

Design Thinking for Training with Serious Games: A Systematic Literature Review

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Abstract

Serious Games use game strategies to encourage participants to make decisions and face challenges in a training environment; the more interactive the game, the more engaged the participants are with the content. Moreover, the best way to train is to simulate and identify scenarios for decision making, recreating situations, and strategies for learning. The Serious Games for training have this purpose. A Serious Game for Training can be refined with a game narrative, a methodology centered on the player to present independent and straightforward scenarios, giving solutions through the game story. The challenge is to rethink a unique narrative according to the individual player's experience. The present systematic literature review aims to answer which are the benefits of using Design Thinking for serious game narratives; the benefits of learning theories; the Design Thinking benefits for innovative solutions; and how game design elements can create an engaging Serious Game experience.

Keywords: Serious Games, Training, Design Thinking, Narrative

1. Introduction

This paper presents an SLR that synthesizes research and findings on the applicability of Design Thinking (DT) to develop a Serious Games (SG) narrative for training. The objective is to research if the player can better understand the narrative during his journey with this association.

Speech, movement, and action as vital elements for storytelling and engagement for different SG users [18][20][30] are still an open question, which suggests a limitation of the narrative's competence for not designing a real drama and not having a pedagogical concern to reflect the real individual player's routine and interests. The problem identified is a lack of user motivation caused by standard SG, and how to promote engagement using a unique narrative method.

Learning theories to explain the dynamic between teaching and the cognitive evolution of individuals can be associated with game design elements, such as mechanics, rules, goals, and feedback, to elevate the game design to a personalized level [13][30].

As a result, the central impulse to be addressed by developing a personalized method is early in-game engagement and motivation with a compelling narrative, which DT can well define as character customization for empathy and narrative mapping for engrossment.

The existing academic SLR on the use of SG for training was examined to answer the following research questions:

- *RQ1: How can DT methodology improve SG narratives?*
- *RQ2: How does the learning theory approach benefit an SG?*

- *RQ3: What are the DT benefits for innovative solutions in SG?*
- *RQ4: How can the game design elements create an engaging SG experience?*

The protocol for SLR proposed by Kitchenham [12] will be followed and presented in three phases:

- Planning: Involving research question and review protocol.
- Conducting: Identify the existing research, followed by paper selection and extraction.
- Reporting: Papers' analysis and evaluation.

2. Research Background

This section describes the main concepts related to the research question.

2.1. Training with Serious Games

The design of a Serious Game narrative for training contemplates the components of learning and interactivity for training, intending to comprise the short stories and epic adventures that we experience within a game and make each journey unique and special, using the gameplay to tell the experience.

SG as game-based learning and instruction, which can be seen as a particular application domain of gamification as a general approach, appears to be at the small intersection of gamification, learning, and edutainment, and thus is a sub-branch of game-based learning [19].

In this sense, emotions, and thus cognitive aspects that the story evokes in its audience, can be expressed through serious storytelling or serious narrative as a basic framework to differentiate them from the others [17].

One alternative is to examine SG affective and cognitive facets of learning engagement during gameplay [10] to increase player participation and foster social and emotional learning through narrative alignment, actions, and plot.

It must be noted that, with a unique narrative for an SG, not all players can understand in the same way the significance of the challenges, objectives, game world, journey, and consequences.

A possible approach is character customization for empathy and narrative mapping for engrossment. The objective is to discover a personalized conversation across the different chapters of the game.

Learning gaps or problems regarding the inability to map narrative issues learned online should be a stimulus to incorporate lessons. Moreover, gameful learning experiences can better motivate and engage if personalized [22, 23].

Serious Game refers to full-fledged games, such as complete virtual environments with avatars, instead of gamification, which refers to game elements [2]. Play is what distinguishes the SG's experience as a game.

A game design framework example that seeks to answer the descriptiveness-prescriptiveness imbalance is DPE (design, play, experience), a core methodological support in formal game design thinking and game design theory constructs [21] [31].

So, what differentiates the DPE framework is a combination composed of *social* game elements [27]. Those social elements are related to the players' behavior and needs, objectives, rules, and feedback.

