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Gamification of Virtual Learning Environments: A Narrative and User Experience Approach

Paula Toledo Palomino

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Gamificando Ambientes Virtuais de Aprendizagem: Uma Abordagem focada na Narrativa e Experiência do Usuário

Tese apresentada ao Instituto de Ciências Matemáticas e de Computação – ICMC-USP, como parte dos requisitos para obtenção do título de Doutor em Ciências – Ciências de Computação e Matemática Computacional. *VERSÃO REVISADA*

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This work is dedicated to my mother, Regina, for supporting and believing in me my whole life and to my grandparents Paulo (in memoriam) and Geralda, whose dream was to see their granddaughter finish her Ph.D.

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RESUMO

PALOMINO, P. T. **Gamificando Ambientes Virtuais de Aprendizagem: Uma Abordagem focada na Narrativa e Experiência do Usuário**. 2022. 307 p. Tese (Doutorado em Ciências – Ciências de Computação e Matemática Computacional) – Instituto de Ciências Matemáticas e de Computação, Universidade de São Paulo, São Carlos – SP, 2022.

Diversas pesquisas na área de gamificação aplicada à educação investigam como incentivar os alunos a realizar tarefas específicas ou progredir no aprendizado. No entanto, muitos estudos são inconclusivos sobre o quanto a gamificação ajuda ou dificulta esses processos. De acordo com a literatura, a maioria dos frameworks de gamificação existentes são estruturais (usando elementos como pontos, medalhas e placares, por exemplo), com poucos frameworks de conteúdo (que orientem como os professores devem usar elementos de jogos dentro do conteúdo de aprendizagem). Além disso, baseado em revisões sistemáticas recentes, não existe uma estrutura narrativa que esteja preocupada com o caminho de aprendizagem e a experiência do estudante, em parte porque é difícil incorporar uma narrativa em uma plataforma que não seja um jogo. A partir dessa premissa, o objetivo deste trabalho foi desenvolver, testar e validar um framework de gamificação de conteúdo baseado em narrativa que os estudantes vivenciariam à medida que avançassem em seus estudos. Nossos principais usuários-alvo são professores, designers instrucionais ou desenvolvedores que possam usar o framework para criar aulas ou sistemas educacionais, e secundariamente os estudantes, que passarão pela experiência. Para tanto, desenvolvemos quatro artefatos utilizando conceitos e técnicas de experiência do usuário (UX); todos com foco em educação: (1) uma definição de narrativa específica para gamificação, (2) um framework de gamificação baseado em narrativa e storytelling, (3) uma nova abordagem — a Jornada da Gamificação — para personalizar estratégias de gamificação e (4) uma ontologia de aplicação em OWL que conecta todos os conceitos. Para avaliar a eficácia de cada artefato, realizamos estudos empíricos, testes com usuários e entrevistas com especialistas. Os resultados demonstram que é possível sistematizar o uso de elementos subjetivos de jogos. Essas abordagens têm grande potencial no campo educacional, considerando a gamificação não como uma ferramenta, mas como uma experiência, abrindo um novo caminho para pesquisas futuras.

Palavras-chave: Gamificação, ensino-aprendizagem, narrativa, framework, experiência do usuário, design instrucional.

ABSTRACT

PALOMINO, P. T. **Gamification of Virtual Learning Environments: A Narrative and User Experience Approach**. 2022. 307 p. Tese (Doutorado em Ciências – Ciências de Computação e Matemática Computacional) – Instituto de Ciências Matemáticas e de Computação, Universidade de São Paulo, São Carlos – SP, 2022.

Several educational gamification studies investigate how to encourage students to do specific tasks or progress in learning content. However, many studies are inconclusive about how much gamifying an environment helps or hinders these processes. According to the literature, most existing gamification frameworks are structural (i.e., points, badges, and leaderboards), with few content frameworks (to guide where teachers should use game elements and concepts within the learning content). Furthermore, based on recent systematic literature reviews, no narrative framework exists (i.e., concerned with the student's learning path and experience), partly because it is difficult to embed a narrative into a platform other than a game. Based on this premise, the objective of this research was to develop, test, and validate a content gamification framework based on the narrative that the students will experience as they progress in their studies. Our primary target users are teachers, instructional designers or developers who can use the framework to gamify classes or educational systems and, secondly, the students who will undergo the gamified experience. Therefore, we developed four artifacts using user experience (UX) concepts and techniques; all focused on education: (1) a specific narrative definition for gamification, (2) a gamification framework based on narrative and storytelling, (3) a new approach—the Gamification Journey—to personalize gamification strategies, and (4) finally, an application ontology in OWL that connects all concepts. To assess the effectiveness of each artifact, we conducted empirical studies, user tests and interviews with experts. The results demonstrate that it is possible to systematize the use of subjective game elements. These approaches have great potential in the educational field, regarding gamification not as a tool but as an experience, opening a new path for future research.

Keywords: Gamification, learning, narrative, framework, user experience, instructional design.

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CHAPTER

1

INTRODUCTION

This thesis is presented in the context of computers in education, addressing some concepts of digital games but focusing on gamification as a tool to motivate students to engage in the learning process. First, we explain the motivation, problem, and objectives with their respective research questions. Then, we describe the thesis' structure and the chapter's conclusions.

1.1 Context

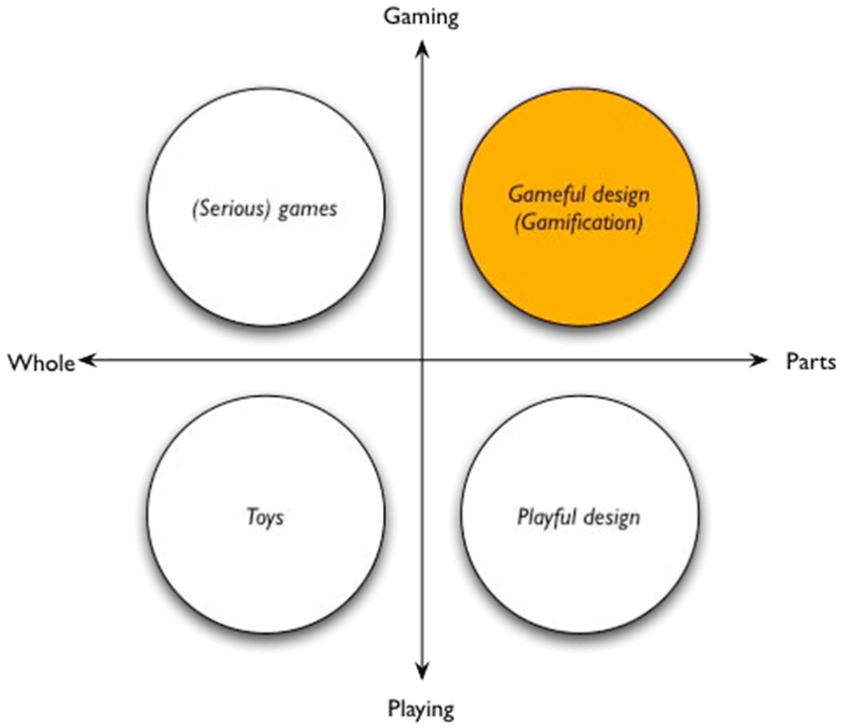
Digital games have evolved rapidly into complex systems. All the investment in technology and artistic creativity have enabled interactive systems that are—at the same time as being a logical and exact software—a form of artistic and social expression. Digital games are now used in diverse contexts, ranging from simple entertainment to education and/or as training tools. Studying digital games is a multidisciplinary endeavour (JENKINS, 2006). In education, games' multidisciplinary influences are materialized in teaching with Serious Games (SEABORN; FELS, 2014), and by using their concepts in environments external to them, through gamification (NACKE; DETERDING, 2017).

With the increased use of games as teaching and learning tools the field of Digital Game-Based Learning has arisen (PRENSKY, 2003). It focuses on how digital games influence and/or can be used in educational processes. The term 'serious game' is attributed to digital games with a purpose focused on training processes and used mainly by companies (AZADEGAN, 2012). Research carried out over the last decade already demonstrated the positive impacts of using Serious Games in teaching processes, such as knowledge acquisition, greater immersion in the learning content and motivation and engagement improvement (BOYLE *et al.*, 2016; ROCHA; BITTENCOURT; ISOTANI, 2015; DUNWELL *et al.*, 2014; CLARKE *et al.*, 2012).

In addition to the advent of Serious Games, there was also the emergence of Gamification, which has gained prominence in both academia and marketing (LEE; HAMMER, 2011), and can

be defined as the intentional use of elements found in digital games to create a playable experience in tasks and contexts external to games (DETERDING *et al.*, 2011). In this sense, both games and serious games can be differentiated from gamification through the parts/whole dimension, and playful design and toys can be differentiated through the playing/gaming dimension as seen in Figure 1.

Figure 1 – Gamification between game and play, whole and parts (DETERDING *et al.*, 2011)



Some authors believe that the process of gamification derives from the game concept defined by Huizinga (HUIZINGA, 1949). In contrast, others believe that the term appeared in the media in the areas of marketing, derived from processes and methods used by the Union of Soviet Socialist Republics (NELSON, 2012), consisting of the use of elements found in digital games, such as mechanics, concepts, logical reasoning, among others, but outside their original scope (NACKE; DETERDING, 2017; DETERDING *et al.*, 2011). A decade after this widely accepted gamification definition, a new discussion emerges in academia, defining gamification as any process that makes use of games or gameful elements to achieve instrumental goals (TONDELLO, 2021; MARCZEWSKI, 2021).

