

Immersive Interfaces: A Practical Experience with Interactive Storytelling in Gamified Environments

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Abstract. *Interactive storytelling and narrative can significantly enhance immersion in learning systems, especially within gamified environments. This study presents an innovative approach to integrating interactive storytelling with instructional design and Human-Computer Interaction (HCI) concepts in a gamified environment. We discuss our methodology and evaluate it through gamification heuristics, reflecting on the positive feedback from specialists. Our findings offer valuable insights for practitioners and researchers in HCI, focusing on the immersive aspects of interfaces.*

Resumo. *A narrativa interativa e o storytelling podem melhorar significativamente a imersão em sistemas de aprendizagem, especialmente em ambientes gamificados. Este estudo apresenta uma abordagem inovadora para integrar storytelling interativo com design instrucional e conceitos de Interação Humano-Computador (IHC) em um ambiente gamificado. Discutimos nossa metodologia e a avaliamos por meio de heurísticas de gamificação, refletindo sobre o feedback positivo de especialistas. Nossas descobertas oferecem insights valiosos para praticantes e pesquisadores em IHC, com foco nos aspectos imersivos de interfaces.*

1. Introduction

Gamification strategies align design theories to create gameful experiences in various environments. It requires significant effort from designers to plan, design, and implement. This field focuses on selecting the best game-like elements to foster users' immersion and motivation [Klock et al. 2018]. Considering those elements, there are known

patterns, such as the Point-Badge-Leaderboard (PBL) triad, which mainly focuses on rewarding users with external incentives and is highly used in many gamified applications [Mora et al. 2017]. However, the constant use of this same approach can cause more harm than good and minimizes the concepts and abstractions from games to a single group of elements [Toda et al. 2018]. This is one reason why literature has recently shifted to explore other non-usual gamification elements, such as Storytelling [Palomino et al. 2023].

According to [Palomino et al. 2023], storytelling is an element related to fiction, which is how a story is told (through text, images, videos, and audio, for example). It is a tool used to support the Narrative of the environment, which directly impacts users' immersion, enabling them to step into characters' shoes and critically contemplate their actions. This immersive quality can transport users into the narrative, fostering a deeper emotional connection and engagement with the content. This approach can be particularly effective in teaching practical and subjective concepts in educational environments [Palomino and Isotani 2024]. By simulating real-life scenarios and dilemmas, interactive storytelling can help learners understand complex ideas and develop critical thinking skills. This method encourages active participation as users navigate various narrative paths, making decisions that influence the outcome and reinforcing learning through experience and reflection. However, storytelling is not so trivial to implement, especially in gamified environments, since many existing frameworks can be too complex for designers.

Based on this premise, this work aims to describe an experience of creating immersive and interactive interfaces with subjective navigation progression, where the story and narrative paths change according to the choices made by the users. By using instructional design and human-computer interaction methods, we contribute to the field with a participatory approach that can be employed in the design phase of gamified applications.

2. Related Works

Recent studies have explored the use of storytelling in gamified environments. [Palomino et al. 2019] analyzed the most relevant gamification elements that could enhance storytelling and narrative, potentially influencing user satisfaction. Building on this, [Ibarra-Herrera et al. 2019] developed an application to teach biology to engineering students using gamification and storytelling as separate elements. They found that a more systematic approach to designing the storytelling aspect was needed for students to receive it better. [Cesário 2019] provided guidelines for integrating storytelling and gamification in museum environments to enhance learning experiences for teenagers and young adults through co-design sessions. [James et al. 2023] created a gamified storytelling tool to improve vocabulary acquisition using Game Design Thinking. The tool positively impacted students' motivation and memory retention. [Karthik et al. 2019] highlighted the importance of storytelling in e-learning environments to boost learners' motivation, exploring the intersection of storytelling and instructional design.

However, none of these studies combine Human-Computer Interaction (HCI) concepts with the immersive aspects of storytelling to systematize its creation in interactive interfaces, indicating a gap in the research.