Novel design solutions built on players' experiences can be based on social dynamics: a feeling of belonging, awareness, engagement, and empathy. Hence, the "sense of place," evoking our feelings and emotions, can provide effects on learning outcomes and stimulate active learning [25].

For this purpose, empathy to develop an SG narrative relies on frequent participant feedback on the individual intervention characteristics [9] for a deeper understanding of the factors influencing the intention to use SG as a training method [16].

2.2. Serious Games Narrative

Different game elements, mechanics, and features within the SG narrative are customized for a better experience. Avatars create scenarios to pay attention to, but the customization features are more representative and influence individual challenges.

An Serious Game developed for people living with inflammatory bowel disease was associated with simple instructions ("go immediately to the toilet") to create scenarios and dangers in which the individual is forced to 'choose' between their disease and their life [9].

According to the authors, while the personalized avatars did show signs of stress and illness during intense narrative sections, it is possible that the customization features in this application were too basic to have an impact. Learning aspects, such as the capacity to reflect on the content and clearly understand the information, are crucial attention points in-game mechanics.

According to a research interpretation, embedding content in the game world or narrative (for example, a summary or feedback screen) does not guarantee content engagement. The findings from the case study suggested that gameplay behaviors and reactions demonstrated individual play preferences in perceiving the game world, narrative, and mechanics (e.g., platform or puzzle) [10].

The challenge is creating a deeply engaging experience, focusing the game's narrative on a compelling customer journey, gathering new insights, and revisiting stories [11]. Another perspective is the explicit narrative. It means storylines indicate information expressed clearly and understandably, while an implicit narrative manifests itself more in actions than words.

Storytelling methods include linear and spiral narratives [6]. The linear narrative approach counts the facts in chronological order. On the other hand, the spiral narrative starts with the same action that ends, making it a feature.

Narratives connect a set of story modules to form a storyline. To make a compatible and enveloping storyline, an individual story module can represent a training objective for story modules in the same category.

Features in terms of interdisciplinarity and multimodality can affect their players, apart from design and technology [18][21]. Therefore, it is essential to know if the player wants to improve his knowledge, and it involves tracing what motivates a pleasant experience.

User types can fit SG if it is possible to develop a test to discover each player style and subsequently merge them. It means to discover the motivation or the reason why the player feels optimistic about the learning effects. Once a player is playing, there is an opportunity to create connections between the environments and interact with other players to make decisions.

2.3. Design Thinking for a Personalized Narrative

Design Thinking provides a reliable way to go from an unproven concept to a validated solution, producing a beneficial outcome: a method for SG to design and develop an empathic narrative for training and awareness.

A suggestion mentioned in the literature is to improve players' motor, cognitive, ability, and personality traits when designing personalized tasks for multiplayer settings [26], solving problems with game-like concepts. DT as a mindset and process emphasizes problem-solving practices and makes them more manageable. DT can be considered a creative approach for storytelling development for specific users [17].

As an example, an SG applying DT was developed to generate creative solutions for business following the steps of (i) understanding the target audience and the context; (ii) defining learning objectives; (iii) structuring the experience; (iv) identifying resources and applying gamification elements, and (v) evaluation [13].

Another example that evolves the personalization of narratives is a mobile tour guide application that provides narratives tailored to the current physical location and the player's profile [5]. In general, game elements of these approaches are committed to a thorough user-centered approach, active participation of users in the design process, evolution in the design process, early and continuous prototyping, and frequent testing in context [2] [19].

Defining the narrative according to the user preferences promotes the assessment findings that will aid in the validation of the solution to the study's problem: the design of personalized emerging narratives for SG to motivate users for training. Looking at how learners can be

motivated to create engaging learning environments, game thinking combines game design and DT to help build engaging experiences [1] [11] [28].

