Co-designing a Financial Literacy Videogame: A Participatory Research-based Approach in Complex Scenarios

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Abstract

This study examines the co-design of a financial literacy videogame as a pedagogical innovation aimed at fostering sustainable economic principles among university students. The co-design process and game development is informed by the needs and preferences of its end-users to ensure the game's educational content is relevant and impactful. This methodology brings together learners, educators, and game developers to co-design a financial literacy video game integrating educational technology and e-learning principles to create an inclusive, engaging learning environment. By simulating real-world financial dilemmas within the game's narrative, players experience firsthand the consequences of their choices, encouraging critical reflection on their personal and collective financial behaviors. Players navigate complex financial scenarios, promoting strategic thinking and responsible decision-making. The effectiveness of the game was assessed using a mixed-methods approach, evaluating financial knowledge, attitudes, and behaviors. Findings indicate participants demonstrated marked improvements in financial knowledge, and decision-making skills. The paper discusses the implications of these results, the potential of gamification in learning complex subjects, and the advantages of participatory design in creating meaningful educational experiences.

Keywords: Financial Literacy, Complex Thinking, Higher Education, Educational Innovation, Participatory Game design.

1. Introduction

Financial literacy is a critical aspect of personal finance management that has been shown to improve individual and household financial outcomes [1]. However, research has consistently shown that young people lack the knowledge and skills necessary to make informed financial

decisions [2]. In response to this challenge, digital games have emerged as a promising approach to enhancing financial literacy skills in young people [3] [4]. In this article, we present the results of a participatory, research-based design method to create a videogame for enhancing financial literacy among university students. Specifically, we elaborate on our four-phase research-based design methodology and share insights from 22 focus groups held across five Mexican cities, involving 229 young participants aged 17 to 24. The insights from our study inform the collaborative design of student-centered videogames.

2. Background

A. Research-based Design

Research-based design is a systematic iterative approach to complex environment development projects, based on problem analysis, design solutions and design processes [5]. Research-based design methodology has been used in a number of studies. For instance, [6] integrated the research-based design approach into garden and landscape renovation processes, finding that landscape architecture has developed from a very practical base, and [7] used this approach with user research and obtained data related to the physiological and psychological characteristics, living habits, and user requirements of the target population as a starting point to design an electric water heater. In the educational domain, [8] describe how to develop learning materials based on ionic liquid research using educational design research as a design strategy; also [9] analyzed the current conditions related to open education in Thailand, integrated a gap and SWOT analysis of open educational operation to present a strategic plan on open education through technologies of higher education institutions. In this sense, research-based design provides tools to come up with new solutions.

B. Participatory Approaches for Game design

Participatory approaches to co-designing videogames focus on involving players and other stakeholders in the development process to create more engaging and relevant gaming experiences. Involving children with intellectual disabilities in the design of educational games ensures that these tools are accessible and effective for this demographic [10]. Similarly, some researchers [11] discuss how engaging local Tanzanian students and teachers in the game design process enhances the cultural relevance and educational effectiveness of numeracy games. Participatory arts-based game design can empower communities and address social issues effectively through games, as seen in a project in Ethiopia [12]. These approaches demonstrate that participatory design can significantly enhance the impact and acceptance of games, setting a foundation for a broader discussion on its implications in diverse educational contexts.

In educational settings, participatory design transforms the development of serious games by involving educators and learners in the design process, which helps align the games with educational goals and learner needs. For instance, [13] found that a participatory approach to designing nutrition education games allowed for the integration of feedback from children and parents, which significantly improved the game's educational impact. Participatory game prototyping in the development of a game for energy transition facilitated the incorporation of

diverse stakeholder insights, which enhanced both the game's content and playability [14]. Redesigning games for educational purposes using a participatory process can invigorate outdated educational methods and inspire creativity among students [15]. Participatory design is crucial for developing educational tools that are innovative, relevant, and effective.

During the development phase, participatory design facilitates iterative feedback loops with users, allowing developers to refine and adjust gameplay based on direct user input. Iterative adaptations based on participant feedback can significantly improve the engagement and self-efficacy of autistic youth in game design workshops [16]. Similarly, participatory methods in game design for autistic children allow for high customization, which is critical for maintaining engagement and enhancing communication skills [17]. Participatory design not only improves the functionality and relevance of educational games but also ensures they are inclusive and supportive of diverse learning needs and deepens the players' investment in the game [18], [19]. This ongoing refinement process is essential for addressing the complex challenges of game design, leading to a final product that resonates well with its intended audience.

