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Designing learning experiences using serious games: innovative village case study

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The increasing interest in Learning Experience Design (LXD) has consolidated this field as a new way to transform educational practices. Thanks to its interdisciplinary nature which is mainly rooted in the close relation between human–computer interaction, user experience design and the learning sciences, LXD is a field that demands frameworks to design and develop products that can grow into services, to create interactive learning environments able to provide improvement-driven analytics and to guarantee a significant and satisfactory experience, designed to achieve learning outcomes. Innovative Village serious video game (IVVG) is a service-oriented product within an entrepreneurship and innovation system of platforms developed as an abilities-focused learning environment, and that builds a case study for LXD. This research aims to contribute to the consolidation of the emergent field of Learning Experience Design by providing a case around the Entrepreneurship and Innovation area from EAFIT University in Medellin, a learning system that comprises several service-oriented products; by being one of the products that constitute this system, and as a serious video game, Innovative Village has proven to be a key player in facilitating the learning outcomes and the knowledge integration that stem from the learning environment of the Interactive Design program, where the students' learning experiences take place. First, related theoretical concepts and historical data will be analyzed to provide background information, then the case study will be addressed focusing on the materials, methods, and results. The study shows that the video game encourages collaborative behavior between players, as perceived by a significant proportion of participants. The research establishes a link between this perception and the role of creaticides in the game. Learning Experience Design (LXD) is about creating products that link the learning process with key competences. The game "Innovative Village" exemplifies this approach and provides insights into design, use, and required competencies. It also presents a framework for designing user-centered learning experiences that incorporate assessments to enhance the learning process. This framework is applicable from the early stages and can be tested in real learning environments.

KEYWORDS

serious game, video game, collaborative learning, competitive learning, learning analytics, learning experience design, entrepreneurship

Introduction

Serious games practices require users a high level of interaction and participation when addressing and solving multiple problems in given contexts, this provides the reason why these games have been researched and used for multiple learning purposes and take special relevance in the field of Learning Experience Design. This is the kind of product that can be considered as an instrument to achieve a desired objective such as learning or training, and in which education is the primary goal rather than entertainment (Michael and Chen, 2005). Innovative Village is a serious game aimed at improving entrepreneurship and innovation skills (that can only be strengthened through training and practice) within a designed learning environment composed of formal, non-formal, and informal learning experiences represented across several media, and through which learners can move and configure their learning journeys; exemplifying the emerging variety of tools to enhance learning experiences that improve learning processes and education for competencies (Marcum, 2014; Zabolotska et al., 2021).

> "The following competencies require special attention: use of digital communication tools with students and colleagues; use of cloud technologies for information exchange, creation of materials, subject communication with fellow teachers; use of software products to create new learning materials and adapt existing ones; practical skills in ways to protect information; tools for identifying information and identifying false or biased information; safe, ethical and responsible use of digital technologies in practice and as a means of communication; creative approach in the use of digital technologies to solve educational problems; creating feedback with students using digital technologies and tracking the online activity of students in the learning process; use digital tools to monitor student progress and identify the need for additional support." (Zabolotska et al., 2021).

Learning Experience Design (LXD) is defined as an interdisciplinary field that integrates learning, experience, and design. This approach adopts principles centered on the human and socio-cultural aspects, focusing on how individuals acquire knowledge and experience learning. LXD utilizes user experience design methods, such as interaction design, user experience (UX) design, and graphic design, to achieve a balance between user experience and learning environment factors. It is a continuous improvement process, where metrics and feedback are used to propel learners toward identified learning goals. In practical terms, LXD involves designing products, services, or systems that constitute learning experiences, with a focus on the learner as the center of the design process.

Learning experience design

To consider Learning Experience Design as an emergent field that comprises a wide variety of disciplines leads to talking about it as an interdisciplinary one and acknowledging its three main components: learning, experience, and design.

In simple terms, learning is how people acquire new knowledge, and it has been considered a science since the 90s. Learning sciences study how and where learning processes occur, not only by questioning formal education like school or university but by examining non-formal and informal contexts; the goal of these sciences is to improve the understanding of the cognitive and social processes, study these insights aiming to more effective learning, and using them to "redesign classrooms and other learning environments so that people learn more deeply and more effectively." […] "The learning environment includes the people in the environment (teachers, learners, and others), the computers in the environment and the roles they play, the architecture and layout of the room and the physical objects in it, and the social and cultural environment." (Sawyer, 2005). This said, one can state that a learning environment is a unique space, made by a particular combination of the elements above mentioned by Sawyer (2005) and intended for learning to occur; when learners have the opportunity to access one, they access a space that comprises products, services or systems to support their cognitive processes.

Given that experiences are what people feel, perceive, or think, these should have outcomes connected to emotions, perspectives, and beliefs. According to Kim (2015), an experience involves products or services as mechanisms to produce real interaction between a person, the organic subject, and surrounding environmental elements, the objects of experience. Furthermore, it has been stated that a learning experience is any situation you encounter and learn from Learning Experience Design (2021) and that it can be formal, non-formal, or informal. As noted, an experience requires environments for interaction, therefore, a learning experience needs both an adequate environment to carry out learning processes as well as a learner-oriented design for its products and services, which should also lead to the achievement of the learning outcomes sought by the instructional design.

Designing requires thinking about how valuable, harmonious, and senseful the user experience can be, for this reason, it is essential to contemplate the four following principles: the experience, the environment, the product, service or system, and the balance between the experiential and the environmental factors (Kim, 2015). Therefore, as a branch of design, LXD must consider both learning competencies, outcomes, and goals, as well as the learning experience itself; hence, it can achieve a balance between the computational environment and the instructional method. "The selection of which instructional methods to apply and the design of computer systems together form a learning environment [12], which determines a learner's learning experience." (Nakakoji et al., 2003).

Due to its interdisciplinarity, over the recent years, LXD has been studied together with other fields of study, as is the case of learning design and technologies, which has recently included user-centered design (UCD) and user experience (UX) in learning contexts (Schmidt and Huang, 2021). "This signals a shift in the field of learning design and technology (LDT), moving the field toward more human-centered approaches to designing digital environments for learning" (Schmidt and Huang, 2021).