According to the Hasso Plattner Institute (HPI), School of Design Thinking models define a 3-phase design process: (1) inspiration, (2) ideation, and (3) implementation [8]. Before implementation, creating an artifact is necessary. A game prototype simulator to measure the performance of a game designed by DT is a practical application. The objective is to evaluate whether students make productive choices in new situations [3] [14]. From the ideation to the prototype test, interviews, observations, and literature reviews can evaluate the narrative personalization process to understand the findings and improve the game design.

3. Planning

During the SLR's planning phases, we identified that it was necessary to review the literature seeking to answer the research questions (**Figure 1**):

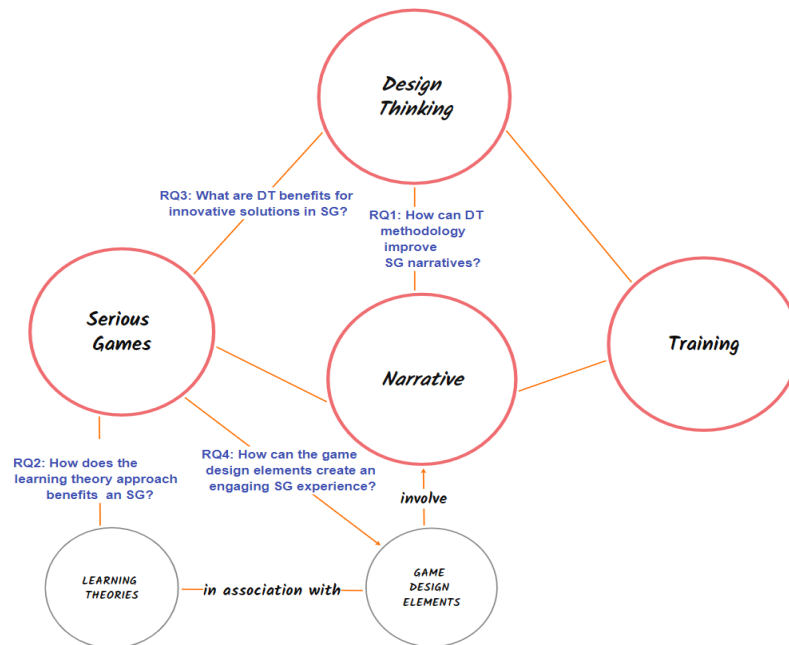


Fig. 1. Research questions related to the paper's keywords.

When the full article text was not available in EBSCO's Discovery Service (includes Scopus and Web of Science libraries), the researchers accessed the respective publication database, as follows:

- ACM (<https://dl.acm.org/>)
- Elsevier (<https://www.elsevier.com>)
- IEEE Online Library (<https://ieeexplore.ieee.org/Xplore/home.jsp>)
- SpringerLink (<https://link.springer.com/>)
- Taylor & Francis (<https://www.tandfonline.com/>)

4. Conducting

The automatic search was divided into three phases:

1st phase: The protocol was conducted, containing the research scope keywords in the following search string: “serious games” and “training” and “design thinking” and “narrative”. Then were selected article abstracts in prominent academic journals and conferences in the EBSCO research database (accessed on 13 January 2022), which is available in the library collection. The filters used to expand the search were “full article text” and “equivalent subjects”. Another filter adopted was “peer-reviewed” articles in English selected by abstracts from January 2000 to January 2022, resulting in 79 articles.

2nd phase: After reading the abstracts from the 79 articles, 49 were selected by the inclusion criteria of secondary and tertiary studies (revisions review) and studies that addressed the intersection of narrative, design thinking, and serious games for training in the objectives. Furthermore, a *snowball* sampling of the 49 articles references filtered more eight articles with the intersection of same terms in the objectives, resulting in 57 articles.