C. Financial Complex Scenarios

Based on scenario-based approaches [20], complex scenarios for learning through digital games [21] and pedagogical scenarios for blended learning [22], we define financial complex scenarios as a series of events and actions within a given timeframe, where each scenario is constructed from a sequence of interconnected elements and occurrences. These actions and events are designed to represent realistic financial situations, requiring participants to engage in and make decisions based on these dynamic circumstances.

Financial complex scenarios are crafted to mimic real-world financial challenges within a game, drawing extensively on principles of pedagogical design to ensure they are realistic and effective in promoting financial literacy. Such scenarios should be supported by computer-aided tools that enhance the delivery and effectiveness of complex financial education [23]. The integration of user-generated content in learning scenarios, which adapts to the dynamic nature of financial environments, makes learning more relevant and engaging for users [24]. Educational video games designed with personalized learning scenarios can significantly improve the learning outcomes by aligning closely with the learners' needs and decision-making processes [25]. This alignment is critical as it ensures that financial education through complex game scenarios promotes knowledge and trains learners in practical financial decision-making skills.

The effective design of financial complex game scenarios relies heavily on the foundational principles of pedagogical scenarios, which are structured to enhance understanding and engagement. Learning dashboards can support complex in-class scenarios by promoting higher levels of cognitive engagement [26], a concept that can be applied to financial education to monitor and enhance learner engagement in real time. Meticulously designed architectural frameworks for online pedagogical scenarios provide the necessary structure and flexibility to accommodate complex financial learning content [27]. Authoring tools that assist educators in designing and operationalizing these scenarios within digital environments are important to design scenarios that are both effective and scalable [28]. Grounding financial complex game

scenarios in solid pedagogical strategy might maximize their educational impact and effectiveness in enhancing financial literacy.

D. Videogames Promoting Financial Literacy

The utilization of game-based learning strategies to teach financial literacy is supported by the ability of these games to provide simulations of financial situations that are often not experienced by young individuals due to their dependence on parental support and limited legal financial rights [29]. Unlike games that are solely for entertainment, educational games primarily aim to educate, using entertainment as a secondary benefit to improve the quality of the learning experience [30].

Research into the effectiveness of serious games on learning outcomes has been widely documented over the last decades. Digital games provide a secure and engaging environment conducive to encouraging students to explore, experiment, and learn from failures through iteration [31]. However, despite the abundance of software tools that facilitate the creation of digital games and continuous technological advancements, the task of designing educational games is complex and fraught with challenges [32], [33]. Among these challenges, the integration of pedagogical elements is particularly significant, involving the alignment of the game's components effectively with educational goals and learning processes [34].

Game-based technological solutions and interventions are documented in recent scientific literature. For example, [35] designed and developed a board game focused on Wealth Creation to enhance financial literacy among high school students. This development process involved iterative cycles of content development, game mechanic testing, and expert reviews, which contributed to refining the game for educational use. Furthermore, [36] developed Shock Economy, a financial literacy game targeting Generation Z that teaches players to adapt to changing financial circumstances, tested both on young adults and those over 30 to assess its broad applicability and impact on learning behaviors. Finally, [37] introduced FinCraft, an open-source platform designed to enhance financial literacy among young people through engaging and interactive gaming experiences. The platform responds to the critical need for financial education tailored to youth, integrating serious game elements with learning analytics to foster effective learning environments. This approach is based on the belief that early exposure to financial education through games can cultivate positive financial habits from a young age. These gamified developments in educational contexts highlight a growing recognition of the importance of specialized, engaging tools for financial education.

3. Motivations and Objectives

The development of educational games that effectively promote financial literacy is a challenge that requires a nuanced understanding of educational content delivery, game design, and participatory co-design methodologies. Recognizing the importance of these elements, this study is motivated by the need to develop and refine interactive learning tools that not only engage but also educate diverse user groups on financial management in realistic and impactful ways. To this end, the objectives of our research are twofold:

1) To document the entire co-design process utilized in the development of the financial literacy videogame.

2) To assess how effectively the participatory research-based design method facilitates the creation of game scenarios that reflect real-world financial challenges.

4. Methods

The research-based design method was implemented to support the co-design and technological development of a videogame with a participatory approach. Research-based design is a systematic approach to complex development projects, based on problem analysis, design solutions and design processes [38]. The adopted method followed four phases starting from opportunity detection from research results, participatory game design, iterations with target audience and transformation (Fig 1).

