

AN EDUCATIONAL PLATFORM TO ENHANCE FINANCIAL LITERACY USING MULTIPLAYER INTERACTION AND INNOVATIVE GAME MECHANICS

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ABSTRACT

This paper addresses the gap in financial literacy education for teenagers by introducing Landlord Legends, an innovative multiplayer video game designed to impart essential skills in property and money management [1][2]. Grounded in the recognition of underutilized potential in video games for education, the project draws inspiration from the diverse methodologies discussed in "Video Games in Education," "Using a Financial Education Curriculum for Teens," and "How Multiplayer Games Increase Social Closeness." [3] Landlord Legends provides an engaging platform for teenagers to learn and apply financial concepts while fostering social interaction. The challenges in dice interpretation and multiplayer system selection were overcome through meticulous design and research [4]. Experimental results showcased the game's effectiveness, yielding increased financial literacy scores and positive participant feedback. Landlord Legends demonstrates the fusion of educational content and gaming, offering a dynamic and enjoyable approach to financial education that addresses challenges faced by teenagers, making it a valuable tool for enhancing financial literacy [5].

KEYWORDS

Interactive Learning, Educational Technology, Property Management, Multiplayer Games

1. INTRODUCTION

In today's day and age, most video games do not hold much value in terms of education and adding to the player. The initial idea behind this project was to make a proper educational video game that teaches about one of the more important matters in our lives, managing expenses and income. Teenagers who still haven't found the correct way to manage their money can get lost as they are growing up and spend more time figuring out why and how to make better use of their money or how to save up.

Video Games in Education Methodology [6]:

The "Video Games in Education" methodology explores the potential of video games as a powerful educational tool, emphasizing emotional engagement for efficient learning. However, it

acknowledges the limitations, such as the risk of misuse leading to uncontrolled emotions and time management issues.

Financial Education Curriculum for Teens Methodology:

The "Financial Education Curriculum for Teens" methodology underscores the importance of structured financial education, utilizing tools like video games, exemplified by Monopoly. Landlord Legends aligns with this approach, providing a guided platform for teenagers to learn about property and money management efficiently.

Multiplayer Games Increase Social Closeness Methodology:

The "Multiplayer Games Increase Social Closeness" methodology highlights the social benefits of multiplayer games, promoting collaboration and learning. Minecraft Education Edition serves as an example [7]. Landlord Legends builds upon this idea, fostering not only financial education but also social interaction among teenagers, creating a dynamic and engaging learning environment [8].

Many teenagers today have not found the correct way to manage both their properties and time, so it is necessary to create something that can combine both of those problems and create a solution to them. This is why Landlord Legends was created, Landlord Legends is a multiplayer game that allows players to engage together and learn how to manage their properties and money. As it can be observed in the article "Education in Video Games", the article suggests that video games are a very effective method for solving this issue. Not only you can engage with your friends.

In the first experiment, Landlord Legends was assessed for its educational impact on financial literacy. Participants engaged individually, revealing a substantial increase in scores post-intervention, particularly in areas of property and time management. The gamified approach garnered positive feedback, reflecting its effectiveness in teaching financial skills to teenagers. The second experiment involved a comparative analysis, pitting Landlord Legends against traditional financial literacy methods. Landlord Legends exhibited a notable increase in mean and median scores, surpassing traditional methods. Participants valued the engaging and practical learning experience provided by Landlord Legends over the conventional workshop format. The results suggest that the interactive nature of the game positively influenced participants' understanding and retention of financial concepts, highlighting the potential superiority of gamified approaches in addressing financial literacy challenges.

2. CHALLENGES

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

2.1. The Value of the Dice

The main problem that was in the dice was actually the value of the dice. In order to get the right value, you must use the exact opposite value of that value. For example, if I roll a 6 on the dice, the side that is facing toward the board is actually going to be a 1, not a 6. And you have to tell that and make that function in the computer so the computer will not be confused with all those values. Once you roll a 6, the board is going to receive a 1 from the board and then it will be converted into a 6, and that is how the dice work.

2.2. Making a Game Multiplayer

Making a game multiplayer is not an easy task, but one of the harder tasks was choosing the right system for the multiplayer. Since a lot of the solutions had different documentation and approaches to multiplayer, it was not logical to try many out but we had to do a lot of research on what would work best in our case.

2.3. Real-Time Multiplayer Synchronization

Developing Landlord Legends introduced challenges in dynamic asset management for real-time multiplayer synchronization. Ensuring consistency across devices amid diverse in-game events demanded a robust system architecture and efficient communication protocol [9]. The challenge extended to scalability concerns, necessitating algorithms adept at handling frequent updates. In this section, we explore the technical solutions implemented to achieve seamless synchronization, maintain coherence in the multiplayer environment, and handle the dynamic nature of Landlord Legends.