Whatever the origin or definition accepted, the purpose of gamification is to engage and motivate, to perfect or to create the desired behaviour in training, and teaching processes (KAPP, 2012b), (ZICHERMANN; CUNNINGHAM, 2011) and to improve the user experience (HUOTARI; HAMARI, 2012).

It is worth citing that in Brazil, the process is not yet as widely used as in countries such as the United States, Canada and Finland, which have used it extensively for a decade (ERENLI, 2012), (HAMARI; KOIVISTO; SARSA, 2014), (KAPP, 2012b).

Regarding the gamification educational potential, especially when related to the area of computer sciences and engineering, the process has been achieving positive results (RODRIGUES *et al.*, 2021c; CAROLINA *et al.*, 2018; SAILER; HOMNER, 2019),when used concomitantly with traditional methodologies or as a complement to virtual applications. According to Smith-Robbins, one can observe that some of these elements are already present in the traditional methodology (SMITH-ROBBINS, 2011). Traditional teaching is compared to the process of gamification through a parallel between concepts found in the traditional model, such as grades, groups and degrees, with game elements such as points, levels and achievements. However, Oliveira argues that, despite this similarity, traditional (face-to-face or virtual) teaching does not provoke the necessary motivation to cause the student to become involved with it and is one of the main causes of school dropout (OLIVEIRA *et al.*, 2015).

However, there is some concern about the use of gamification processes in teaching, as demonstrated by Waltz and Deterding (WALTZ; DETERDING, 2015), who postulate that gamification as it has been worked on, is based mainly on the use of points ("Point-Badge-Leaderboard" approach, or simple PBL), that is, in structural frameworks. For some academic researchers, it is a derogatory simplification of the concepts of digital games since they are not limited to just that (BOGOST, 2014; HERZIG; AMELING; SCHILL, 2012; KAPP, 2012b). Such a view is confirmed in systematic reviews, where there is an excess of applications with this approach and a lack of use of other game elements, especially those related to narrative and immersive experience. Recent gamification studies also lack consistent classifications, where not all of them achieve the results expected from the implementation of gamification (TODA; VALLE; ISOTANI, 2018b; BOGOST, 2014).

Several authors still disagree on the classification and definition of these terms, and few use a formal definition for use in gamification processes (APARICIO *et al.*, 2012). As an example, we can cite the framework developed by (DIGNAN, 2011), in which the author classified 19 concepts found in games, in contrast to the study by (APARICIO *et al.*, 2012), where these concepts can be classified according to the motivational pillars of (PINK, 2011).

One of these underused elements is the narrative. Described as the 10th element of Marczewski's Periodic Table of Gamification Elements (MARCZEWSKI, 2015), in the general group, under the feeling of facilitated and personal fun of his Gamification Design Framework, the narrative is described only as the element that should deal with stories and plot lines. Other works have similar superficial descriptions, which contributes to the element being misunderstood and underutilized (KLOCK *et al.*, 2015; TODA *et al.*, 2018a; DIGNAN, 2011).

To use these kinds of complex elements, such as narrative, with the same understanding and breadth as we have regarding the structural elements of game mechanics in the development of future frameworks and/or gamified solutions, it is believed to be of utmost importance the correct understanding of the characteristics that carry such a definition, both in its literary origins and consequent unfolding in films and in the digital games themselves, as well as in the specific

context of gamification for education (PALOMINO *et al.*, 2019b).

1.2 Problem

Based on the above, this section formulates the research problems addressed by this thesis. We divided the main problem into two perspectives: general and technical problems. The general problem consists of a generalized approach that, when solved, directly impacts society or some aspect of it (within the scope of this study, teachers, instructors and students). Technical problems consist of specificities in the field of computer science, particularly in the area of computer science in education, and partially contribute to solve the general problem (DERMEVAL; BITTENCOURT, 2017).

1.2.1 General Problem

The general problem focused by this research is related to the user experience (UX) while using gamification in educational environments, concerning their learning process and the fact that gamification strategies are being used superficially. Therefore it can be tackled through the following research question:

"How to embed narrative in the gamification design of educational environments so that the user experience is affected in a positive way?".

1.2.2 Technical Problems

The technical problems are related to the analysis and formalization of existing gamification approaches. According to Mora *et al.*, (MORA *et al.*, 2015), most of these approaches do not meet all the requirements to aid implementation and/or that are relevant to the area of game planning and development.

It is known that a significant part of the studies related to the use of elements of games considers several sets of elements without attesting or proving the efficiency and effectiveness of these elements in an isolated form (PEDREIRA *et al.*, 2015). According to Kapp (KAPP, 2012b), most gamification frameworks developed are structural (e.g. aggregating scoring systems, ranking), with few content frameworks (where elements and concepts of games are applied in the content) (HAMARI; KOIVISTO; SARSA, 2014). Based on the most recent systematic reviews of the area (MORA *et al.*, 2017a), (TODA *et al.*, 2018), it is stated that there is no narrative framework (i.e., concerned with the student's learning path and experience). This happens partly because of the difficulty of embedding the narrative on a platform other than a game. However, due to the high potential engagement that the different types of narrative have, we believe it is important to deepen research in this area. These variables lead to the following research questions:

What is narrative in gamification for education and what are its specific features? and, ***How to apply narrative in gamification design?***

This information is intended to provide subsidies for the next steps of this research and other future works that wish to make use of this content element.

Furthermore, we need to analyze aspects related to the experimentation and validation of gamification in these approaches. It is necessary to verify if the approaches describe empirical experiments regarding their use since it is remarkable in the area of gamification a lack of empirical experiments that relate the practice and theory (CAPONETTO; EARP; OTT, 2014; SEABORN; FELS, 2014). Another critical factor is personalization, if these approaches allow the modification of elements and properties to implement gamification, focusing on the user experience (SÁNCHEZ-MENA; MARTÍ-PARREÑO, 2016; MARTÍ-PARREÑO; SEGUÍ-MAS; SEGUÍ-MAS, 2016). Also, the way to evaluate the efficiency and effectiveness of content gamification is another essential factor in guaranteeing the success of the implantation, since a significant part of the studies of the area present different and discrepant forms as far as the methods and instruments of evaluation (FAIELLA; RICCIARDI, 2015). These metrics address the following research questions:

How to personalize user experience in a gamified educational system using a narrative approach? and ***How to evaluate the benefits of a narrative approach?***.

Finally, it is necessary to consolidate the knowledge acquired and formalized in a framework that could be used to develop advanced educational systems. The objective is to guide the students in a personalized user's journey (KALBACH, 2016) where, subtly, they are motivated to engage in tasks and the process of learning, directing the subsequent questioning:

How can we represent our approach to support the design of educational systems?

This final research question aims to document and organize the entire previous process to allow further research and improvements in the area.This final research question aims to document and organize the entire previous process, in order to allow expansion and improvements in the area.

1.3 Objectives

After defining the research questions that guided the work, the main objective was defined as ***the development, test, and validation of a narrative-based content gamification framework to be used in educational systems***. As such, it is an integral part of the CeMEAI Project (Center for Mathematical Sciences Applied to Industry)[1], whose main objective is to promote the use of mathematical sciences and, in particular, applied mathematics, statistics and computer science

[1] <http://www.cemeai.icmc.usp.br>

as an industrial resource, in specific within the project "Learning Environments using Game Elements"[2].

1.4 Thesis Division

We divided the thesis into the following chapters:

- chapter 2: presents and discuss the main themes related to this project: HCI and UX; Engagement and Motivation; Gameful Experiences, Gameful Systems, and Gameful Design; Frameworks for Gamification and Narrative for Digital Games;
- chapter 3: presents the results from a theory-driven study whose aim was to create a narrative definition exclusively for gamification in education purposes and a case study that first tackled the research gap applying narrative empirically in a classroom through the use of educational technologies;
- chapter 4: presents the data-driven study that identified, from the users' perspective, how narrative could be used in addition to other game elements in educational environments and the design process of the Narrative Gamification Framework for Education, as well as its validation through semi-structured interviews with domain specialists such as teachers, instructors, game designers and psychologists, with the results synthesized using reflexive thematic analysis.
- chapter 5: presents the theory-driven design of a new user type approach solely for use in gamification for education, the Gamification Journey, based on Jung's 12 Archetypes, as well as the card sorting experiment that validated the approach and the prototype of a gameful interface based on this novel approach;
- chapter 6: presents the gamification for education application ontology's creation process and evaluation using the FOCA methodology by domain experts.
- chapter 7: presents the final remarks for the thesis, general limitations, ongoing research and future works.

[2] <http://www.cemeai.icmc.usp.br/projetos/item/208>

CHAPTER

2

LITERATURE REVIEW

This chapter aims to present and discuss the main theories related to this project: Human-Computer Interaction (HCI) and UX; Engagement and Motivation; Gameful Experiences, Gameful Systems, Gameful Design; Frameworks for Gamification and Narrative for Digital Games.