Fig. 1. Research-based design method to co-design a financial literacy videogame

Withing the phase 1 and 3, qualitative data collection and analysis took place with the target audience as part of the participatory activities. To recruit participants for the study, Convenience sampling was adopted to recruit participants for the study, which means we selected participants due to their availability to represent a group of people needed for the research we were preparing [39]. Focus groups [40] and survey online questionnaires were used as data collection instruments. Content analysis [41] was performed. Results and study findings informed the design decisions and improvements of the videogame.

5. Results

A. Opportunity detection from research results

To accurately assess the financial literacy levels and needs of our target demographic, we conducted 22 focus groups across five major cities in Mexico, involving 229 participants aged 17 to 24. These sessions were designed not only to assess participants' current understanding of financial concepts but also to actively involve them in generating solutions tailored to their specific needs. The insights gathered from these discussions were systematically analyzed to inform the development of complex financial learning scenarios and game universe.

Participants identified various income sources including financial support from parents, assistance from relatives, scholarships, entrepreneurial activities, selling personal items, both formal and informal jobs, and temporary employment during holidays. Their expenses consisted of food, groceries, school fees, transportation (either gasoline or public transport), household contributions, cell phone bills, and regular payments for streaming services and applications. Also, non-essential items such as entertainment, social activities, hobbies, online shopping, apparel, occasional luxuries, and emergency expenses such as medical bills. As for financial literacy, participants indicated they did not know how credit cards payments, charges, and fees work. While a considerable number of participants name a few strategies for saving money and making budgets, the majority declared to lack basic financial knowledge.

B. Participatory game design

Work meetings were held with the design team to brainstorm ideas for the game scenarios, game story, mechanics and universe integrating the findings from phase 1. The team included specialists in educational technology and game design, programmers, technology developers, and instructional designers. Learning content was selected by prioritizing the lowest evaluated knowledge of participants in the previous phase. The documented expenses and income sources reported by the participants of the study were incorporated into real-life scenarios where participants can make financial choices that are related to their context in the real-world. While several proposals were analyzed, only three were tested using paper prototypes to visualize game dynamics until one proposal was selected to become the first prototype of the videogame. These resulting scenarios were improved and included in the educational videogame for content to be relevant and related to the real-world financial challenges faced by young adults.

1) The first scenario focuses on promoting regular savings habits. In this scenario, the avatar must save a predetermined amount of money by engaging in various money-earning activities, avoiding unnecessary expenditures and managing unavoidable costs like public transportation fees, and school tuition.

2) The second scenario presents the fundamentals of credit card usage, focusing on the effects of interest on one's personal finances. Here, the avatar is already in credit card debt, and must strategize his spending and repayment behaviors to minimize interest charges, enhancing their comprehension of credit management.

3) The third scenario transports players into a simulated world where the avatar's primary goal is to prepare for retirement. In this scenario players need to integrate long-term savings strategies into their financial planning, navigate investment options and savings plans that can yield long-term benefits.

C. Iteration with target audience

In the iterative development phase of the financial literacy videogame, recurring cycles were critical for refining the game through continuous feedback and technical improvements. During each cycle, a comprehensive review is conducted to identify necessary technical adjustments and enhancements that can significantly elevate the user experience.

Key technical changes identified include the correction of typographical errors, which can affect the clarity and professionalism of the game content. Ensuring compatibility across various browsers and devices was also crucial. This involved optimizing the game's performance and display to ensure that users have a seamless experience regardless of the platform they are using. Improvements in feedback mechanisms are another area of focus; enhancing how the game solicits and incorporates player feedback will enable a more adaptive and responsive gaming experience.

Content-related changes are also addressed in these cycles. These adjustments may include the refinement of financial scenarios to better reflect realistic situations, updates to the instructional content to align with current financial practices and regulations, and the inclusion of diverse financial contexts to broaden the game's relevance to a wider audience.

Additional enhancements to consider include making navigation more intuitive and engaging, enhancing the graphics and audio effects for a more immersive experience, and making financial learning more appealing. Lastly, integrating more robust data analytics tools can provide insights into how players interact with the game, which can inform further refinements and content updates. Each iteration aims to refine the game further, ensuring that it meets the educational needs of its users while providing an engaging and informative experience.

D. Transformation

The final phase of the adopted method focuses on evaluating the outcomes of digital game-based learning and the overall user experience. This assessment is crucial in understanding how the game promotes the enhancement of financial literacy and how effectively these skills are transferred to real-world contexts.