> "Learning experience design is rooted in a combination of several design disciplines with the field of learning. Key design principles used in LXD come from interaction design, user experience design, experience design, graphic design, and game design. These design principles are combined with elements of education, training and development, cognitive psychology, experiential

> learning, educational sciences, and neuroscience." (Learning Experience Design, 2021).

To this extent and after considering its essential components along with its interdisciplinary attributes, a formal definition of LXD in the field of learning design and technologies is: Learning Experience Design, as a human-centric, theoretically grounded, and socio-culturally sensitive approach to learning design, is the discipline intended to propel learners toward identified learning goals using UXD methods, feedback and metrics (Schmidt and Huang, 2021).

Based on the above, the products, services, or systems that compose the interaction between a learner and the environment can be denominated learning experience, "Learning experience design (LX) is a subset of user experience design (UX) that addresses the synthesis of learning sciences, human–computer interaction, and design thinking. Learning experience design puts the learner at the center of the product or service design process." (Raybourn, 2016). To design learning experiences, it is fundamental to locate the learner at the center and design the product, service, or system with UX methods, not only thinking of the interaction but also of the learning process and the learning experience. Designing for learning experiences requires a process to improve in each iteration that happens within the environment proposed by the designer; setting a learning ambiance needs to have a fast test with the learner, who comes to be the user in the case of LXD; then data can be provided using UX methods (Brown, 2013; Gothelf, 2013). Thus, to the same degree as similar methods, the process of configuring better learning experiences opens the possibilities to extract and carry out data and analytics which act as helpful tools for designers to improve each learning environment; "The Society for Learning Analytics Research defines Learning Analytics as: ".. the measurement, collection, analysis and reporting of data about learners and their contexts, for purposes of understanding and optimizing learning and the environments in which it occurs." (Siemens and Baker, 2012).

Serious games

Since the development and use of serious games have significantly grown in recent years (Van Eck, 2006) and the main object of this case study is a serious game, it is worth addressing this topic starting by mentioning that serious games have been used in multiple fields other than education, such as simulation, marketing, advertisement, health, military, social awareness, and impact games; covering a variety of topics like science, religion, politics, nature among others (Göbel, 2016) and are commonly used for enhancing learning.

A general definition could be the following, stated by Zyda (2005), "Serious game: a mental contest, played with a computer by specific rules, that uses entertainment to further government or corporate training, education, health, public policy, and strategic communication objectives," however, in the field of learning it is more specific; "Serious games can be defined as the use of interactive digital technologies for training and education in private, public, government, and military sectors" (Raybourn, 2014). It is important to note that serious games are not just video games "For example, serious games can include role-play experiences, and social-process, immersive simulations for exploring interpersonal development, adaptive thinking, combat tactics, emergency response, diplomacy, governance, health, education, management, logistics, and leadership." (Raybourn, 2014).

Part of the mentioned growth (Van Eck, 2006) has happened due to the decrease in the costs of the technologies required for their development, but also to the better understanding of their design for purposes other than entertainment. In addition, new generations have demystified the use of video games only as an entertainment tool and have adopted it as an additional strategy for training and learning (Squire, 2002; Squire and Jenkins, 2003). Training with serious games is more effective than training with conventional methods and it can potentially improve the acquisition of knowledge and cognitive skills (Wouters et al., 2013). These games can also support collaborative learning along with enhanced communication and should be a key resource in any learning environment since they have been proven to be highly effective (Corrigan et al., 2014); they have been also defined as games that have an additional purpose to entertain (Michael and Chen, 2005), however, this concept is recent; other theories were used to define the strategies adopted for the design and development of games in other environments and applications. Some of the terms used to define this type of applications were e-learning, edutainment, game-based learning and digital game-based learning (Michael and Chen, 2005).

Serious games for learning experiences in innovation and entrepreneurship education

In recent years, serious games have been used to support the development of learning experiences and learning processes, their use in many different areas of education has demonstrated this potential. Some works, particularly for the teaching and learning of innovation and entrepreneurship, have been reported in the state of the art; several authors have demonstrated the relevance of using active methodologies such as game-based learning (GBL) for entrepreneurship education (EE), where it is proposed that serious games can fulfill a supporting role in learning processes that involve how entrepreneurs think in conditions of risk, uncertainty, and unknowability (Neck and Greene, 2011; Bellotti et al., 2012; Nieland et al., 2021).

Some authors have explored the impact of serious games on the student's academic performance in an entrepreneurship course. The impact of serious games on the development of hard and soft skills in entrepreneurship using quantitative and qualitative methods has been explored by Almeida and Buzady (2023). An initiative that intends to provide tools, such as serious games, to understand and develop e-commerce that accelerates economies has been proposed (de Carvalho et al., 2019). The authors use qualitative tools to evaluate the impact of the serious game and the fulfillment of the purpose intended.

The integration of MOOC courses and serious games as part of an approach to widen access to content and tools that allow the training of entrepreneurship skills is described in Nieland et al. (2021), who mention two serious games, MetaVals, designed to support the topic of finances for entrepreneurs within a finance course at a business school environment, and Hot Shot Business, a web-based game where students learn how to open and run an enterprise from the very beginning. Another case regarding the usage of serious games is the one based on Nonaka's SECI model for the transfer of experiential knowledge in entrepreneurship, reported by Liberona and Rojas (2017), who use the SECI model to determine the features of the game

design, where the gameplay is focused on the activities related to the venture creation of a startup.

Although several of the consulted authors have reported the creation and use of serious games for learning in entrepreneurship, so far, none of them has described how these nor the different products and services that compose them support and complement the complete learning experience for EE. Likewise, it has not been stated how Serious Games Design maps the development of student learning outcomes and competencies.