2.1 Human-Computer Interaction and User Experience

According to Barbosa (BARBOSA; SILVA, 2010), a system is the interface set plus the application itself, the interface being

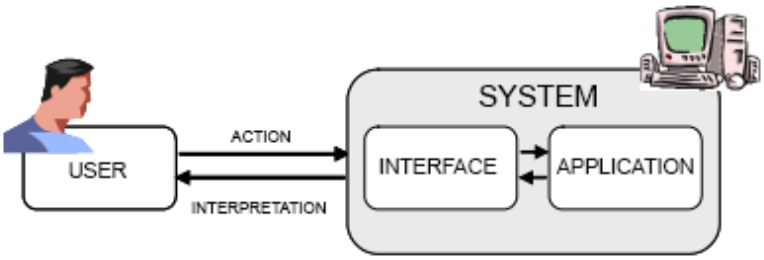
> "The entire portion of the system with which the user maintains physical (motor or perceptual) or conceptual contact during interaction. [...] The vast majority of users believe that it is the system. [...]. We can consider user-system interaction as being a process of manipulation, communication, conversation, exchange, influence, and so on. " (author's translation from (BARBOSA; SILVA, 2010).

Barbosa further defines that "a set of operations that can be performed with the interactive system, as well as [...] the ways to accomplish them by manipulating the interface elements" are called affordances.

It is possible to visualize the basic scheme of the human-computer interaction process in Figure 2.

Much like games studies, HCI is a multidisciplinary science that encompasses several areas such as Computer Science, Cognitive Psychology, Organizational and Social Psychology, Ergonomics and Human Factors, Engineering, Design, Anthropology, Sociology, Philosophy, Linguistics and Intelligence Artificial. The set of all these areas aims to systematically support several steps and procedures of the Human-Computer Interaction methodologies since this is an area that works with aspects of science, technology, engineering, and mathematics (STEM) as

Figure 2 – The process of human-computer interaction - adapted from (BARBOSA; SILVA, 2010)



with the physical, psychological and behavioural aspects, also considering the social context in which a particular system is inserted for its users (PREECE; ROGERS; SHARP, 2015).

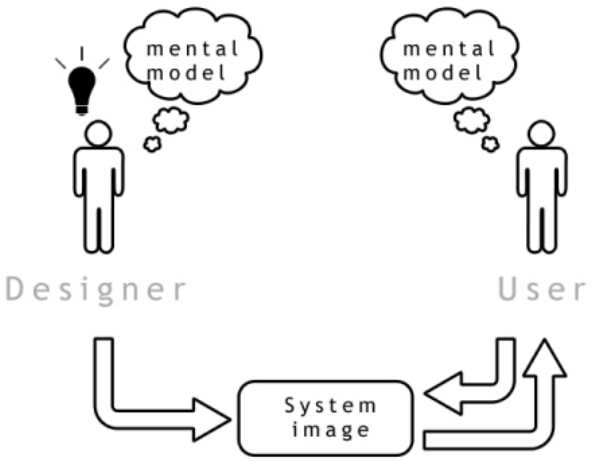
To measure the quality of a particular software, including digital games, HCI has some criteria and goals that can be analyzed, cataloged and used to validate the resulting interface and interaction, such as Usability and User Experience, Accessibility and Communicability (BARBOSA; SILVA, 2010). Usability is related to the ease of learning, use of the interface and user satisfaction due to this use (NIELSEN, 1994). In this sense, this research is highly based on the hedonic qualities of usability (novelty, stimulation, and attractiveness) (HASSENZAHL, 2018). User Experience, commonly known by the acronym UX, measures the quality related to the feelings and emotions of the users during the interaction (PREECE; ROGERS; SHARP, 2015). The user experience field also studies the practical, experiential, affective, meaningful and valuable aspects of Human-Computer Interaction (HCI) (NORMAN, 2004) and how it can influence the system's design. Accessibility is related to the removal of barriers that prevent more users from being able to access and interact with the system interface and can be defined as the flexibility provided for access to information and interaction so that users with different needs can access and use these systems (BARBOSA; SILVA, 2010). Finally, communicability deals with the designer's responsibility in communicating to the user their design intentions and the logic that governs the behaviour of the interface.

> "An interactive system is the result of a design process in which a designer establishes a vision (interpretation) about the users, their objectives, the domain and the context of use and makes decisions about how to support them. For the user to enjoy better computational support, it is desirable for the designer to remove interface barriers that prevent the user from interacting (accessibility), making it user-friendly, and communicating to the user their conceptions and intentions when designing the system." (BARBOSA; SILVA, 2010).

This process can be better represented by relating the designer's mental models (design model, which is the image of the system from the perspective of the designer, that is, as the designer imagines the system to be), the user (system image from the perspective of the user, that is, as the user imagines that the system will attend) and the system itself (the image of the

system, which constitutes the physical materialization of the two mental models) (NORMAN, 2004). Ideally, the System Image must be identical to the design model and user model, as shown in Figure 3 below.

Figure 3 – Three aspects of mental models (NORMAN, 2004)



It is desirable that the system's image faithfully convey the experience it was intended to offer. To achieve this goal, one must explore how the user perceives and interacts with an application and the satisfaction and emotions brought about through this interaction. In this sense, the concepts of gamification become highly relevant to the user experience itself (HSU; CHEN, 2018) and our final framework was developed considering these theories.

2.2 Gameful Experiences, Gameful Systems, Gameful Design

Based on the recent studies by Hodent (HODENT, 2017), the part of UX that is most relevant for a user to want to use a system and to continue using it (*i.e.*, its retention rate) is the "engagement capacity," or "game flow," a well-known term that, despite representing some aspects of engagement, does not encompass everything essential to engage these users (or players) and keep them in that state. For the author, the term expresses the ability of an application or game to engage its user. The variables behind usability and engagement ability are not working in silos; they interact with each other (HODENT, 2017). She also describes the capacity for engagement divided into three aspects: motivation, which is the origin of all human behaviour, the emotions that serve the motivation in the sense that they help to choose the correct behaviour (for example, to escape when one is afraid) and the game flow, a state of deep focus and immersion, which is a concept derived from Theory of the Flow (CSIKSZENTMIHALYI, 2014),and which functions as a connection between all other aspects.

Also, according to Pink's motivational theory (PINK, 2011), the motivation of the individual is influenced by three predominant factors: Autonomy, Mastery and Purpose, the first

being the control of the individual about their actions, the second dealing with their abilities that are improved, and the latter is represented by the intrinsic need of the individual to perform a particular action. These three pillars can be observed in digital games since the player is able to control their actions (autonomy), hone their skills (mastery) and do it voluntarily (purpose).

Recent research sought to refine these concepts to help design these game-like systems. According to (LANDERS *et al.*, 2019), gamefulness is commonly cited as the primary goal of gamification, encompassing engagement, motivation and behaviour changes; however, the term is not well defined across the literature, hampering the definition of what to expect from gamification strategies. Therefore, the authors presented a theory that divided gamefulness into three different constructs: ***i)*** **gameful experience,** a psychological state resulting from three characteristics: having non-trivial and attainable goals to pursue; being motivated to pursue them according to a set of rules and being willing to accept those rules because they make such activity possible; ***ii)*** **gameful system**, as any system that provides for its users a gameful experience and ***iii)*** **gameful design** as a process to design systems with characteristics that can provide their users' gameful experiences. This process, according to (TODA *et al.*, 2017), consists of a series of events that results in a gamified strategy, that is, a specific action related to game elements. The success of a gamification strategy can be hindered by the absence or inadequate implementation of a gameful design. For example, an inadequate gamification strategy in education can lead to the loss of motivation and engagement to the impairment of the learning process (DICHEV; DICHEVA, 2017a; TODA; VALLE; ISOTANI, 2018a). However, according to the literature, frameworks can support the design process, ensuring that all steps and elements of the gameful design are present (AN *et al.*, 2021).

The user is considered a key agent in the process, and their experience is paramount. As research that seeks to combine Narrative and User Experience in a single approach, these constructs helped build part of the reasoning behind the framework created.

2.3 Gamification Frameworks

In the context of this research, frameworks are defined as a set of steps and tools aimed at specific results (in this case, a gameful design). According to recent research, the number of frameworks for gamification significantly increased in the last few years (MORA *et al.*, 2017a).

These frameworks can be categorized in *structural frameworks* (based on structural game elements such as ranking, points, badges and leaderboards); and *content frameworks* (based on subjective game elements applied directly to the content such as narrative, storytelling and sensation) (KAPP, 2012a).

Currently, one of the most accepted frameworks for the digital game and gamification design by academia and the market is Mechanics-Dynamics-Aesthetics, or MDA (HUNICKE; LEBLANC; ZUBEK, 2004). Mechanics are understood to be base components of the game - its

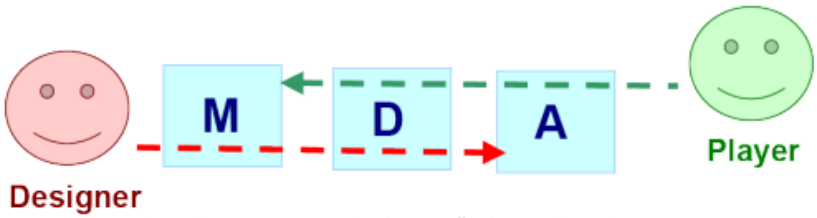
rules, each main action that the player can take in the game, algorithms and data structures of the game engine; Dynamics is the run-time behaviour of mechanics that acts on the player's input and cooperates with other mechanics, and aesthetics are the emotional responses evoked in the player. Figures 4 and 5 illustrate how the MDA formalizes the consumption structure of a game and makes the parallel with its parts in the design.

