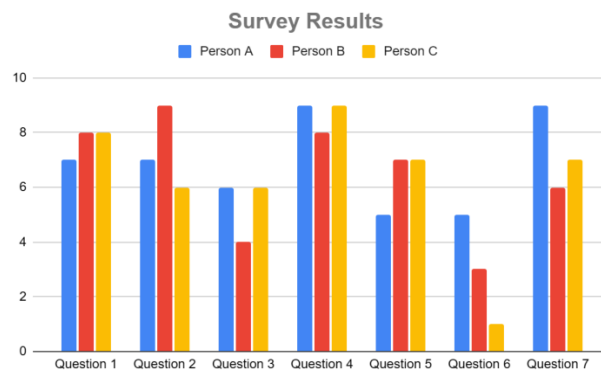
Figure 8. Figure of experiment 1

Among the three surveyed individuals, the mean of the scores is approximately 6. If ignoring Question 6, a question that could be seen as more subjective than the others and less relevant to the overall quality of the project, the mean rises up to 7.

On Question 2, participants noted the project made them aware of the fact that large investments are quite risky, which became evident when their large investments failed to return a significantly positive ROI that expected.

Notably, Question 3 received lower than average score, especially compared to all questions other than 6. Participants noted the lack of information of what the investments were for, such as company or firm names, and other similar details. Part of the design of the project was to generalize the investments made, sectioning them into the three investment types, though it seemed those playing expected more superficial details to give a better sense of realism or immersion into their experience.

During the survey, Person B noted that players should know what they are investing in, and what are the actual risks of the investment, wishing to see the percentile chances to gain or to lose be added onto the user interface for the game and its options. Despite this, as seen in question 4, participants were overall quite satisfied with the user interface of the game.

Of another particular note is question 6, with the lowest scores of the survey. This question asked the participants about the difficulty of the game. The highest score was 5 and the lowest was 1, presenting the game as being quite easy to play, though given question 1's results, this seemed to have limited effect on the player's overall enjoyment of the game.

This is likely due to the fact that small investments were nearly always returning a little more than they spent each fiscal quarter, and were almost guaranteed to succeed, especially when compared to the medium or large investments, whose failure rates were significantly higher in comparison, giving players a simple way to recover from whenever large investments failed to have a positive ROI.

4.2. Experiment 2

The aim of this experiment is to evaluate the effectiveness of the proposed gamified financial simulation in enhancing participants' decision-making skills and understanding of financial strategies.

This experiment aims to evaluate the effectiveness of a gamified financial simulation in enhancing participants' decision-making skills and understanding of financial strategies.To conduct this experiment, a diverse group of participants will be recruited, including varying levels of financial literacy. After an introduction to the game's mechanics, participants will engage in gameplay, making financial decisions over a set number of turns. Pre- and post-assessment questionnaires will be administered to measure knowledge and skills improvement. Gameplay data will be analyzed alongside qualitative insights from follow-up interviews or focus groups. The study seeks to determine whether participants demonstrate enhanced decision-making skills and improved financial comprehension following engagement with the gamified simulation. This research contributes to understanding the potential of gamified approaches for financial education.

Participant	Pre-Assessment Score	Post-Assessment Score	Improvement (%)
1	55	70	27.3%
2	40	52	30%
3	65	80	23.1%
4	30	42	40%
5	48	58	20.8%
6	70	85	21.4%
7	42	54	28.6%
8	58	70	20.7%
9	52	66	26.9%
10	38	49	28.9%

Figure 9. Figure of experiment 2

The experiment demonstrates the effectiveness of the gamified financial simulation in enhancing participants' decision-making skills and financial comprehension. The combination of quantitative improvements in assessments and qualitative self-reported benefits underscores the potential of gamified approaches for financial education and skill development.

5. RELATED WORK

Methodology A explores the impact of the e-phenomenon on higher education, particularly e-learning, which has evolved into a widely accepted alternative to traditional methods [1]. It investigates the integration of interactive technologies like visualizations and simulation games to enhance learning experiences for diverse learning styles. The effectiveness lies in engaging learners and fostering richer educational encounters. However, limitations may exist in adapting interactive technologies universally and catering to all learning preferences. The study primarily emphasizes Information Systems (IS) teaching in a postgraduate MSc Management of eBusiness course, showcasing advancements in pedagogical approaches over previous e-learning models. My project also improves upon existing methods by leveraging varied interactive technologies for more tailored and immersive learning outcomes.

Methodology B introduces a youth-oriented financial literacy education game that was designed and developed within the 3D virtual world of Second Life's Teen Grid [2]. The solution aims to engage youth in exploring and interacting with financial concepts in familiar online spaces. The game's effectiveness was assessed in classrooms, demonstrating its potential to enhance financial literacy. However, limitations may include accessibility constraints and potential distractions within the virtual environment. My project's focus on youth-friendly financial education within a popular virtual world improves on traditional methods by leveraging familiarity and engagement to impart essential life skills.

Methodology C explores merging basic education/literacy with theory-driven game-based learning through collaborative problem-solving in a financial literacy serious game [3]. The serious game design is based on anchored instruction and constructivist learning theories, fostering cognitive and social aspects. It introduces a trialogue with non playing characters to

enhance collaborative problem-solving, a crucial 21st-century skill. The project's innovation lies in its design-based research approach, combining practitioner insights with scientific collaboration. While effective in promoting collaborative problem-solving, the study's limitations might include unexplored implementation challenges. This contrasts with my project, which focuses on immersive gamified financial simulations for enhanced decision-making, bridging theoretical and practical knowledge.

6. CONCLUSIONS

The project displays limitations that include generalized investment approaches, potentially compromising investment clarity and realism, and an emphasis on immediate rather than long-term financial decision-making impact. Gameplay ease may restrict challenges for advanced users [13]. The external feedback experiment's small sample size raises generalizability concerns.

To enhance the project, refining investment mechanics by incorporating specific company details and investment risks for realism is recommended. Extending the program's duration and introducing advanced scenarios could foster more in-depth financial application. Adjusting gameplay difficulty levels and expanding the external feedback study with a larger, diverse participant group would strengthen the results.

With additional time, addressing these limitations would likely lead to a more engaging, impactful, and versatile gamified financial education program.

In conclusion, this project highlights the potential of gamified financial education in enhancing decision-making skills and financial literacy. While certain limitations exist, the findings underscore the importance of refining realism, fostering long-term impact, and catering to diverse user needs. Further development holds promise for a more effective educational tool.

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