Entrepreneurship capabilities involve acquiring various types of skills, some related to innovation as reported in Gedik et al. (2015), and others specific to entrepreneurship. Specifically, the innovative village serious game addresses the following types of skills:

- Observation: The game requires the player to pay attention to the details and clues around them to solve tasks that will lead them to identify the creaticides and win the game, which encourages the ability to analyze and identify patterns in the information.
- Collaboration: The game has mechanics that encourage the player to work as a team with other players, and teach them to listen to and understand others to achieve a common goal.
- Communication: The game challenges the player to communicate clearly and effectively with their teammates to solve puzzles and advance the story.

The article will explore the dynamic synergy between Learning Experience Design (LXD) and serious games. Serious games, known for their high user interaction, align seamlessly with LXD's goals. Using Innovative Village as a case study, designed for entrepreneurship and innovation skills, the article exemplifies how serious games can enhance learning within a diverse environment. LXD, an interdisciplinary field, emphasizes creating unique learning spaces, essential for effective experiences. Adopting a human-centric approach, LXD draws from various design disciplines to drive learners toward identified goals. This learner-centric focus is crucial for designing comprehensive learning experiences, including serious games. The primary aim is to uncover how serious games, integrated into LXD, elevate learning processes and outcomes, providing a nuanced understanding of their intricate relationship.

Materials and methods

Overview of the learning experience

This section focuses on describing the learning experience of an Interactive Design undergraduate student and describes the learning experience designed to strengthen competencies around innovation and entrepreneurship. It also reports in detail the design process carried out to design, develop, and evaluate the Innovative Village serious game as one of the service-oriented products that make part of the learning experience. With the aim for students to acquire a set of proposed competencies in innovation and entrepreneurship, EAFIT University has created a learning environment composed of the following service-oriented products: (i) a Massive Online Open Course (MOOC); (ii) a Blended Course that makes part of the Institutional Formation program (IF), which is a set of subjects that allow the EAFIT University student to develop competences that the University considers as priorities for its graduates (iii) Innovative Village, a Digital and Analog Serious Videogame; (iv) a Business Initiative Contest; (v) a set of Entrepreneurship and Innovation talks; and for the case of the Interactive Design Bachelor's students, (vi) an minor in Innovation and Entrepreneurship as well as a set of courses that use problem-based learning as methodology, this last one is called (vii) Medialab Challenges (see Figure 1).

The system that defines the learning experience visualized in Figure 1 starts by entering a student archetype; this archetype is defined by the student who is admitted to the University and considers that the learner does not have previous competencies related to innovation and entrepreneurship. After going through the system, the student exits with the specific output profile of a creative and innovative learner. The learning experience is made up of a set of transversal services and service-oriented products that are part of the curriculum (Medialab Challenges), in addition to another set of products and services taken at specific moments in the curriculum (IF and minor), and others which are transversal but are defined as extracurricular (entrepreneurship and innovation talks, business initiative contest, and MOOC).

Each product and service that composes the learning environment has a learning outcome; for the case of Innovative Village, the main competence is to identify and learn about the main actors that are part of the entrepreneurship ecosystem to develop innovative businesses.

Innovative village board game description

Innovative Village Board Game (IVBG) is a role-playing game with hidden identities that aims to reinforce skills, competencies and values associated with entrepreneurship as well as socializing basic concepts around it in a playful way. The game consists of 27 cards that represent seven characters: Cultural Entrepreneurs, Social Entrepreneurs, Traditional Entrepreneurs, Technological Entrepreneurs, Indecisive Entrepreneurs, Creaticides (Creativity killers), a Mentor, an Innovator, a Networker, a State, Investor, and a Multinational CEO. Guided by a narrator, the user-learners assume the roles of these characters; facing situations that arise in the real-life context of an entrepreneurship ecosystem, identifying the roles involved in it, and strengthening skills and competencies such as observation, collaborative work, problem analysis, decision making, creativity, among others. In this way, they experience the dynamics of the entrepreneurial process.

Innovative village video game description

Game design

Innovative Village video game (IVVG) design is based on IVBG but with adapted gameplay and mechanics to improve the experience using a multi-user serious videogame.

In a normal IVVG session, there are two groups: the "Entrepreneurs" who want to make the village progress, and the "Creaticides" who do not want the prosperity of the village and will do their best to prevent that from happening. At the beginning of each game, the players are given a random role that determines their group, each role has different characteristics and abilities, which they can use during the game. After this, the players choose a delegate who