3rd phase: From the total of 57 articles, the exclusion criteria included out-of-scope articles and gray literature (conference abstracts, presentations, proceedings, regulatory data, unpublished trial data, government publications, reports, white papers, working papers, internal documents, dissertations/theses, patents, and policies and procedures). The full-text out-of-scope sub-selection from the 57 articles was performed in January 2022, resulting in 30 articles. (Figure 2)

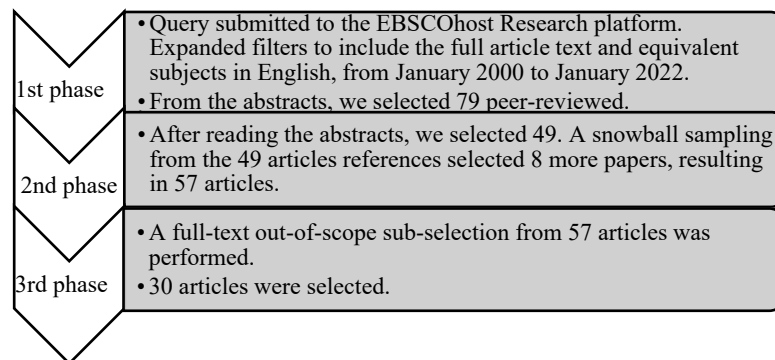


Fig. 2. Paper's selection phases

The 30 final articles are composed of papers published in conferences, journals, and book chapters (Figure 3).

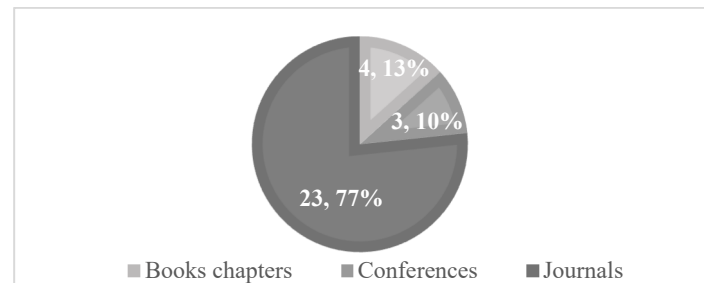


Fig. 3. Papers and percentage by publication type.

It is worth mentioning that most of the 30 selected papers are concentrated between 2018 and 2021 (Figure 4).

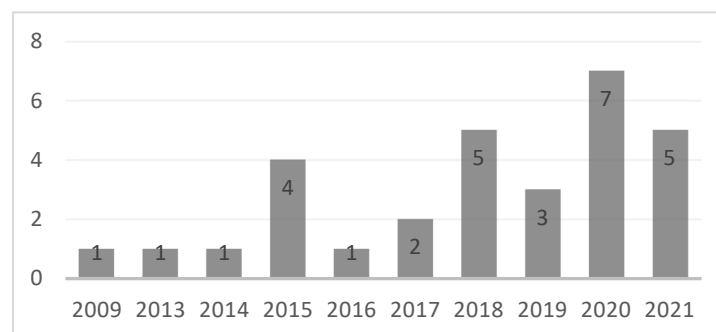


Fig. 4. Articles per year.

After defining the search string and testing it, primary studies were selected, and the inclusion and exclusion criteria were applied. The full-text papers were read, and data was extracted to answer the research question.

For the evaluation of the studies selected—30 articles total—for a quality assessment, we followed some rules to be followed, such as:

- If the study is clearly stated,
- If participants and observational units are well defined,
- If procedures for data collection are well discussed,
- If the findings are resonant with other studies.

Data extraction and quality assessment were performed from the primary studies to conduct a synthesis of evidence.

Data extraction is intended to collect all the information that can be used to answer the research question and the study quality criteria.

5. Reporting

The purpose of this SLR is to discuss and answer the research questions and present a data synthesis and interpretation of the findings.

5.1. RQ1: How can DT Methodology Improve SG Narratives?

Game features have many benefits for players, primarily increasing retention by capturing the interest in continuous learning.

An empathic method can recognize users' preferences for story events and positively improve user satisfaction and experience [4]. As a result, a personalized narrative can represent players' senses and set expectations.

The usefulness of Design Thinking to prototype is perceived in a study using BABLR when testing the ability to recreate real-life learning in existing health curricula [14] with empathy for the story's characters and imagination of the plot in narrative transportation.

Even for a different purpose than Serious Games, personalized storytelling makes sense to present the experience of a given story from a uniquely personal perspective, not from the average preferences of their audience, which does not guarantee satisfying narrative experiences for its members [4].