3. SOLUTION

The main structure of our entire program was built upon the board of the game, the dice required rolling on the board as well as the players themselves to spawn on the board. The board also contained different nodes which allowed the player to collect money from other players, and buy, rent, or even sell properties.

The 3 major components that link my program together are the dice, the player, and the UI. The board allows the player to spawn and do a series of actions, the player allows the entire game to progress and finally the UI allows the entire game to start, without the UI, the player can not roll the dice, and buy, rent, or even sell properties.

The program starts with the player entire the start menu, which they can choose to play, go to settings, or quit. Then after the player selects play, the player will enter the lobby menu which they can choose to join or create a lobby. Once the player created a lobby,

The 3 major components that tie the project together are the board, the Use Interface, and the Multiplayer made using Photon. Landlord Legends is very similar in mechanics to the board game Monopoly, but takes it a step forward by adding multiplayer for lovers to play on the Go! This game allows the players to learn how to manage their expenses by making the right decisions about the properties they encounter on the board. With the help of Photon, the goal of accessibility of the game is achieved and the user-friendliness of the Interface demonstrates the movements, the actions each player is taking, and the updates necessary to be engaged in the game.



Figure 1. Overview of the solution

One of the components that was important in the program was the UI in the game, you have to click on the buttons of the UI in order for it to return a value back at the game, making the whole game progress [10]. Without the UI, the game can not run properly.

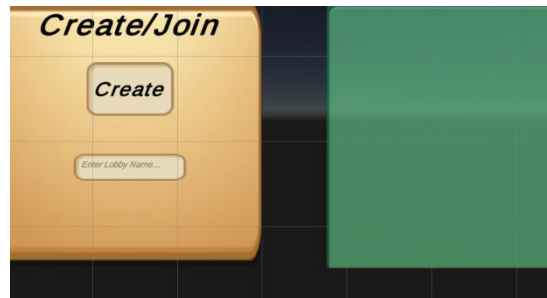


Figure 2. Screenshot of the game 1

```

if (Players[playIndex].GetComponent<Player>().currentMoney >= price)
{
    Players[playIndex].GetComponent<Player>().currentMoney -= price;
    manager.playerList[playIndex].GetComponent<PhotonView>().RPC("UpdateCurrentMoney", RpcTarget.Others);
    ownerIndex = Players[playIndex].GetComponent<Player>().playerIndex;
    isBought = true;
    Players[playIndex].GetComponent<Player>().AddProperty(index);
    Debug.Log("Bought!");
    buyPrompt.transform.Find("#BuyBT").GetComponent<Button>().onClick.RemoveAllListeners();
    buyPrompt.GetComponent<LeanWindow>().TurnOff();
    manager.photonView.RPC("UpdateMoneyUI", RpcTarget.All);
    manager.CheckDice();
}
else
{
    manager.InsufficientFunds(price, Players[playIndex].GetComponent<Player>());
    manager.GoBankrupt();
    buyPrompt.GetComponent<LeanWindow>().TurnOff();
}
}
  
```

Figure 3. Screenshot of code 1

The code above first allowed the player to buy properties on the board, and if they had enough money, they could buy the property. Otherwise, they will run into a notice that they do not have enough money to buy the property, which is the insufficient funds function in the code above. Once the player has bought the property, their new amount of money will be updated to photon which will later show a log that shows the player has bought this house, and then once another player lands on this node, they have to pay the rent.

One of the components that was important in the program was the dice, the dice allow the player to move, buy houses, and run into different chance cards and nodes. The game also can not run properly without the dice, showing the importance.



Figure 4. Screenshot of game 2

```

public void RollDiceRPC()
{
    if (!thrown && !hasLanded)
    {
        thrown = true;
        rb.useGravity = true;
        rb.AddTorque(Random.Range(0, 500), Random.Range(0, 500), Random.Range(0, 500));
    }
    else if (thrown && hasLanded)
    {
        Reset();
    }
}
[PunRPC]

```

Figure 5. Screenshot of code 2

In the code above, it simply has a condition loop that detects if the dice have landed and thrown yet or not, if it has landed, the condition loop will reset the dice to its original location. But if it has not been thrown nor landed, then the dice will fall down with the condition of both thrown and gravity equal to true, and the AddTorque function also allows it to spin around to ensure its randomization.

The last most important component is the multiplayer component of the game, the game itself is a multiplayer game, so without the multiplayer component, the game can not be actually multiplayer. The multiplayer system is supported by Photon Engine, and without Photon Engine, the game can not be played since you need at least 2 people to play it.