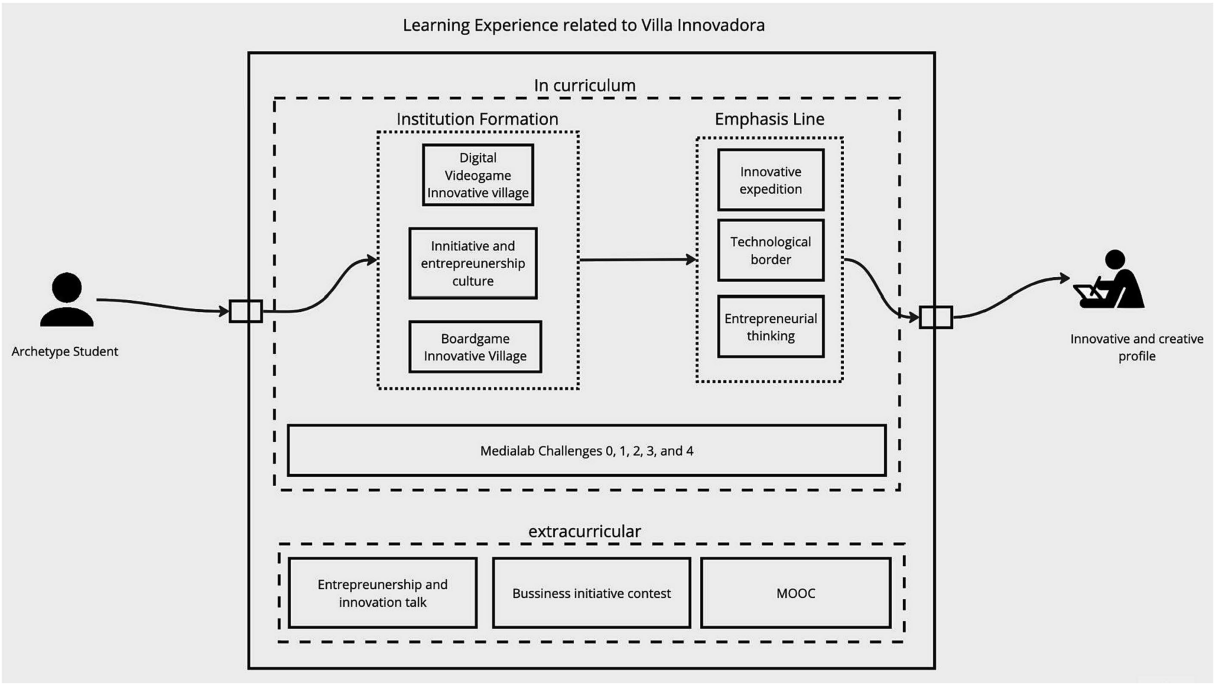

FIGURE 1
A learning experience designed for strengthening entrepreneurship and innovation skills.

TABLE 1 Mapping among minigames and learning outcomes.

Name	Learning outcomes
Start up	Understand the basic components of a startup: a problem, a need or an opportunity, an entrepreneurial team and the financial resources to reach a specific market.
Who wants to be an entrepreneur?	Interpret the elements related to the generation of ideas (e.g.,: creativity techniques, sources of ideas, entrepreneurs and their skills).
Financing	Identify the different sources of financing according to the stage in which the venture is located.
Entrepreneurship concepts	Classify the basic concepts in different entrepreneurship topics through an association game.
Technologies	Recognize new technology trends (e.g.,: Extended Reality, Artificial Intelligence, Internet of Things, Robotics).

introduces and argues the reasons why he or she should be chosen as a representative. Once this process is finished, each player can choose three places to appear in the village; depending on the player's role, he or she can do different activities; as an "Entrepreneur" you are allowed to move freely, performing tasks around different places on the map; while as a "Creaticide" you must sabotage different places on the map to prevent the village from advancing by disabling certain tasks with a command, so other users cannot solve it for a while. To uncover a sabotaged task, an extraordinary meeting which every player must attend and try to discover who the "Creaticide" is, to remove him or her from the entrepreneurial community, can be called. The exercise of finding the real identity of the other players stimulates critical thinking within the user-learners, especially the ones who play the role of entrepreneurs, who need to evaluate whom to trust and whom not to. As can be observed, this generates a collaborative and competitive environment between the participants.

Before the game session starts, the creator of the room, the first user who connects to the session, can decide whether to create In Game Events which are short events that occur during game time at a random or a set time and that are based on themes given by the creator of the room; the players are required to state their ideas to vote for the best one. The brainstorming, ideas presentation, and voting are activities that elicit the social skills of the players/user-learners. The person with the winning idea will get a reward either in-game or out-of-game, these rewards can be esthetic features for the character and/or a special power in the game.

Additionally, the game counts on different minigames which are distributed around the map, and that the "Entrepreneurs" must accomplish to win. These minigames address the strengthening of entrepreneurial competences through the development of learning outcomes. The mapping between the different minigames from IVVG and their corresponding learning outcomes is described in Table 1.

Game development

This section describes the development of the game using Unity Engine and considering the proposed game design. A 2D environment in a village where you can move freely, solve tasks and interact with different elements was created with a team of engineers. Figure 2 shows the user moving freely and interacting with other users in the gaming scenario.

The map of the game represents a city with different places associated with the innovation and entrepreneurship ecosystem. The

player has the purpose of winning the game by moving through these places and collaborating with his or her team, analyzing the Creaticides, or interacting with the other roles defined in the game. A map of the city that the player must go through in the game to accomplish the tasks related to innovation and entrepreneurship and fulfill his or her purpose can be observed in Figure 3.

In several places of the game map, players with a role other than creaticide not only have as objective identifying the creaticides and expulsing them from the innovative village, but also identifying the mentioned activities in Table 1 as a way to obtain benefits in the game while learning concepts and dynamics related to the innovation and entrepreneurship ecosystem. One example of the activities performed by the user-learner is shown in Figure 4.

For the development of Innovative Village as a multi-user serious game, it was necessary to create a multi-user architecture as it is observed in Figure 5:

1 User app: This node allows the user to view and interact locally with IVVG.
2 Main Scene Manager: This node is the application CMS (Content Management System) that allows the creation and management of the rooms, where the players connect.
3 Villa Innovadora (Innovative Village in Spanish) Server: This node is dedicated to the user control data, metrics preview, and user account authentication.
4 Firebase server: In this node, the real-time database stores the persistent data of the in-game data and user static data runs.
5 Photon Server: This node manages the shared state of the videogame, like in-game events, global complete tasks, users' position and rotation, and template data.

The methodology proposed for the design, development and evaluation of the serious games is described as follows:

- Analysis of the purpose and the audience: the player's profile and the serious purpose to which the videogame is focused are analyzed in this step. To define the player's profile the archetype format was used. The purpose on which a serious game is focused is an important design requirement since the gameplay and other content and interactions in the game must reinforce and emphasize the main purpose of the serious game. For the innovative village videogame, the entrepreneurship skills to training were identified, and then a mapping between these skills and videogame design decisions was made.
- Analysis of the context of design and use: The context in which the serious game is going to be used, for example, remote and distance learning, with or without a teacher monitoring the learning process is defined and analyzed. All these elements affect and define serious game design. In this aspect, Klabbers (2006) refers to designing considering this step as design-in-the-small (DIS) and design-in-the-large (DIL).
- Definition of the mechanics of the serious game and mapping with the serious objectives set and the purpose of the game. At this point, the same categorization in entertainment games and proposed by Schell (2008) is applied to the design of the videogame.
- Identification of the narrative, aesthetic, and technological elements that will reinforce the mechanics. One of the fundamental purposes of mechanics in learning games is to motivate the students and quantify their progress, so these design elements aim to reinforce the mechanics that have this main purpose.
- Development of the videogame: The design requirements of the videogame were described in a one-page design format proposed by Stone Librande (Kapp, 2013), detailing the interactive, narrative, and aesthetic layers of the videogame. Using this document, the development team used agile methodologies to perform the development of the game, defining activities to implement each one of the requirements defined at the design stage. The technologies used and the architecture implemented are described in Figure 5.
- Validation and evaluation of the design concept through the development of a low-quality prototype of the serious game, and the development of a playtesting session with experts and players. Several sessions of testing were performed to evaluate the gameplay of the videogame and the usefulness perception of the game in the learning process. After each session a debrief of the users' comments was made and improvements in the videogame were defined.