In a nonindividual way, the game “The Island” [19] allowed the development of creativity, critical attitudes, and systemic thinking in the role of a social entrepreneur who must manage resources, not only reducing waste but also creating energy, employment, transport, housing, and telecommunications in a clean, economic, and sustainable way.

Another application is based on the principles and stages of Design Thinking, focusing on the difficulties of its implementation in a company for the innovation process [13], proposing a gamification experience: using the persona and the empathy map to generate relevant results and generate solutions during the game to deliver value to the user.

In the education domain, a study [24] applied a DT approach (intangible) to knowledge-sharing research (tangible) to propose feasible research directions on how an invisible research concept can be executed as a tangible design application, through creative and innovative storytelling.

Design Thinking provides a structured methodology that allows a diverse range of teams to go through all phases and, as a result, learn in different ways than they would otherwise. The objective is to create a compelling narrative around the SG user's experience. With this objective, designers can develop a deep and emotional understanding of the user's motivations and needs.

5.2. RQ2: How Does the Learning Theory Approach Benefit an SG?

This section presents some learning theories applied to SG for training (**Appendix A**). In association with DT, the purpose of learning is to go from the abstract to the concrete, beginning with finding ideas, testing prototypes, observing users, and making a synthesis of ideas.

As a learning theory, the Instructional Design approach underlines that the roots of gamification are in the psychology of games and the field of game design, where the learner is cognitively open, motivated, and engaged [19][25].

Insightful instructional design can be achieved if the learning objectives are clear, and the material is appropriately designed for the target audience. The cognitive theory supports personality, emotions, and behavior as fundamental aspects of serious storytelling [17] [26], re-defining the story and plot as a sum of cause-effect events.

A possible application to the SG is the combination of active learning and DT in collaborative workshops [29] to meet the needs of a specific group of users to improve the narrative of the SG.

To that end, constructivism theory, based on the principles and stages of DT, focusing on the difficulties of its implementation with the teacher acting as a facilitator of the learning process [13], is a view of learning based on the principle that students construct knowledge through an active and mental process of development. The learning experience is more of a cycle that the audience goes through iteratively. Most of the audience follows a pattern of observation, synthesizing, idea generation, and prototyping.

Social Constructivism by learning psychology is a personal construction of reality. In SG for training, the objective is to interact with others actively to construct learning artifacts. In the Education domain, learning DT as a strategy to solve problems [3] can be interesting to test alternative designs for problem-solving and choose a behavioral outcome of effective instruction.

The results from the SLR show that the innovative SG's method for training can be based on different theories of learning, such as Cognitive or Constructivism with an emphasis on personal experience when constructing knowledge in different domains, such as Management Education [16], Cybersecurity Awareness [22], Public Policy Arena [23], Medicine [26], Sustainable Development [29], among others, is helpful.

5.3. RQ3: What Are DT Benefits for Innovative Solutions in SG?

This section presents ways of using DT for innovative solutions in SG (**Appendix B**). From the literature review, domains such as Education, Innovation Process, Health Psychology, and Sustainable Development are examples of successful applications of DT.

Other alternative methodologies are mentioned to emphasize the interest in practices to customize or personalize the stories in an SG context. For those emotionally engaging experiences that offer immediate feedback and are highly compatible with human learning [23], SG can recreate mental models and motivate the learning environment for training once the learning objectives are defined.

At this opportunity, the person's creative ability to overcome the difficulties identified in different domains is supported by the DT phases to provide innovative solutions. DT takes part in it, developing a creative approach.

Therefore, to develop an innovative SG with DT to generate convergent ideas, intending to capture the basics of experience and interactions is necessary to make it tangible through a prototype, constantly striving for user feedback. Under this aspect, Personality Modeling and Preference Modeling create personalized narrative experiences, which can be seen as examples of engagement, encouraging players to progress in the ongoing story.

In the Innovation domain, an SG designed to facilitate DT's use for innovation provides a pleasant and motivating learning environment for collaborative multidisciplinary work [13]. The individual's or group's creativity applies a DT approach because of the knowledge-sharing study in the co-creation act [24][26]. However, innovation challenges depend on the participants' social aspects [28].