Figure 4 – Consumption structure of a game (HUNICKE; LEBLANC; ZUBEK, 2004)

Figure 5 – Parallel with its parts in design (HUNICKE; LEBLANC; ZUBEK, 2004)

For the authors, the development of digital games is a "double-way," where the player and the designer observe the artifact (digital game) from different perspectives, and it is possible to draw a parallel with the three mental models of Norman (NORMAN, 2004), as shown in Figure 6.

Figure 6 – Diagram explaining the perspective of player and designer observation (HUNICKE; LEBLANC; ZUBEK, 2004)

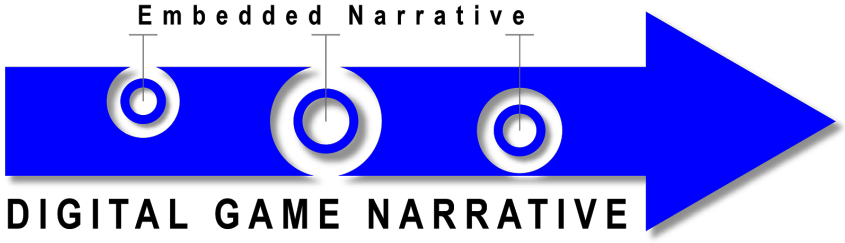


According to Hamari *et al.*, (HAMARI; KOIVISTO, 2014), most of the frameworks for gamification developed are structural (*i.e.* aggregating scoring systems, ranking), with few content frameworks (where you apply elements and concepts of games in the content itself to be explained, to make it more like a game). This view is confirmed by the recent systematic review by Mora *et al.* (MORA *et al.*, 2017a), where 40 unique works that addressed the development of frameworks for gamification were studied and cataloged. However, most of these frameworks were developed based on MDA, and very few have a content approach. Furthermore, among the few existing content approaches, there is no one designed with narrative focus, in part because of the difficulty of embedding such an element on a platform other than a game (MORA *et al.*, 2017a).

2.4 Narrative Concepts

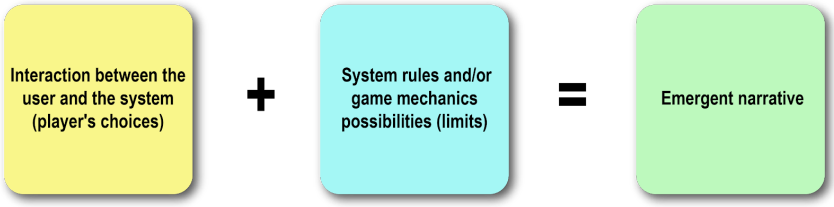
For Salen *et al.* (SALEN; TEKINBAŞ; ZIMMERMAN, 2004), there are two distinct narrative lines in a game: the embedded narrative and the emergent narrative, the first containing the predefined story of the work, that is, the script, and consisting of two narrative axes (the first focusing exclusively on the logical chain of events portrayed in the story, comparable to the narrative found in literary works) and the axis of sensory experiences (which extends the previous axis, bringing all other sensory elements such as image and sound to the narrative, being comparable to the narratives of cinema). Figure 7 illustrates it.

Figure 7 – Embedded Narrative (SALEN; TEKINBAŞ; ZIMMERMAN, 2004)



On the other hand, the emergent narrative, also called ludonarrative by other authors (BISSELL, 2011), has only one narrative axis, that of interactivity, dealing with narrative development directly related to the actions performed by the player throughout the game. It can be said then that the emergent narrative is the story that each player builds throughout the game, using the available gameplay features (ROGERS, 2014). Figure 8 shows this relationship.

Figure 8 – Emergent Narrative (SALEN; TEKINBAŞ; ZIMMERMAN, 2004)



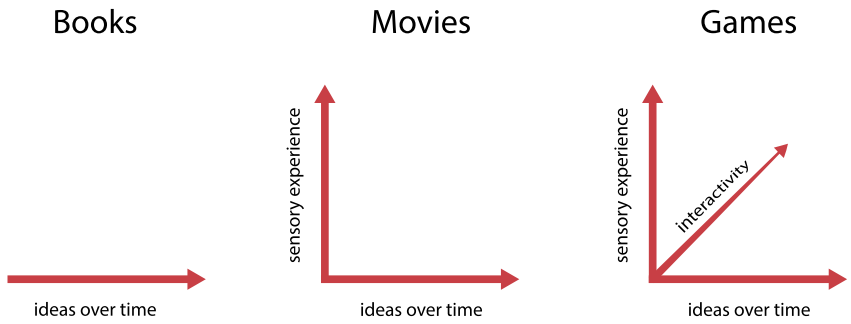
The narrative using these features (gameplay) is responsible for engaging and motivating the player, providing a decent and acceptable user experience that keeps them in the game.Figure 9 shows how game narrative incorporates these two types of narrative and their three axes.

Although much is discussed about narrative in other media, this does not happen in gamification, where users of gamified environments may benefit far more by using this concept.

2.5 Chapter Conclusions

This chapter described the general theoretical basis for this thesis, providing some digital games basics for the understanding of gamification and some HCI basics, connecting the

Figure 9 – Narrative Axis (SALEN; TEKINBAŞ; ZIMMERMAN, 2004)



user experience to gamification. Then it presented some concepts related to engagement and motivation and their relationship with the gamification design process and frameworks. Finally, it presented a digital game definition for narrative, which was further explored in this research to create a definition that could be applied specifically to gamification in education, and whose results are presented in the following chapters. This thesis utilized several different methods to create each one of its four main artifacts: *i)* the narrative definition for gamification, *ii)* the Gamification Journey user type approach for personalizing gamified educational system, *iii)* the Gamification for Education Ontology; and *iv)* the Narrative Gamification Framework for Education. Therefore, each chapter describes its specific methodological approach, related works, and specific background information.

CHAPTER

3

NARRATIVE FOR GAMIFICATION IN EDUCATION

This chapter presents and discusses the theoretical and empirical studies results that created a narrative definition exclusively for gamification for education purposes.

3.1 Narrative for Gamification in Education Definition

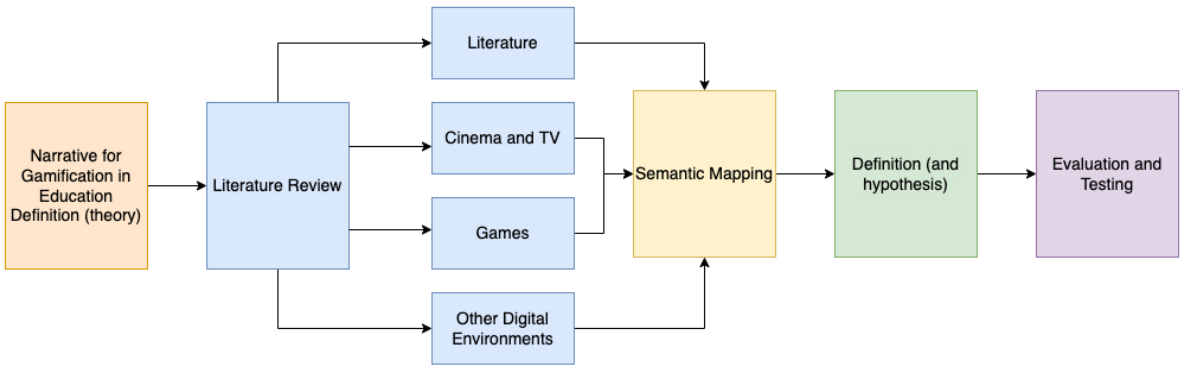
As shown in Figure 10, the first step was to do a review of established literature on Narrative in different areas, such as literature, cinema, TV, games and other digital environments. Then, we semantically mapped these concepts in keywords representing individual features and searched for common ground between the different definitions. Finally, we considered what features should be used for a Narrative definition for Gamification in Education and created our first definition, which was tested with a case study in a real classroom teaching Interactive Fiction through educational technologies and therefore evaluated empirically. Our results show that the narrative element definition used in gamification in education contexts best drifts from the games ones. However, its definition is unique in that, as an element to be isolated and worked on in future frameworks, its features resemble some mapped user experience characteristics.

3.1.1 Existing Gamification Educational Frameworks

This section aims at presenting what the current literature on gamification defines and uses as the concept of "Narrative", as well as related approaches and frameworks.

Klock's *et al.* gamification conceptual model is a great example in engaging students in e-learning systems (KLOCK *et al.*, 2015), where they deal with adaptive gamification that also influences the user experience. They also consider the narrative game element, defining it mainly in its correlation with the story, as in embedded narrative (SALEN; TEKINBAŞ; ZIMMERMAN,

Figure 10 – Narrative Definition Study - Steps and Methods



2004), that is a pre-generated narrative content that exists prior to a player's interaction with the game, such as cut scenes and back story. However, they only addressed a part of the whole concept of narrative. Marczewski's "Gamification Periodic Table of Gamification Elements" also describes the narrative as the element that deals with stories and plot lines, again including only one of the concepts related to the narrative definition (TONDELLO *et al.*, 2016c).