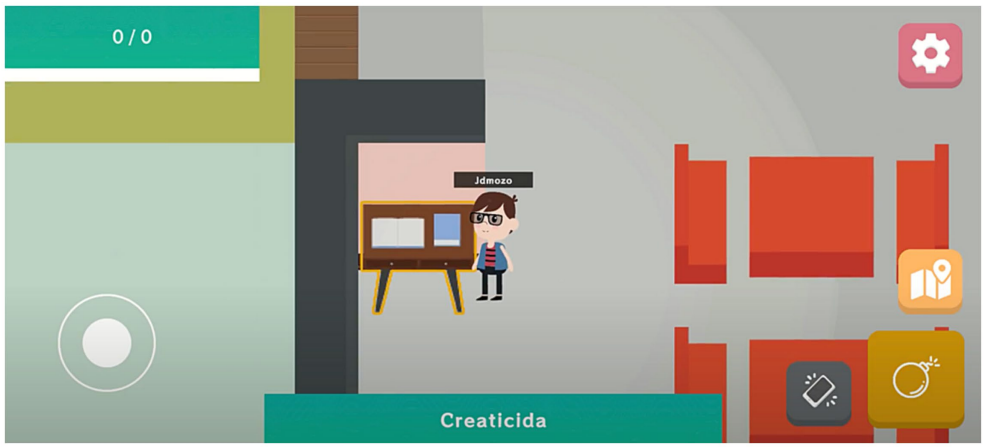

FIGURE 2
User moving around the game stage.

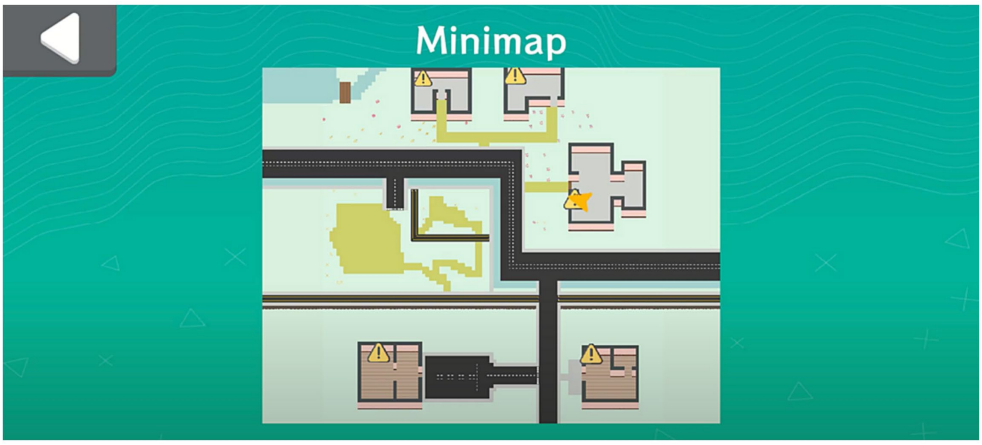

FIGURE 3
Places in the map related to innovation and entrepreneurship.

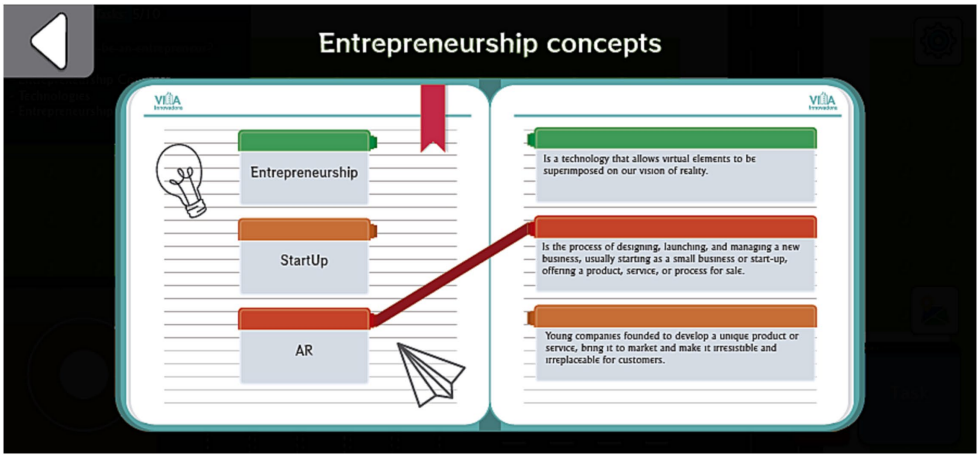

FIGURE 4
Entrepreneurship concepts minigame gameplay.

Experimental setup

To determine the video game's effectiveness in strengthening the competences associated with entrepreneurship, such as team collaboration and competition, a quantitative and qualitative experimental test was developed to determine the behavior of the players in the game, as well as how the game's purpose and roles affected the mediation of these behaviors. In the experimental test, a control group and an experimental group were formed to contrast the behavior and performance of the players during the gaming activities. The control group had the objective of using the IVBG, and the experimental group used the IVVG.

In the control group, 29 students from the Initiative and Entrepreneurship Culture course at EAFIT University with an average age of 22 years participated. Every subject had previous experience playing multiuser online games or board games involving multiple users. 50% of the players were female and the other 50% were male. 45% of the subjects had no prior knowledge of topics related to innovation and entrepreneurship and the remaining 55% did have prior knowledge related to these topics.