Other domains such as sustainable development, management education, and public policy SG exemplify training domains of innovative concepts compatible with human learning [16] for collaborative interaction. Participants follow prototyping in a co-creation process, coming out of the abstract and going into something tangible in a guiding process to achieve a goal-oriented project [3] [14].

As a co-design process, the DT methodology helps to work out the learning content [15] [29] with the participation of all players. Creativity, co-creation, co-design, and collaborative learning are the perceived benefits of using DT to develop innovative solutions in an SG.

5.4. RQ4: How Can the Game Design Elements Create an Engaging SG Experience?

Game thinking often appears to be not sufficiently considered in many gamification approaches, thus reducing it to the bare provisioning of points, levels, and leaderboards [7] [19]. In a complementary way, DT can be used to redefine character, plot, and theme for the game's narrative design. Game Design Thinking offers how they could be applied outside of an entertainment context to solve problems.

Within this approach, social game elements must be considered, given that students are interested in interacting with others through SG. Namely, social interaction, engagement, feedback, and increased learning suggest that gamification is particularly suited to learning approaches such as social constructivism [2]. In other words, SG elements can be classified as "game design interface patterns" for social interaction. Ideation of artifacts or elements of interaction design of interpersonal relations impacts the subjective experiences, specifically regarding "social game elements".

Game elements are the main constituents of games, which can be differentiated into interaction elements and rating elements [19] and represent a role or behavior to be evaluated by social aspects.

A primary objective is a learner-centered approach based on user experience, gameplay, and participation. Obstacles to gameplay can be contoured by the active participation of users in game design. In different domains, the main objectives of social game elements are knowledge dissemination, interacting with the stakeholders, and performing meaningful activities in the respective contexts [27].

Learning theories associated with game design elements can improve the interaction between the player and the mechanics and systems. For example, the rules, goals, interaction, narrative, motivational attributes, and challenges are the elements to be used in interactive problem-solving.

Game design elements involve the narrative in an SG to tell the story and how it turns the player into a part of the game's interface. Demonstrating a game's story with its gameplay and its levels and ambiance depends on how to tell a story through everything that encompasses the player's experience.

Nonetheless, the game design development process is iterative, with repeated phases of testing and revision. The result is the gameplay, which describes the ease with which the game can be played, the number of times it can be completed, or its duration.

6. Conclusion

This study shows that the Design Thinking methodology can collaboratively improve the narrative of SG for training, particularly in the sense of co-creation activities. Co-creation motivates players to find solutions to the problems and raise awareness.

However, SG to learn, practice, and assess competencies is not easily achieved by traditional training methods. However, a personalized narrative based on DT practices is presented to facilitate engagement in an SG simulation game, motivating compelling experiences in users.

SG for training develops skills and motivation to play for learning, and the present study shows that the most frequently applied theories for this purpose are Constructivist Theory and Cognitive Theory.

The objective is to associate de collaboration and co-creation initiatives with narrative improvement in a practical combination of theories and DT methodology to reveal how to improve the narrative.

The learning theories mentioned above are based on internal psychological processes involving motivation and environmental perception. In addition, the player experience is strategic for game design and the DT to create solutions.

From the empathize phase, following the problem's definition, to the ideation phase, the player's experience can iteratively improve gameplay and narrative. Interactive prototypes are crucial to test if the narrative as a personalized proposition is well done.

Knowledge-sharing in an iterative way makes better storytelling possible through interdisciplinary collaboration and a creative approach.

In this way, the game producers do not necessarily plan the actions and plot but rather let them happen randomly while playing.

One opportunity is to use social game elements within the gameplay to develop a social SG for training to enable more participants to persevere on the challenge by creating social spaces and experiences in games that lie outside of the core gameplay experience.

Further studies need to be conducted using an "emergent narrative" with a non-linear or pre-planned story structure to build up over the interactions in a pre-existing SG.