Toda *et al.* created an approach for planning and deploying gamification concepts with social networks within educational contexts. (TODA *et al.*, 2018a). In this approach, the storytelling is considered an element option for teachers to choose when planning their solution. However, the description utilized, as in the context created by the designer (MORA *et al.*, 2017a) is too broad and confusing with the narrative concepts, which the paper also address as what occurs when the designer create a background to contextualize the user outside its reality (DIGNAN, 2011), being examples of its uses: i) Create a storyline to join multiple levels (BELL; SHETH; KAISER, 2011) and ii) Create a storyline that allows the students to form groups and discuss with their peers their next actions (SUNG; HWANG, 2013). As for the user experience, they define it as per Mora *et al.* 's definition, aka everything within the gamified practice that can be interacted by the participant (MORA *et al.*, 2017a).

Later on, Toda *et al.* adopted a data-driven approach to provide a set of game element recommendations based on user preferences that could be used by teachers and instructors to gamify learning activities. For that, they applied a survey to 733 people and collected information regarding user preferences on game elements (TODA *et al.*, 2019c). This survey, however lacked the existence of narrative and storytelling game elements, leading to updated research where a new survey was elaborated and first validated with specialists from the areas of gamification and game development and/or research (TODA *et al.*, 2019a). This validation led to the inclusion of the two elements on the updated survey to re-ran the research.

Santos *et al.* proposed an approach to tailor gamified educational systems according to the user player types. The approach proposed by Santos and his colleagues considers personalization in terms of game design elements; however, it does not address the personalization of narratives, leaving an open gap for conducting searches that seek to personalize this type of

system in terms of narrative (SANTOS; BITTENCOURT; VASSILEVA, 2018). Other recent studies have proposed approaches (e.g., architectures, frameworks, methodologies) for tailor gamified educational systems or even serious games (ORJI *et al.*, 2013), (ORJI; VASSILEVA; MANDRYK, 2014), (MONTERRAT; LAVOUÉ; GEORGE, 2014). However, again, such studies propose personalizing specific game elements (i.e., points, trophies, ranking, and others) but do not consider the narrative, leaving open such challenges.

Finally, Dermeval proposed a process to aid teachers in developing gamified ITS. However, his process is centred on the teacher/instructor and not the students. Also, he does not address the concept of narrative in his work (DERMEVAL *et al.*, 2018).

To the best of our knowledge, no other studies aim to provide gamification recommendations in educational scenarios based on narrative approaches and being user-centred.

3.1.2 Narrative Theories

One of the simplest and most basic ways of seeking a definition for a term is from the dictionary. The Oxford Living Dictionaries Online [1] defines narrative as 'A spoken or written account of connected events; a story', or as:

1. The narrated part of a literary work, as distinct from dialogue.
2. The practice or art of telling stories.
3. A representation of a particular situation or process in such a way as to reflect or conform to an overarching set of aims or values.

These concepts emphasize the importance of narrative as a way to report or communicate something. In this case, this communication is of a story that, in turn, can be defined as an event or a sequence of events that are impacted by an individual in a given context (PALOMINO, 2015). If we look to the same dictionary definition of the term '*story*,' it is described as '*An account of imaginary or real people and events told for entertainment*.' As for the term '*plot*,' the dictionary states that it is '*the main events of a play, novel, film, or similar work, devised and presented by the writer as an interrelated sequence*.'

These definitions for '*story*' and '*plot*' reveal a direct connection with the concept of narrative. In other words, based only on these descriptions, we could roughly define narrative as a literary work, usually in prose, in which there is an event or a set of events, real or not, with the intervention of one or more characters in a set space and time.

The act of telling stories is as old as humanity itself. Ricoeur centred on the discussion and analysis of two particular works, The Confessions of St. Augustine (AUGUSTINE, 1876)

[1] https://en.oxforddictionaries.com/

and the Aristotles Poetics (HALLIWELL *et al.*, 1998), and writes his considerations regarding the reason human being narrates and tells stories, as well as the stages (or *mimeses*) through which these representations take shape (RICOEUR, 2010).

According to Ricoeur, one of the explanations to why human beings need to tell stories is connected to the relationship between time and narration, where the notion of time comes mainly from the considerations made by Augustine. He discusses the anguish of time and the weight of this temporal existence that humanity faces (RICOEUR, 2010).

In this sense, the narrative becomes a way of assuring humans against their anguish and pain in the face of the passage of time. Life can take unexpected turns, but the story, created by humans, will always follow its designs and a programmed logic (PALOMINO, 2015). Thus, the narrative is a sequence of events conveyed by an individual. This sequence may undergo modifications and be changed in quantitative or qualitative terms, by the way, *i.e.* how it is told, aka storytelling. The narrative also fulfills a calming function, and, in this sense, it is crucial to understand their role as a gamification element related to motivation and purpose. Narrating stories comes together with a purpose of meaning and constant transformation - by establishing a dialogue with the receptor.

3.1.3 Narrative in Digital Media and Games

To discuss narrative in games, it is essential to observe the role of the narrative as it is lived through the game. In this sense, the narrative begins to unfold from the moment the player reads the title of the game or interacts with the options menu, the visual representation of the game and its interaction mechanics. Everything is an element that contributes directly and uniquely to this narrative experience in games (PALOMINO, 2015). Bellow, we present three base narrative definitions in digital media, especially in games.

Manovich *et al.* (MANOVICH; MALINA; CUBITT, 2001) discusses what the new media would be and how this new language or digital code affects the narrative. For the researcher, the changes in the media have triggered transformations in the cultural body, promoting new communication, language, behavioural, and representative strategies. The narrative, in turn, is established as a modality within a broader aspect, which is the way the human being experiences their existence and how they choose to represent it in the digital age. Manovich *et al.* (MANOVICH; MALINA; CUBITT, 2001) verifies its basic elements can be found in the fundamentals of programming. Data, elements, goals, descriptions, problems and possibilities of reaching solutions are common features to the traditional plot and a simple algorithm. In addition, as novels and movies favoured the narrative as a crucial piece of the cultural expression, the computing age exhibits its equivalent correlate: *the database*.

As for Salen *et al.*, (SALEN; TEKINBAŞ; ZIMMERMAN, 2004) narrative is defined as a composition of rules that are experienced through play, so the player interacts in the space

of possible actions within a game, allowing them to explore, discover, manipulate and activate the game's universe. They further stress that it is essential not to rely only on comparison with narrative in other media not to be distracted from essential elements such as rules, objectives, the player's participation and the impact of their actions in the game universe.

To the authors, there is no genre or cultural form that is not understood by the concept of narrative (SALEN; TEKINBAŞ; ZIMMERMAN, 2004), establishing an approximation with Ricoeur's (RICOEUR, 2010) definition of narrative and so the necessity of studying digital game's narrative in the context of interactivity and player participation.

This can occur in two distinct ways. The first one is called by Salen *et al.* (SALEN; TEKINBAŞ; ZIMMERMAN, 2004) of embedded narrative and is defined as a pre-generated content that exists prior to the interaction of the player. This kind of narrative is designed to motivate playing the game, the games' story, for example, because it gives a sense of purpose to actions. The embedded narrative aims to give a significant stake to the player through the plot, as a premise to story, characters and sequence of events, which give a dramatic unity to the player's interactions and journey.

The second narrative possibility is called emergent, configuring itself in the story created from the player's interactive experience. The game designer also plans its base, but its unfolding is often not. This is due to the events created as an organic consequence of the player's freedom of choice in the face of the game mechanics and their meaningful experience as a user. (SALEN; TEKINBAŞ; ZIMMERMAN, 2004; PROTÁSIO, 2014; PALOMINO, 2015).

By this logic, the emergent narrative is only possible because it is directly connected to the chain of mechanisms that make up the game system and the meaningful participation of the player who is able to interfere. Thus, a change in the system from the player's actions can result in another modification of the narrative patterns of the game and affect the experience as a whole. The emergent narrative depends not only on the player's action but also on what is happening in the system at that very moment. Thus, the same actions may result in different outcomes since the changes that occurred in the systems are not necessarily the same. The emphasis of narrative is how the player interacts with the game system and creates their own, and unique sequence of events (PROTÁSIO, 2014; PALOMINO, 2015). In addition, Salen *et al.* (SALEN; TEKINBAŞ; ZIMMERMAN, 2004) believe that the two narrative types should balance each other when well worked. This balance allows unique narrative experiences, only possible in games.

In the same field, Bissell also explored narrative in digital games. According to the author, games with narrative structure usually have two ways of telling stories. One is the framed narrative of the game, what happens in the "fictional present" of the game, in the animations films, and usually occurs independently and beyond the player's control. The other modality would be the "ludo-narrative". In other words, the narration of the sequence of events triggered and occurred due to the decisions and participation of the player in that fictional universe (BISSELL, 2011). This contrast between the two forms of narrative - which are similar to the

definitions of embedded and emergent narrative proposed by Salen *et al.* (SALEN; TEKINBAŞ; ZIMMERMAN, 2004) - gives rise to great difficulty for the management of stories in games. After all, one model is rigid and unchanging, while the other is fluid and free. This is known as ludo-narrative dissonance. Still, they coexist in a game or interactive system and are both parts of the narrative. The author also criticizes how the framed narrative aims to bring meaning and relevance to the events witnessed by the player, while the ludo-narrative is only concerned with creating exciting situations for the player. Finally, he points out that without communication between the two narrative modalities, it is not possible to overcome the contrast between them and the strangeness that arises from it (BISSELL, 2011).