3. Methods and Tools

To better understand how to implement storytelling as an interactive aspect in gamified environments, we tackled two fronts: (i) understanding the structure of storytelling and (ii) designing the approach to systematizing and implementing stories.

To understand Storytelling, we focused on the concept defined by [Toda et al. 2019], which ties Storytelling and Narrative in gamified environments. Storytelling is how stories are created through text, video, audio, and other types of media to support immersion provided by the Narrative. The Narrative addresses the users' experience in the gamified environment. Our approach involves a multidisciplinary team composed of instructional designers, gamification designers, and designers. The gamification designer must have experience with storytelling, the instructional designer must align the content with the storytelling, and the designer must apply HCI techniques to create characters and scenarios. These roles work together to create the storytelling structure.

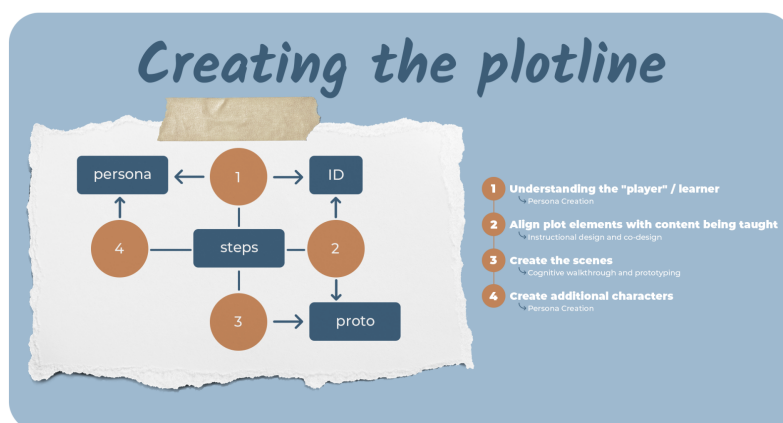


Figura 1. Plotline creation steps

Instructional design is a systematic process for creating and evaluating learning materials. The ADDIE model (Analyze, Design, Develop, Implement, Evaluate) [Morrison et al. 2019] is commonly used. In our context, designers used ADDIE to create the content basis for the gamified strategies. We determined essential story elements for the environment and used HCI methods like cognitive walkthrough and prototyping [Lazar et al. 2017]. The plotline must align with the content created through co-design sessions. Scenes guide learners through the story, using cognitive walkthroughs to visualize user routes and prototyping to test interactions. Characters, created with personas [Lazar et al. 2017], act as mentors, as shown in Figure 1.

4. Results and Discussion

We implemented our approach in a prototype designed for a teacher training course focused on practical situations. The course requires critical thinking to progress through the learning content. Four experts with extensive backgrounds in gamification and educational technology were selected to evaluate the course using gamification heuristics developed by [Tondello et al. 2019]. These experts provided valuable feedback, highlighting our approach's strengths and areas for potential improvement. They also praised the prototype for its engaging narrative structure and the seamless integration of storytelling with

instructional content. They noted that the interactive elements and the branching narrative paths effectively maintained user engagement and facilitated deeper immersion. The character development and plotline were appreciated for creating a relatable and compelling learning experience. Using personas to design characters also ensured the scenarios were realistic and contextually relevant, further enhancing the overall immersion.

Despite the positive feedback, the evaluation revealed several areas that require enhancement. The experts emphasized the need for progressive challenges to sustain user engagement and promote a sense of achievement. They suggested incorporating a more structured progression system, where the difficulty of tasks increases gradually as learners advance through the course. The onboarding process was identified as another critical area for improvement. The experts noted that a comprehensive introductory phase is essential to familiarize users with the system and its functionalities. This phase should include tutorials and guidance to help users understand how to navigate the interactive elements and make informed decisions within the narrative. The absence of social features was also highlighted as a significant limitation. The experts recommended integrating social interaction elements such as collaborative tasks, peer feedback, and competitive challenges. These features can enhance the experience by fostering community and enabling users to learn from each other. Lastly, the evaluation pointed out the need for varied rewards. While the current prototype primarily relied on points as incentives, the experts suggested diversifying the reward system to include badges, achievements, and personalized feedback. This variety can cater to different motivational drivers and maintain learner interest over time.