The limitations involve the best combination of narrative and logic in which stories emerge bottom-up from characters' behaviors in an SG story, where the game does not allow a linear development or a single correct design.

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Appendix A. Learning Theories for Serious Games

Ref. #	Learning Theory	Serious Game elements	Approaches	Recommendations	Domain
[2]	Social Constructivism	Game design interface patterns	Usefulness of game elements	Prototype with DT	Education
[16]	Constructivism Componential Theory of Emotions	Play in the learning process	Collaborative learning for innovative SG	Choose more innovative participants	Management education
[17]	Cognitive Theory	Human beings' response to narrative flow, time-space, structure, characters, plot, content, interactivity, and cause-effect	Serious storytelling Serious narrative	Discuss whether serious storytelling is a new way to tell stories	Wellbeing, health, medicine, psychology, education, ethics and religion, e-leadership and management, traditional media
[19]	Cognitive Theory (Instructional Design)	Interaction elements Rating elements Motivation	Teaching and training tool in a serious context	Develop a more sophisticated design process with DT	Education
[22]	Cognitive Theory (Instructional Design)	Motivation (ARCS model)	Personalized learning	Prototype and test	Cyber Security Awareness
[25]	Cognitive Theory (Instructional Design)	Design elements (Casebuilder)	Sense of place	Refine the survey instruments to measure the students' perceived sense of place besides learning.	Virtual Clinic
[26]	Cognitive Theory	Design personalized tasks for multiplayer settings	Collaboration is the more suitable game strategy to promote social involvement	Consider player's motor and cognitive ability and personality when designing personalized tasks.	Medicine
[27]	Self-determination Theory	Social game elements	DPE game design framework	Test more of the hypotheses to prove their validity	Massive Multiplayer Online Role-Playing Game
[29]	Constructivist Learning (Active Learning)	Solve real problems	Collaborative learning with DT	Extend the sample to students with transversal skills	Sustainable Development

Appendix B. Innovative Solutions for Serious Games.

Ref. #	SG Domain	Approach	Innovative Solutions	DT (y/n)	Benefits
[3]	Education	Interactive design and prototype	Measure in-game problem-solving Measure out-of-game learning	Yes	DT as a strategy
[4]	Literature	Using Personality modeling and Preference modeling	Plot generation method used to compose stories Proposed (narrative) preference model	No	Interactive and adaptative storytelling
[6]	Earthquake emergency	Using personalized stories	Process of creating a customized training environment	No	Linear and spiral narratives based on trainees' capabilities
[13]	Innovation process	Applying DT methods and techniques	Difficulties regarding the understanding and implementation of DT	Yes	Development of creative confidence
[14]	Health Psychological fidelity	Using narrative transportation	Development of creative confidence	Yes	Empathy for the story's characters and imagination of the story plot
[15]	Sustainable Development	Interactive design and prototype	The design, play, and experience (DPE) framework were applied to meet the requirements of SG.	Yes	Co-design process contribution
[16]	Management Education	Fostering knowledge as a competitive asset	Personal innovativeness	No	Collaborative learning for innovative SG
[23]	Public policy arena	Collecting valuable intelligence about the operations of programs and policies	Framework about evaluation inquiry: function and nature of the evaluand	No	Collaboration in interactions to co-create social change
[24]	Education	Co-creating using Storytelling	Created an app exploring features from books to provide storytelling-based knowledge-sharing among multiple users.	Yes	Collaboration as the more suitable game strategy to promote social involvement
[26]	Medicine	Using gaming modes for increasing adherence and effectiveness of therapy.	Personalization for individual patient's specific needs with a multi-user interactive table with a custom-made SG.	No	Collaboration as the more suitable game strategy to promote social involvement
[28]	Corporate Innovation	Asking how organizations actually can play with people.	Ask whether and how organizations in the context of gamification and innovation actually can play with persons.	Yes	Creativity and innovation.
[29]	Sustainable Development	Measuring knowledge acquired and importance are given to the SDGs	Educational intervention workshops with DT and SG about awareness of sustainability	Yes	Collaborative learning with DT