As we can see from these three main definitions, narrative in digital media is intrinsically connected to the system from which it derives. In this aspect, we found it essential to consider the Human-Computer Interaction (HCI) concepts such as user experience (NORMAN, 2004). From this point in the work, what can be stated is that narrative (be it embedded or emergent) in interactive digital systems depends heavily on the user experience. (PALOMINO *et al.*, 2019b).

3.1.4 Narrative in Gamification

The analysis of the basic definitions of the term, as well as its most recent and technological derivations allowed us to map and catalog features in common, as shown in the following table:

Table 1 – Breakdown of the narrative definitions common features (PALOMINO *et al.*, 2019b)

Features	Ricoeur	Manovich *et al.*	Salen *et al.*	Bissell	Marczewski
Actor		X	X	X	
Choice or Possibility		X	X	X	
Interactivity		X	X	X	
Narrator		X	X	X	
Plot			X	X	X
Sequence of events	X	X	X	X	
Space	X		X	X	
Story/Data	X	X	X	X	X
Time	X		X	X	
User Experience		X	X	X	

Based on Table 1, we can assume that:

1. The terms narrative and story (as storytelling) blend and are often confused, especially in older definitions. It is believed that this is one of the reasons why it is still so rare today to work with narrative as an approach/framework in the specific case of gamification (and its application in education). If the problem space is not well delimited, its practical use becomes too complex. More easily defined and delimited structural elements become more viable alternatives for use in the instructional design of gamification projects.

2. Existing frameworks of gamification see the narrative as the same as story or storytelling, not as the events developed through users' interactions, aka as part of the user experience.

3. The definition of narrative for digital games by Salen *et al.* (SALEN; TEKINBAŞ; ZIMMERMAN, 2004) followed by Bissell's (BISSELL, 2011) are the most complete in terms of the concepts they are built on, having as a differential the classification of the two types of narrative (embedded and emergent, or framed and ludo-narrative), which in principle would solve the problem of the confusion regarding the terms narrative and story. However, by working with other intrinsic elements of digital games, it is impossible to use them as they are for gamification, where we do not have the whole game universe to support the narrative.

4. Of the mapped features, only one is unique to all definitions applied to digital games: user experience. This is supported by the fact that in the academic context, especially in computing, the use of gamification is a means for conditioning behaviours in the user (BERENGUERES *et al.*, 2013) and, in this respect, intersects with the design view of HCI software.

Based on these premises, to design a narrative project, one should answer the following questions: Where do narratives in a game reside? How can one design games as narrative experiences? What kinds of narrative experiences do games make possible? What is the role of narrative in the design of meaningful play?" (SALEN; TEKINBAŞ; ZIMMERMAN, 2004).

Therefore, we concluded that to be able to use narrative as an element for the design of gamified educational projects; the term narrative should cover at least the following features: The existence of the actor (as the user/student), the element of choice (while options available for content progression), interactivity (the system must respond to user actions), sequence of events (there must be a logical chain of these actions so that progress makes sense to the user), space (as the virtual space), date (as the information presented), time of interaction and mainly, so that it is constituted in an element capable of motivating the student, the feature of the user experience.

As such, we could say that **Narrative** in gamification for education is:

"the process in which the users build their own experience through a given content, exercising their freedom of choice in a given space and time, bounded by the system's logic." (PALOMINO *et al.*, 2019b)

Accordingly, **Storytelling** in gamification for education can be defined as:

"how the context is presented and the plot developed (the story is told) in a particular environment."

As for the limitations of this research, we opted to work only with grounded theories about narrative. We are aware that recent communication studies are delving into the cross media (as in the same content being transmitted via different media platforms (JENKINS, 2006)) and

transmedia (as in different contents that are parts of a whole transmitted on different media platforms (JENKINS, 2006)) viewings of narrative, researching the development of complex worlds and narratives that can be experienced through a myriad of different media. As we believed the very base definition of narrative in gamification did not match the concepts from game studies literature, we chose to develop a solid definition that could be understood and used with different areas aiming to build and relate with content gamification frameworks.

We believe the path to using narrative as a content element for gamification frameworks or approaches is the ability to map and control the user experience to guide the student through learning. To do that, we should delve into UX concepts and cross them with digital games interaction. If we can bring to software outside a game the same feeling a player has when creating their path through the game, we achieve the goal of narrative in a gamified environment.

As stated before, the engaging ability is, amongst other things, directly connected to the experience and satisfaction resulting from the interaction process (HODENT, 2017). It is possible that, in progressing through this topic, the viewing of transmedia and vast narratives may be helpful for even more complex frameworks.

This research generated a short paper that was published at ICALT 2019: "Narrative for Gamification in Education: Why should you care?" that can be read at the appendix of this thesis.

3.2 Applying Narrative in Practice

This section details a case study conducted using action research methods (HAMMOND; WELLINGTON, 2012), where the researcher actively participated in the environment being researched and focused on how to teach complex narrative definitions using educational technology support.

Audiovisual and interactive narratives are used in movies, series, digital games, websites and apps (MURRAY, 2017). Traditionally this content is taught through multimedia learning methods (MAYER, 2005). However, given the specificities of the various types of narrative, such as digital and interactive narratives (embedded and emergent; linear and non-linear) (MANOVICH; MALINA; CUBITT, 2001; SALEN; TEKINBAŞ; ZIMMERMAN, 2004; BISSELL, 2011; PALOMINO *et al.*, 2019b) we found that this method alone was not enough for students to internalize knowledge and to apply it in a practical way (e.g., in the creation of such narratives and stories in games) (RAU; ALEVEN; RUMMEL, 2009; POLICARPO; SANTAELLA, 2018). Given this context, there is a concern on how to prepare students to write for the digital media (LEWIS, 2007). This teaching practice experience was inspired by the following question: **“How can we add a level of complexity to writing lessons and still engage students?”**

In this sense, this research proposes a new approach, using digital tools whose resources provided an environment for the actual construction of an interactive narrative. Furthermore, we choose the "Interactive Fiction" subject from a Digital Games undergraduate course. Formerly, this subject was taught using multimedia learning resources. Although the students succeeded in the evaluations and theoretical tests (*i.e.* they could define each concept in words), we noticed that in the practical tasks, these definitions had not been assimilated correctly. Thus, students were able to repeat the concepts without really understanding and internalizing, unable to retain that knowledge or even apply it in practice. Then, we taught the same subject using multimedia learning resources (MAYER, 2005) plus direct practical application with the support of Information Technologies (ITs), the platform *Storium*[2]. Storium is a platform that supports writing stories through game-like elements and experience (PROTAGONISTLABS, 2019). From novice to professional levels, the platform is an excellent way to apply the concepts of the subject taught.

3.2.1 Methods and Materials

This experiment was based on the constructionist learning method, which understands that learning takes place between teacher and student together; that is, the teacher is a mediator of the knowledge that the students already have in search of new knowledge, creating conditions for the student to experience situations and interactive activities, in which they will create their new knowledge (ERTMER; NEWBY, 1993).

The research method used was the "action research", which can be understood as a strategy for conducting qualitative and applied scientific research, of a participatory approach, which includes the objective of seeking a collective solution for a specific situation. Action research proposes that the researcher take a collaborative and iterative approach, aiming, together with the participants, to transform their practices and the understanding of life and work situations (HAMMOND; WELLINGTON, 2012).

For research to be characterized as action research, there must be an intervention process that is an integral and central part of the research itself through joint action with the other individuals involved. This method has two objectives: through the research, it promotes the expansion of scientific knowledge; through action, an improvement is promoted for a real problem existing within the environment where this research is performed (FILIPPO DENISE; ROQUE; PEDROSA, 2019).

In the educational area, action research contributes mainly to the improvement of the teaching process by teachers, based on their research, reflecting on the students' learning process. Although a group of teachers most commonly uses this method, instructors and other members of an educational institution (FILIPPO DENISE; ROQUE; PEDROSA, 2019). For this experiment, guided by the concepts of constructivism, we sought to assign students, in addition to the role of

[2] <http://www.storium.com>

learners, the role of researchers whose construction of knowledge would occur in an iterative and incremental way. Therefore, we aimed to teach the students how to plan an embedded narrative and an emergent narrative in interactive stories and create these stories in a collaborative way.

3.2.1.1 Participants Profile

In total, 27 students were enrolled in the "Interactive Fiction" lecture, 25 male and two female, age group of 18 - 28 years; all of the students were in the third semester in the Digital Games undergraduate course at the University of Araraquara (UNIARA). These students had experience with storytelling because of the previous lectures of "Script and Storyboard I and II", focusing on Digital Games. The progression of these two disciplines was "Interactive Fiction", whose objective, according to its instructional plan, is to enable the student to reflect on the artistic and technical genres (traditional and interactive), debating the nuances of the technological and literary universe. At the end of the lecture, they should be able to elaborate narratives focused on the development of digital games.