To measure and assess learning, the game incorporates built-in assessment tools that track the player's progress through various financial scenarios. These tools include quizzes and challenging mini games that are directly tied to the game scenarios. For instance, after completing a scenario on credit management, players might be asked to decide whether to use a credit card for a significant purchase considering the interest rates and their current financial situation. The game records the player’s choices and provides real-time feedback and explanations, helping to reinforce learning or correct misunderstandings.

The assessment also extends to evaluating how well players can apply their learned skills to new, unscripted scenarios within the game. This approach tests the transferability of knowledge to real-life situations. For example, players who have learned about savings strategies will be faced with sudden financial emergencies in the game, requiring them to apply their knowledge to overcome these challenges without compromising their long-term financial goals.

User experience is assessed through a combination of direct user feedback, and behavior tracking. Surveys and focus groups provide qualitative data on user satisfaction and the perceived value of the game in learning financial concepts. Additionally, analytic tools embedded within the game collect data on how frequently different parts of the game are accessed, the completion rates of various scenarios, and where users encounter difficulties. This data helps identify parts

of the game that may need redesigning to enhance user engagement or clarify instructional content.

The ultimate goal of this phase is to ensure that the game effectively promotes financial knowledge and engages users in a meaningful way to prepare users for real-life financial decision-making.

E. Participatory Research-based design and Game Scenarios

This section focuses on evaluating how the participatory co-design method contributed to the development of game scenarios that accurately mirror real-world financial challenges. The initial findings from the participatory research phase highlighted key areas where the target audience demonstrated significant gaps in financial knowledge.

Leveraging these insights, the game design team crafted scenarios that not only aim to improve financial literacy but also prepare players for practical financial decision-making. For instance, scenarios were developed based on common financial dilemmas such as managing student loans, budgeting for living expenses, and planning for unexpected financial setbacks like medical emergencies. Each scenario was designed to challenge players' decision-making skills under realistic conditions, thereby encouraging the application of learned concepts in a controlled, simulated yet lifelike environment.

To address the identified deficiencies in financial knowledge, the game includes progressive difficulty levels that adapt to a player's learning curve. Initial levels introduce basic concepts such as budgeting and saving, while more advanced levels involve complex tasks like investment decisions and retirement planning. The game provides contextual help and feedback to assist players in understanding the consequences of their decisions, thereby reinforcing learning through practice.

The participatory research-based design process has proven instrumental in developing game scenarios that not only educate but also equip players with the necessary tools to navigate the financial realities of everyday life. This approach ensures that the game remains relevant and effective, meeting the educational needs of its audience while preparing them for future financial independence.

6. Discussion

Considering the findings of the data analysis gathered from 22 focus groups carried out in 5 cities in Mexico, learning content was integrated into the game-based solution to promote financial literacy in terms of budgeting, savings, good credit management and savings for retirement knowledge. The participants reported diverse sources of income including financial support provided by parents, financial aid from relatives, scholarships, entrepreneurial endeavors, selling personal belongings, formal and informal employment with parents or relatives during vacations. This information was considered to design the learning scenarios of the videogame. Similarly, as shown in Fig 3, participants' declared expenses data was considered to inform the design of the video game universe (e. g., game spaces, game objectives, mechanics). As indicated by [29],

the context of a game should be inspired from the needs and pains of the users of a learning solution given that learners' individual characteristics should be taken into consideration to maximize the benefits of game-based learning solutions. For this reason, in-game actions were shaped by considering the income sources reported by the participants in real-life. By creating a game context based in real-life situations, players can learn from trial and error in the game system to later act in the real world.

7. Conclusion

The development of the video game for financial education was significantly enhanced by integrating participatory approaches to co-design, research-based methodologies, and the inclusion of complex financial scenarios within the design process. Guided by the proposed methodology, these elements facilitated a collaborative environment where users and stakeholders actively contributed to the ideation, conceptualization, design, and creation stages. This approach addressed the nuanced needs and expectations of its intended young audience, aged 17-24. The game effectively merges complex thinking skills with financial literacy competencies through realistic financial challenges, making it a robust tool for active learning environments. The participatory design process led to the creation of a minimum viable product for targeted learning sessions.

This project exemplifies the synergistic effect of employing participatory co-design and a research-oriented approach to embed financial complexities into the game, creating a highly engaging and educationally relevant tool for financial literacy. Future research should focus on refining the game through iterative design, enhancing user experience, extending its usability across various learning contexts, and conducting thorough post-launch data analyses. These steps are crucial for the continuous improvement and efficacy of the video game as a transformative educational tool in financial literacy for young individuals

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