In the experimental group, 16 students from the Innovation and Entrepreneurship course at EAFIT University with an average age of 20 years participated. All of them had previous experience playing multiuser online games or board games involving multiple users. 55% of the players were female and the other 45% were male. 60% of the subjects had no prior knowledge of topics related to innovation and entrepreneurship, and the remaining 40% did have prior knowledge related to these topics.

Results

This section reports the results of the experimental tests carried out by the players. Table 2 shows the results of the control group and Table 3 the results of the experimental group. These results are associated with the responses of two surveys that were carried out on the participants of each one of the groups, considering their perception during the gaming experience.

These surveys also allowed to determine the perception of the students who used the videogame and the board game. Tables 1, 2

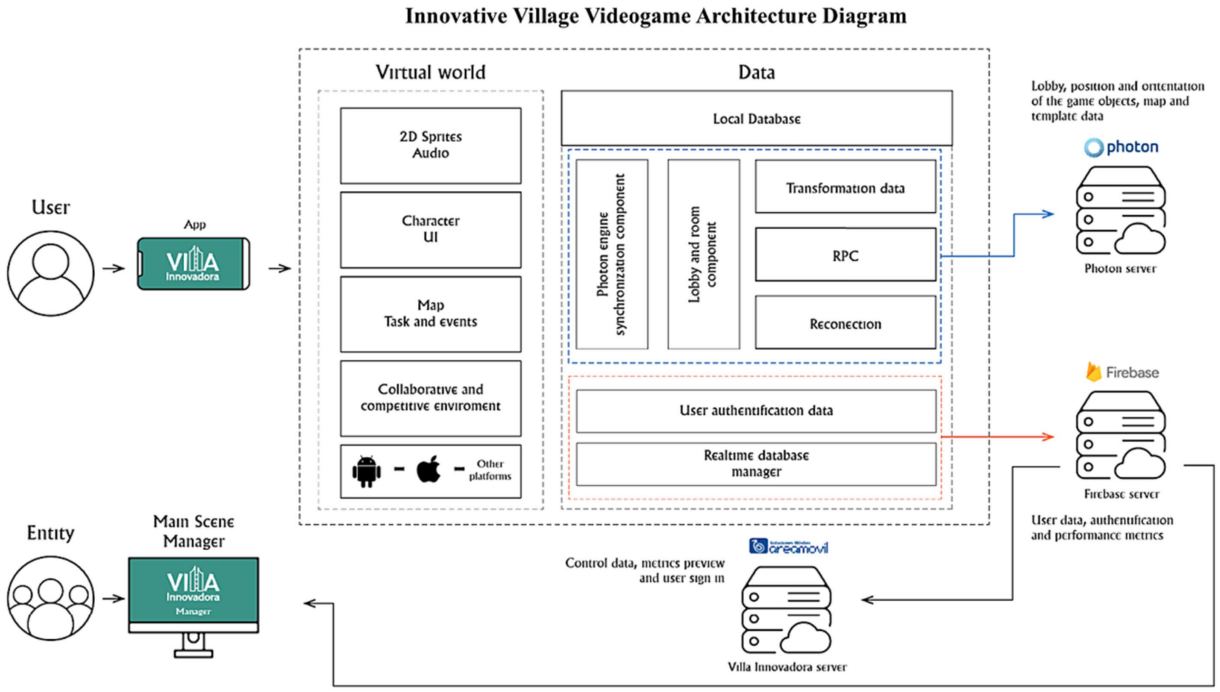

FIGURE 5
IVVG architecture diagram.

summarize the results of both groups, considering the understanding of the game's purpose, mechanics, and gameplay. This study was particularly interested in identifying if the gamers were able to recognize the gamers they had to collaborate, cooperate, and compete with.

Tables 2, 3 report that a higher percentage of players perceived that it is easier to understand the purpose and mechanics of the game in the video game than in the board game. In both games, the students recognized that they could collaborate and socialize with other classmates.

Additionally, 44% of the players considered that the video game promotes collaborative behaviors and activities among players, 35% acknowledged that the video game promoted competitive activities and 25% considered that the game encouraged cooperative behavior. Correlating the percentage of players who considered that the game was competitive, it was found that the role of creaticides holds an important relationship with this perception.

Discussion

A learning experience could be defined as the interaction between a learner with a learning environment developed as a system of interconnected services and products; therefore, LXD must consider students as user-learners and design learning environments as well as service-oriented products that can locate them at the center, always thinking in their user experience together with the competencies or learning outcomes to be achieved. Consequently, three steps must be followed for designing learning experiences; (1) first, know the learner and establish the output profile which means the profile with the acquired skills (2) second, design the learning experience taking into account the micro, meso, and macro dimensions, and (3) third, assess the competencies and learning outcomes.

To know the learner and establish his/her profile, it is necessary to create archetypes. In this case, the first one is the learner, the entry profile that interacts with the learning environment; this archetype needs to be created taking into account his/her background knowledge and motivations regarding the main content, his/her preferences about media and technology, and the context of use characteristics. The second one is the output profile, which is the goal of the learning environment, it is the learner archetype that comes out of the learning experience; in this case, the designer needs to establish what the new knowledge acquired by the learner will be, what he/she will be able to do with it and what the practical contexts where the learner will apply this new knowledge will be. The entry profile responds to the UXD practice, and the output profile responds to the competencies and learning outcomes for which the learning environment is going to be designed.

Thereafter, the learning environment must be designed to define the micro, meso, and macro learning experience. The micro experience is the interaction between the learner and one of the products that compose the environment, in this case, it is necessary to design the products with UX methods to guarantee a significant and satisfactory experience; the meso experience is the connections and transits between the different service-oriented products and services, this can be implicit or explicit, it will depend on what the goals of the designer are; and the macro experience is the learning environment, a system of connections between products and services. These three dimensions of the learning experience are fundamental to understanding the reason why each product and service is adequate for the entry profile and how each one contributes to the learning outcome for the output profile, as well as how the learner is going to connect the products that are at his/her disposal within the learning environment to improve his/her experience. The products and services need to be designed to understand both profiles.

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TABLE 2 Survey statements and responses of the students that participated in the control group.