3.2.1.2 Instructional Plan

This section describes the instructional plan of the subject, the standardized structure for each class (Figure 11) and the lesson plan used (Table 2), with classes being weekly and having 100 minutes each, during a whole semester. The lesson begins with a **theoretical explanation**, followed by a **task** to demonstrate the concept explained in real situations. This task can link the concept to the activities of the IT platform and the examples of students' daily life in an interactive way, leading them to seek their examples. Then, the second half of the lesson deals with the **discussion of practical activities**, with students' follow-up and discussion of strategies, always connecting with the main topic of the lesson, presented in the theoretical explanation. Finally, it ends with a brief **review and questioning time**, reminding the activities that need to be delivered next week.

Figure 11 – Standard structure created for all classes

3.2.1.3 The Storium Platform

Storium is a web-based collaborative game. It allows the player to choose from a library of imaginary worlds to play in or build their own. They can create their story's characters and decide what happens to them (PROTAGONISTLABS, 2019). Storium uses game design elements that are favourable in educational environments, such as avatars, narrative, storytelling,

Table 2 – Interactive Fiction Lesson Plan

Lesson	Topic
01	Subject Presentation
02	Brief history: from the literary universe to the technological one
03	Traditional Fiction x Interactive Fiction
04	Narrative x Storytelling (What is the difference?)
05	Narrative in Digital Media - Websites
06	Narrative in Digital Media - Series
07	Narrative in Digital Media - Games
08	First Bimester Test
09	Delivering of results and Test discussion
10	Using flowchart to aid in the narrative construction
11	Character Creation for Interactive Narratives
12	Embedded Narrative - Linear Progression
13	Embedded Narrative - Non Linear Progression
14	Emergent Narrative - The Power of Choice
15	Second Bimester Test
16	Delivering of results and Test discussion

challenges and rewards (TODA *et al.*, 2019a). In each Storium game, one player is the narrator, and everyone else takes on the role of a character in the story. The narrator creates dramatic challenges for the other players to overcome. In doing so, they move the story forward in a new direction. Everyone gets their turn telling the story.

The platform uses the same basic concepts as RPGs (Role-playing Games), where a storyteller tells a story and players interact with scenes and NPCs (non-player characters) to build a shared narrative (GYGAX; ARNESON, 1974).

3.2.1.4 Practical Tasks

The learning theory behind this instructional plan was the constructivism paradigm, which postulates that we learn to do something in doing it - actively building our knowledge, and the environment can act as a facilitator (or an obstacle) (PIAGET, 1964). The emphasis on this theory is in the learning process itself, which directly relates to the way in which our memory works: the deeper the information processing, the better the retention of knowledge (CRAIK; LOCKHART, 1972). The student is encouraged to explore, discover and experience as long as there is feedback on their successes and failures. This approach emphasizes the importance of purposeful learning (as opposed to learning forced) or meaning.

The teacher first designed the world for the interactive fiction to be created, based on one of the imaginary worlds from the platform's own library, and called it "Monster Academy". Then, the students were directed to create their characters inside this world, their own avatars with whom they would create their narratives and a collaborative story. The story was organized into three acts and seven scenes, being each scene related to 1-2 of the traditional classes detailed

on Table 2.

The scenes were triggered by the teacher, who described some sort of situation that was happening in the imaginary world. This situation was related to a challenge that the characters needed to overcome. The students then needed to interact with that situation, describing their characters' actions, trying to solve the challenge in the most efficient way. The teacher would intervene wherever needed to guide the scene, but most of the time, the students were free to construct their whole scene. This could end in one of three ways: strong ending, weak ending, and neutral ending. This would be the metric from which the teacher would then construct the next scene, continuing with the story progression, and so on. As the story narrator, the teacher thought about the scenes in a way to link the situation to the theoretical concepts they were working on in the face-to-face classes.

In this task, the students would face the embedded narrative (*i.e.*, the teacher's scene triggers) and the construction of the emergent narrative (*i.e.* their choices as characters and their strategies). In parallel with the interactive story's construction, the teacher conducted other practical activities such as the characters' origin's story in a solo adventure format (HARRIGAN; WARDRIP-FRUIN, 2010). As for the theoretical content, the instructional plan was created using multimedia learning concepts (*i.e.*, learning from words and pictures), assuming that the students should first select the information, then organize and finally integrate it (MAYER, 2005). The content was presented as pictures (via slides) and words (via teacher's presentation).

The students were warned that their grades would be given for their participation in the face-to-face classes and execution of tasks (regardless of performing them in the Storium platform or the other complementary works). The First and Second Bimesters Tests were the surveys to gather the students' feedback and evaluate their knowledge assimilation and were not considered for the grade composition. The First Test collected feedback about the Storium tasks so that the teacher could calibrate the following activities. The second one was focused on getting the students' final feedback on the whole experience.

3.2.2 Experience Report

In this section, we present the experience reports of the teacher who led the "Interactive Fiction" class, the report of the participating students and an analysis of the results of the practical tasks performed by them.

3.2.2.1 Teacher's Report

The teacher reported that it was an excellent experience in which it was possible to share the knowledge between them and the students in an organic and playful way. According to them, the experience was something fun and did not seem like a traditional subject itself. The students seemed engaged in building the story, and most of the class actively participated until the end of

the activities. Only three students did not get involved and did not meet the deadlines, thus failing in the subject. One student had trouble writing with his classmates, requiring close supervision of the teacher to complete the assignments. In general, the teacher considers that the classes had a high level of acceptance on the student's side, favouring the understanding of the concepts of embedded narrative and emergent narrative (SALEN; TEKINBAŞ; ZIMMERMAN, 2004), through the construction of their own interactive story. Regarding the instructional plan, the teacher considers that the integration of face-to-face classes focusing on multimedia learning (MAYER, 2005), adding to the practical activities carried out at home through the digital platform, was enough to pass theoretical concepts and immediately test and validate the students with the aid of Storium.

One of the greatest challenges encountered by the teacher was precisely to focus on the didactic aspect of the classes. Since it was widely accepted, and for many students, these activities became something they looked forward to as entertainment rather than an educational task; the teacher had to mediate some of these interactions to maintain the cohesion of the teaching/learning process. According to the teacher, some students even lost interest in other subjects taught by the same teacher to only learn and talk about this discipline.

Regarding "what topic did the students have the most difficulty in? And Why?" the teacher replied that it was the understanding of the breadth of students' options on the platform to build their stories and how far they could influence the stories of their peers (*i.e.*, emergent collaborative narrative). About "Which subject was best understood by students and why?", the teacher replied that it was the concept of embedded narrative, collaborative writing and character building.

The teacher also noted that most of the students who didn't like and/or had difficulties with this approach also didn't like and/or understand the core subject. This can be demonstrated by these same students' poor performance on the previous related subjects of "Script and Storyboard I and II". Students that had difficulties with the base subjects from their first year on the course continued showing the same problem in the following subject. From this insight, we can infer that this approach was helpful to deepen the learning process of those already understanding the basic concepts but was not effective in motivating those who already had difficulties and getting them to learn from scratch something they had not understood before.

3.2.2.2 Student's report and evaluation

In order to obtain an account of the experience of the students who participated in the "Interactive Fiction" subject, a survey that included the level of satisfaction, learning and difficulty was applied, as well as a group interview. Of the 27 students who were present on the first day, 23 fully succeeded the course, with four students doing final recovery exams where only one student failed as seen in Figure 12a. Of the total number of students, 78% said they liked it or liked to have participated, while 22% reported feeling lost, and because they did not like writing,

they did not feel motivated to write so much and preferred entirely theoretical classes as seen in Figure 12b.

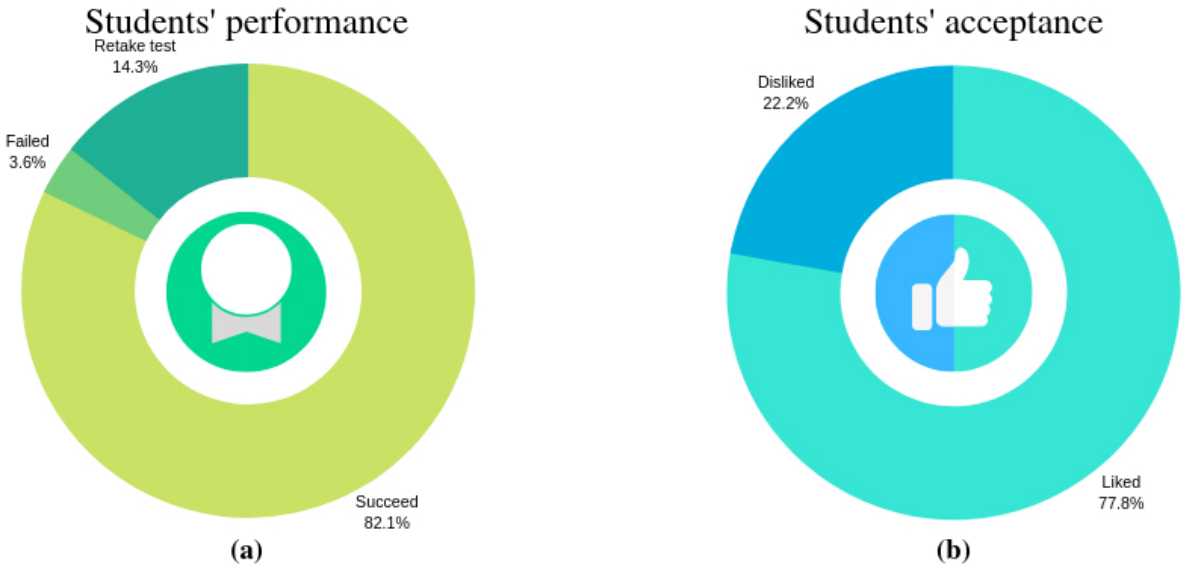


Figure 12 – Students success rate on the subject

The students also reported having identified themselves with the created universe and having fun creating the characters and role-playing them to describe their actions. Also concerning the experience, some students complained there were colleagues who, according to them, "did not write together and did not worry about all the scene details, wearing it down". This vision and behaviour generated some misunderstandings among the students and thus needed the teacher's intervention.