Integrating narrative and storytelling within gamification and instructional design offers promising opportunities for creating immersive educational experiences. Our findings underscore the importance of a robust narrative, which is the backbone of the immersive experience. A well-crafted story can engage users emotionally and cognitively, making the educational content more relatable and memorable. Progressive challenges are crucial in maintaining user engagement. Users can develop a sense of accomplishment and motivation to continue by gradually increasing the complexity of tasks. This approach aligns with the principles of scaffolding in education, where support is gradually removed as learners become more competent [Wood et al. 1976]. User self-expression is another vital component of an immersive environment. Allowing users to make meaningful choices within the narrative and see the consequences of their actions can enhance their critical thinking and decision-making skills. This interactivity transforms passive learning into an active, participatory experience. Social interaction enriches the environment by providing opportunities for collaboration, competition, and peer support. Integrating features that enable users to interact with one another can create a more dynamic and engaging experience. It also mirrors real-world scenarios where teamwork and communication are essential.

5. Final Remarks

This study presents a novel approach to integrating interactive storytelling with instructional design in gamified environments. Our methodology, which combines narrative-driven immersion with systematic instructional design principles, demonstrates significant promise in enhancing user engagement and learning outcomes. However, further research is essential to fully realize this approach's potential, including larger-scale evaluations in-

volving end-users to validate and refine our methods. Such research would provide deeper insights into the effectiveness and applicability of our approach across different educational and professional contexts. By continuing to explore and develop this intersection of gamification and interactive storytelling, our work contributes to a broader understanding of how these elements can be harnessed to create rich, immersive experiences, having implications not only for education but also for various other fields where user engagement and experiential learning are critical.

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7. Authors Biography

Paula Palomino, a FATEC-Matão professor, specializes in HCI, UX, and Innovation. She has a Ph.D. in Computer Science, with expertise in IT Project Management and Audiovisual Communication. Her research focuses on HCI, UX, Gaming, Artificial Intelligence, and Computers in Education, and she has extensive industry experience in technology and innovation.

Armando Toda has a Ph.D. in Computer Science from the University of Sao Paulo. His research explores the uses of gamification and games in society, culture, and education, intersecting with the fields of Human-Computer Interaction, Software Engineering, and Artificial Intelligence.

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Carlos dos Santos Portela has a Ph.D. in Computer Science from the Center for Informatics (CIn) at the Federal University of Pernambuco (UFPE) (2017), obtained a Master's degree in Computer Science from UFPE (2012), and a Bachelor's degree in Information Systems from the Federal University of Pará (UFPA) (2009). He has academic experience in the area of Software Engineering, working on the following research topics: Project Management (SCRUM), Process Modeling (SPEM and BPMN), Software Process Quality Models (MPS.BR and CMMI-DEV), Teaching-Learning of Software Engineering, and Human-Computer Interaction (HCI).

Rodrigo Lisboa Pereira is a professor Ph.D. at UFRA, leader of the Computational Technologies Laboratory (LabTeC), a researcher in Computational Intelligence and Software Engineering, and a member of the Center for Excellence in Social Technologies (NEES), working on projects with the Ministry of Education in Brazil.

Thiago Cordeiro is a professor at the Federal University of Alagoas (UFAL), focuses on processing biomedical signals using AI for heart disease classification. He leads educational tech projects at NEES-UFAL and collaborates on evidence-based policies with the Brazilian Ministry of Education, earning UNESCO recognition in 2022 for innovative teaching methods.

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