No	Statement	1*	2	3	4	5
1	"I understand what my role is in the game and what I should do."	0	4	5	0	20
2	"It is easy to understand how to configure and start the game."	0	10	10		9
3	"I understand the purpose of the game, which means how and when I win in the game."	1	1	8	19	0
4	"I am clear with whom in the group of players I should compete with and whom I should collaborate with."	0	0	0	2	27
5	"I am comfortable with the individual and team tasks assigned to me."	0	11	9	6	3
6	"I am clear about how I can participate and what my contribution is during the game."	0	0	3	3	23
7	"The game allowed me to socialize with my classmates."	0	1	7	5	16
8	"For most of the game, I felt that my team and I would achieve the goals and purpose of it."	1	1	11	5	11
9	"The decisions I made in the game allowed me to protect a player"	3	4	7	3	12

*Likert Scale: 1 "Strongly disagree"; 2 "Disagree"; 3 "No opinion"; 4 "Agree"; 5 "Strongly agree".

TABLE 3 Survey statements and responses of the students that participated in the experimental group.

No	Statement	1*	2	3	4	5
1	"I understand what my role is in the game and what I should do."	0	0	0	6	10
2	"It is easy to navigate around the map within the game."	0	0	1	5	6
3	"It is easy to identify the minigames within the map."	1	0	0	13	3
4	"It is easy to understand how to configure and start the game."	0	0	0	2	14
5	"I understand the purpose of the game, which means how and when I win in the game."	0	1	0	3	13
6	"I am clear with whom in the group of players I should compete with and whom I should collaborate with."	0	0	0	1	15
7	"I am comfortable with the individual and team tasks assigned to me."	0	1	1	6	8
8	"I am clear about how I can participate and what my contribution is during the game."	0	0	1	3	13
9	"The game allowed me to socialize with my classmates."	0	1	7	5	3
10	"For most of the game, I felt that my team and I would achieve the goals and purpose of it."	0	0	0	5	11
11	"The decisions I made in the game allowed me to protect a player"	1	1	1	1	12

*Likert Scale: 1 "Strongly disagree"; 2 "Disagree"; 3 "No opinion"; 4 "Agree"; 5 "Strongly agree".

In LXD, assessment methods can be used as a learning analytic since every product that composes each learning environment can provide data for analysis, for this reason, it is important to think in the way of evaluating; considering assessments, more than a rating system, as a data obtention mechanism to improve both the learning environment as well as understanding where learners have better results and where they have opportunities for improvement; consequently, these assessments can be used to improve the products, services or contents, thinking always in attaining the established competencies and learning outcomes for the output profile. This data can be combined with UXD methods such as surveys, Likert scales, or interviews to improve the products, the services, and the system (see Figure 6).

Each product has to be designed with a purpose inside the learning environment, always using UXD methods for improving the learner experience and evaluating the interaction between the product and the learner in each iteration. The experience must be evaluated in its three configurations of experience, in each one, it is necessary to use UXD methods and evaluate competences for achieving the learning outcomes, the first one could be used to improve the experience between the products, services, or system and the learner, and the second one can be used to improve learning to achieve the competences and the learning outcomes; micro, meso, and macro experiences could be used in the same system (Figure 7).

The scope of the proposed experimental design sought to analyze the serious game considering the students' perception from various points of view. The questions included in the student perception evaluation instrument were aimed at evaluating the usefulness of serious games in collaboration, observation, and communication entrepreneurship soft skills. However, it is recommended to identify an instrument that allows evaluating the development of these skills using a longitudinal study, so that not only the perception but also the acquisition of these skills could be defined and measured. This is proposed as future work of the research.

Conclusion

Learning Experience Design is about designing products or services that compose a system of connections between learning as a process and the key competencies for which it is designed, when the user-learner interacts with the learning environment, this is what produces the learning experience, and it is for this reason that it is necessary to argue that LXD is about designing products and services, especially service-oriented products. This research contributes from the design perspective by giving an example of a product designed as a part of a learning environment. Innovative Village serious game provides insights into how the design process

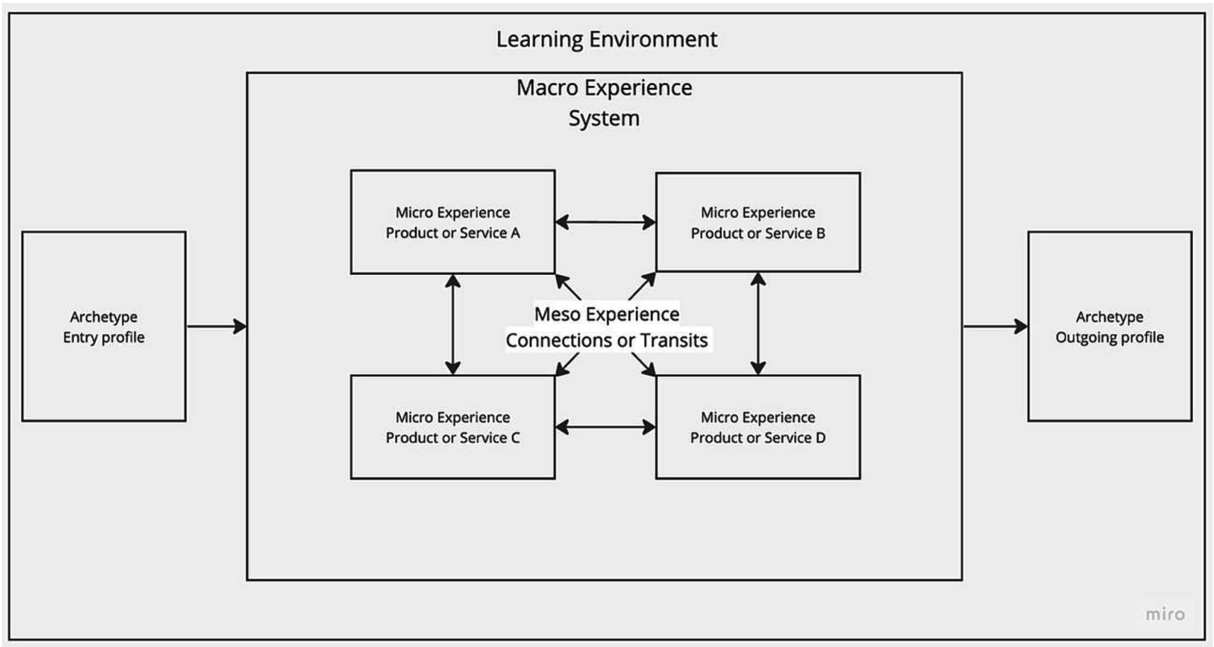

FIGURE 6
Learning environment.