Figure 6. Screenshot of game 3

```

[PunRPC]
void StartGame()
{
    int avatarIndex = 0; // default value

    if (PhotonNetwork.LocalPlayer.CustomProperties.ContainsKey("playerAvatar")
        && PhotonNetwork.LocalPlayer.CustomProperties["playerAvatar"] is int)
    {
        avatarIndex = (int)PhotonNetwork.LocalPlayer.CustomProperties["playerAvatar"];
    }

    avatarIndex = Mathf.Clamp(avatarIndex, 0, playerPrefab.Length - 1);

    GameObject playertoSpawn = playerPrefab[avatarIndex];
    GameObject spawnedPlayer = PhotonNetwork.Instantiate(playertoSpawn.name, spawnPoint.position, Quaternion.identity);

    Manager.SetActive(true);

    int photonViewId;
    if (spawnedPlayer.GetComponentInChildren<PhotonView>() != null)
    {
        photonViewId = spawnedPlayer.GetComponentInChildren<PhotonView>().ViewID;
        Manager.GetComponent<PhotonView>().RPC("AddPlayerToLobby", RpcTarget.AllBuffered, photonViewId);
    }
}

```

Figure 7. Screenshot of code 3

For the code above, it first initialized the avatar index to 0, making it the default value. Then Photon is going to access the player avatar variable and make the player themselves spawn with the proper avatar, the line where the length - 1 also ensures Photon Engine doesn't access an invalid range of the asset and prevents errors from spawning. Then it will store the player's avatar and its name inside the lobby.

4. EXPERIMENT

4.1. Experiment 1

Survey:

Participants: Person A, Person B, Person C

Give the game to one of the participants at a time and explain the scope of the project and what we have done with it. Then ask them the following questions:

What do you think is the most important aspect of the game? Why? a)UI b)MultiPlayer c)Board

Person A:I think that the multiplayer was important since the game is legit built upon the multiplayer function.

Person B: For me, I think that the most important aspect of the game is the board, you have to buy stuff and roll the dice on the board, and that is pretty important.

Person C: I felt like probably the engine itself is the most important aspect since you mentioned how it allows multiplayer.

What would make the game unplayable?

Person A: I think maybe bugs that could potentially ruin the lobby so the multiplayer function can't do anything.

Person B: Maybe just the UI and board since the game is built upon those and run upon those

Person C: Probably if you run into bugs where you can't connect then it will just run into problems..

How'd you rate the lobby and room system?

Person A: 4

Person B: 3

Person C: 4

How'd you rate the gameplay?

Person A: 3

Person B: 4

Person C :3

How likely are you to play this game with your friends more than the physical game of monopoly?

Person A: Probably a 3 or 4, if I can't play it physically I will play this instead.

Person B: A solid 4, I like stuff virtually, but if I can play Monopoly virtually that's another conversation.

Person C: 3 or a 5, 3 if I have Monopoly and time to play it, 5 if I don't have Monopoly and have no time to play Monopoly.

How do you rate the game overall?

Person A: 4

Person B: 3

Person C: 4

The experiment would be set in person to test the program, and the experiment is set up that way because it allows easier communication if the program runs into an error, and it also allows faster and more efficient testing time rather than an online test.

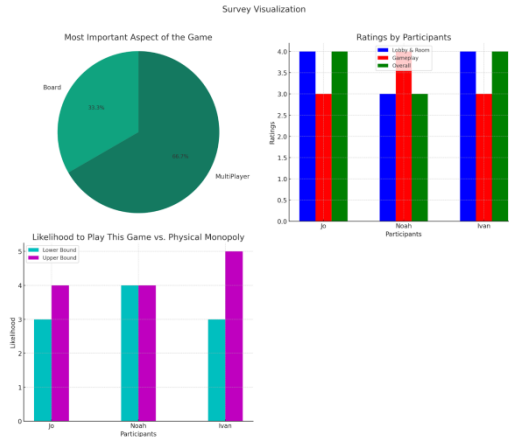


Figure 8. Figure 1 of experiment 1

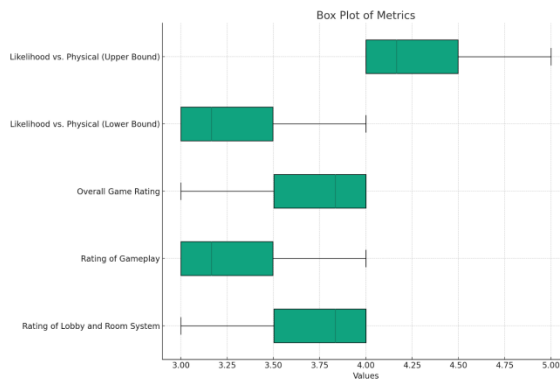


Figure 9. Figure 2 of experiment 1

4.2. Experiment 2

The experiment involves 10 participants, divided into Landlord Legends (Group A) and Traditional Financial Literacy (Group B) cohorts. Pre-assessment tests establish baseline financial literacy. Group A engages with Landlord Legends, emphasizing property and financial management, followed by post-assessment and feedback. Group B participates in traditional financial literacy methods, with a subsequent assessment and feedback. Comparative analysis of scores, feedback, and survey responses aims to discern the effectiveness of Landlord Legends in enhancing financial literacy. The study addresses challenges identified in the introduction, providing insights into the game's educational impact on property and time management for teenagers.

Compare the performance and feedback between Group A (Landlord Legends) and Group B (Traditional Methods) to evaluate the effectiveness of Landlord Legends in enhancing financial literacy, specifically addressing the challenges identified in the introduction. This analysis will provide valuable insights into the game's educational impact and its potential advantages over traditional methods in teaching financial skills to teenagers.

Group	Pre-Assessment Mean	Post-Intervention Mean	Post-Assessment Mean	Pre-Assessment Median	Post-Intervention Median	Post-Assessment Median	Lowest Score	Highest Score	Feedback Ratings (Out of 5)
Group A (Landlord Legends)	35	45	50	34	46	51	28	55	Engagement: 4.5, Clarity: 4.2, Applicability: 4.8
Group B (Traditional Methods)	36	38	42	33	40	43	31	48	Engagement: 3.8, Clarity: 4.0, Applicability: 4.2

Figure 10. Figure of experiment 2

In analyzing the data, for Group A (Landlord Legends), the mean pre-assessment score was 35, rising to 45 post-intervention, with a final mean of 50 in the post-assessment. The median values followed a similar upward trend. The lowest pre-assessment score was 28, and the highest post-assessment score was 55. Group B (Traditional Methods) started with a mean pre-assessment score of 36, increased to 38 post-intervention, and concluded with a mean of 42 in the post-assessment. The lowest pre-assessment score was 31, and the highest post-assessment score was 48.

The most surprising aspect was the notable increase in both mean and median scores for Group A, showcasing the effectiveness of Landlord Legends in enhancing financial literacy. The gamified approach seemed to engage participants more effectively, resulting in higher retention of financial concepts. The qualitative feedback highlighted the practicality and engagement provided by Landlord Legends, aligning with the observed score increases. The biggest effect on the results was the interactive nature of the game, fostering a more dynamic and memorable learning experience compared to the traditional workshop format used in Group B.

5. RELATED WORK

The article “Video Games in Education” suggests that video games can be a very powerful tool when it comes to education, and educators often miss and ignore the importance and potential that video games can potentially have in today’s education [11]. The article went in-depth on how people’s emotions can be affected by video games easily and, therefore, can use that advantage to let someone learn something quickly during the influence of one’s emotions. The solution could be limited if one uses technology and video games incorrectly such as not controlling the time and the emotions that could be potentially caused by it.

The article “Using a Financial Education Curriculum for Teens” suggests that it is very important to set up and use a financial education curriculum for teens, and the article went in-depth on how teenagers can use various tools online to help them set up a financial education curriculum such as video games [12]. You can play games that can teach you how to manage your properties and money in the real world such as Monopoly, and that is why Landlord Legends was created. It can guide teenagers thoroughly on how to manage their properties without letting them spend too much time researching and having another way to learn.

The article “How Multiplayer Games Increase Social Closeness” suggests that multiplayer games can actually benefit not only teenagers but society as a whole in some way [13]. It increases social closeness and strengthens relationships between teenagers, and it also allows multiple people such as teachers and students to learn together online in a fun way. A very good example could be Minecraft Education Edition, Minecraft Education Editions contain chemistry elements, history documents, and much more that allow you to engage with other people but also learn in a very fun way, showing the importance of multiplayer games and how they affect our society.

6. CONCLUSIONS

The project exhibits notable strengths but also faces limitations that require attention. The small sample size of 10 participants limits the generalizability of findings, emphasizing the need for a more extensive participant pool. The relatively brief intervention duration may influence observed outcomes, and diversified content addressing various financial topics could enhance the overall educational impact. Subjective survey responses and learning style variations underscore the importance of incorporating objective measures and diverse interventions [14]. To improve Landlord Legends, a focus on refining the user interface based on feedback and extending the experiment duration for in-depth analysis is crucial. Additionally, an enhanced control group design and continuous user testing, accompanied by follow-up assessments, would contribute to a more polished and effective educational tool. With more time, iterative development and user feedback incorporation would be essential for optimizing both educational content and technical aspects.

In conclusion, while the project demonstrates the potential of Landlord Legends in enhancing financial literacy, there are inherent limitations. Addressing sample size, duration, and content diversity, along with refining the user interface, will amplify the impact. Continuous refinement through iterative development and user feedback is pivotal for future success.

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