must be, what is the use of the product in the system, and which competencies must be kept in mind to achieve the learning outcomes, it also permits evidence an evaluation of the experience by using a survey as a User Experience Design method. The second contribution of this research is the creation and supply of a framework for designing learning experiences where the user-learner is placed at the center, using three levels for the experience and using assessments as a mechanism to improve the learning experience itself. This framework should be applied from the earliest stages to assess its significance and effectiveness, in addition, it needs to be applied within a learning environment able to be tested with user-learners to acquire data and support the learning analytics processes; this is early research that can be used and tested by those interested in creating learning environments in formal, non-formal and informal education.

Data availability statement

The raw data supporting the conclusions of this article will be made available by the authors, without undue reservation.

Ethics statement

The studies involving humans were approved by Comité Institucional de Etica en Investigación, Universidad EAFIT, Yaromirde Jesus Muñoz Molina: ymunoz@eafit.edu.co, Jorge Mauricio Cuartas Arias: jmcuartasa@eafit.edu.co, Nicolas Pinel Pelaez: npinelp@eafit.edu.co, Ricardo Mejía Gutierrez: rmejiag@eafit.edu.co, and Maria Paula Pérez Gómez: mperezg1@eafit.edu.co. The studies were conducted in accordance with the local legislation and institutional requirements. The participants provided their written informed consent to participate in this study.

Author contributions

CD: Investigation, Software, Validation, Writing – original draft, Writing – review & editing, Conceptualization, Funding acquisition, Methodology. NA: Conceptualization, Validation, Visualization, Writing – original draft, Writing – review & editing. MG: Conceptualization, Writing – review & editing. JMC: Investigation, Project administration, Writing – original draft. SA: Data curation, Software, Writing – original draft. JMO: Data curation, Software, Validation, Writing – original draft.

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Conflict of interest

The authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

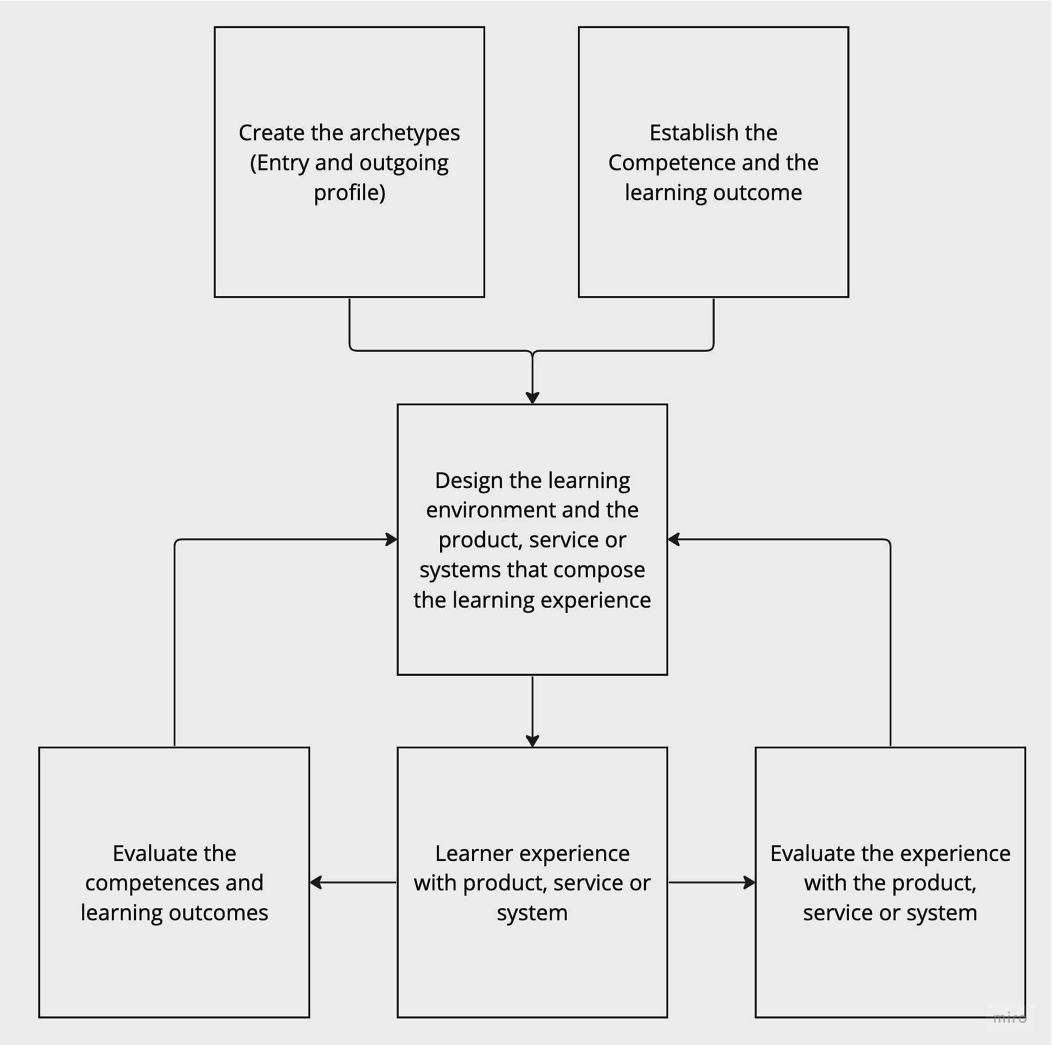

FIGURE 7
Learning analytics for improve the experience and the learning.

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