In general, the students realized that to create a strong narrative, they could use strategy with their colleagues and align their movements on the platform so that the writing of one would directly support the writing of the next one. Through this behaviour, the students reported that they were more successful in making their choices and how they would unfold.

Regarding the level of difficulty, 45% of the students reported that the platform could be more intuitive because they had some difficulty in understanding the mechanics of challenges and cards that the platform offers as support for the construction of the story, while 23% of the students reported having had no difficulty with the platform and 10% reported that by the end they had not understood the platform's supporting mechanics. Nevertheless, even without their use, they had been able to understand the concepts and build their stories. Besides that 22% of the students reported that they did not like or did not understand the tasks and therefore abandoned the subject, preferring to face a final test before ultimately failing the subject as seen in Figure 13.

As a result of this experience, the new class, using the playful and interactive environment, finished the discipline both knowing how to define the concepts (*i.e.*the 'research' part of the

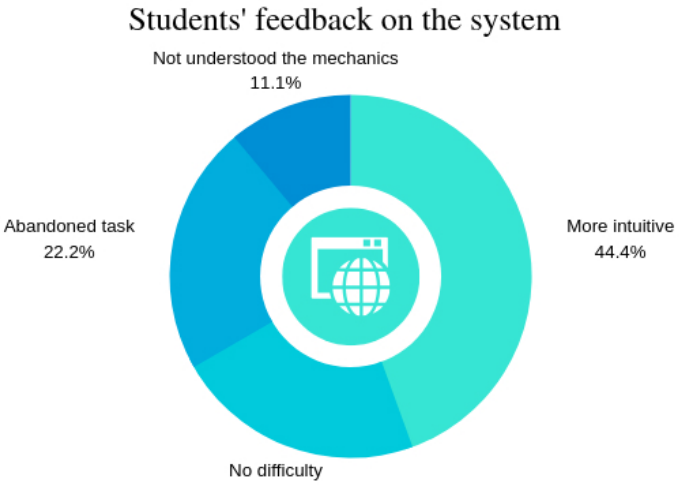


Figure 13 – Students feedback regarding the IT use

action research method used) and knowing how to apply them in practice (*i.e.* the action part of the action research method). Also, the same definitions were more profound than the previous class, attesting that the students were able to internalize the knowledge successfully. However, some problems arose in the course of the experiment. A few students were completely demotivated, others engaged excessively to the point where they did not want to deal with the other course subjects, and there were some conflicts between colleagues because of the high level of involvement with the characters and the story (which some authors call gaming the system (PEDRO; ISOTANI, 2016)). Because of this, although they were working around problems, the overload on the teacher became more significant than in a traditional classroom. Also, this kind of approach will not work in larger classes because the content the teacher needs to read, create, moderate and mediate would be too large.

This research was published as a full paper on RENOTE 2020 journal, under the title: "Teaching Interactive Fiction for Undergraduate Students with the Aid of Information Technologies: An Experience Report" and can be read in this thesis appendix.

3.3 Chapter Conclusions

This chapter presented two studies whose objective were to answer **sRQ1** : **What is narrative in gamification for education and what are its specific features?**. The first study, theory-driven, described the process we used to create the Narrative and Storytelling definitions for use in the rest of the research. The second one described a case study where the narrative was applied in a classroom with the aid of Educational Technologies, considering our theoretical definitions, with positive results. Both studies generated published papers as contributions and are the basis for the following chapters.

CHAPTER

4

NARRATIVE GAMIFICATION FRAMEWORK FOR EDUCATION

This chapter presents and discusses the process to create and validate the Narrative Gamification Framework for Education. First, we describe an exploratory data-driven study to understand how, from the users' perspective, the elements of Narrative and Storytelling could be used to improve learning, and then, a second study describing the process to develop the final framework.

4.1 Exploring Narrative and Storytelling: A Data-Driven approach

In this section we sought to answer the following research question *"How can we use Storytelling and Narrative alongside other gamification elements to improve students engagement?"*. Therefore, we proposed a data-driven study based on a previous work developed by (TODA *et al.*, 2019c), where they explored the acceptance of gamified strategies. Our main contribution is a new set of recommendations based on the group of preferred game elements that can be used alongside Narrative and Storytelling elements, by teachers and instructors.

4.1.1 Narrative and Storytelling in Education

Narrative and Storytelling have been explored by humanity for a long time, and their importance understood, as we described in previous chapters. Nevertheless, few works focused on exploring the concept of Narrative or Storytelling in games applied to education. One example is (CHAMPAGNAT; DELMAS; AUGERAUD, 2010), who dealt directly with the storytelling concept applied to learning. The authors presented a variation of Campbell's Hero Journey (CAMPBELL, 2008) exclusively for interactive storytelling and show how this model can be

used in an educational context using serious games.

Following, (ADAMS *et al.*, 2012) stated that the narrative hypothesis deals with how a story or narrative element can impact on learning outcomes, suggesting that when considering learning from texts, if the information is in a narrative genre style, it is better learned and retained than the information from an expository or descriptive text (LANDERS; ARMSTRONG; COLLMUS, 2017). Although this narrative view is restricted to text literature, it provides insights into how the narrative element can be applied to improve the learning.

Next, the theory of gamified learning (LANDERS, 2014) presented a model in which game elements could be used in isolation or in limited combination, to gamify the instructional process aiming to improve learning. Each game element should be linked to specific behavioral, motivational or attitudinal outcomes that connect with learning outcomes, in order to make gamification in education effective (LANDERS; ARMSTRONG; COLLMUS, 2017).

(CHAUVIN *et al.*, 2015) presented a study directed to supporting player-triggered narrative processes in game emergent narratives, working with methods such as procedural content generation (TOGELIUS *et al.*, 2011; HENDRIKX *et al.*, 2013) to increase the number of possible situations the player encounters. Although it is focused towards games that are not educational and do not deal with gamification, the aspects covered by the study (*i.e.,* support the generation of emergent narrative using ”Interpretation Engines” and Procedural Content Generation techniques) can point to a practical way to use narratives for gamification in educational environments.

Finally, (TODA *et al.*, 2019c) designed an approach to identify gamification patterns using Association Rule Mining (ARM), by applying surveys of people who play games and analysing their preferences. Although showing interesting initial results, the authors do not specifically explore in-depth the concepts of Narrative or Storytelling, and instead look into the genders' influence over general gamification patterns.

There are no studies, to the best of our knowledge, which focus on designing and applying the concepts of Narrative and Storytelling to gamified systems through a data-driven approach.

4.1.2 Methods and Tools

To conduct our study, we replicated the methods used in (TODA *et al.*, 2019c), which consisted of three phases: Data collection, Analysis and Summary.The first phase consists in applying a survey designed in (TODA *et al.*, 2019a) asking which are the game elements (N = 21 game elements) most preferred by students[1]. To recruit users, we used social networks. In total, we obtained 430 answers. To verify the reliability of the questionnaire, we applied Cronbach's

[1] The survey uses a Likert scale (TAVAKOL; DENNICK, 2011) from 1 (where they do not think the game element is important to them) to 5 (where they think the element is really important to them). More details can be seen in (TODA *et al.*, 2019a).

alpha and obtained $\alpha = 0.81$ (high reliability) (TAVAKOL; DENNICK, 2011).

This population is composed of Brazillian individuals, where 347 consider themselves as males, 80 females, 1 agender, 1 non-binary and 1 transgender. The average age is 26.9 years (SD = 8.2), with most individuals between 15 - 34 years (82.6%). This population has an experience in playing games of approximately 17.9 years (with relatively high variance, SD = 7) and play an average of 16.6 hours per week (with very high variance, SD = 17.2). This population also prefer RPG genre (43.3%) and single player games (68.4%).

Secondly, we analyzed the data through Association Rule Mining (ARM) (MANIMARAN; VELMURUGAN, 2015a), which is a method to discover patterns within data based on the frequency of the items. ARM uses the support (frequency) of an item in the dataset, and creates rules based on logical sentences (*e.g.*, $A \rightarrow B$) (AGRAWAL *et al.*, 1993). These rules are measured through their *confidence* and *lift* (MANIMARAN; VELMURUGAN, 2015b). To conduct the analyzes and report we analyze rules focused on Narrative and Storytelling with high confidence (> 0.8) and lift (1.5). These analyzes were made in R version 3.4.3 with packages *arules* and *arulesviz*. After extracting the rules, we evaluated and analyzed them with specialists in the field of gamification and aimed at creating the recommendations in a way that could be understood by teachers and instructors.

4.1.3 Results and Discussion

First, when we analyzed the element of Narrative, we found a total of 43 rules (Table 3) [2] that met the predefined conditions, as can be seen in Figure 14. As per Table 3, we identified the following: *i)* users who consider the elements of Cooperation, Objectives and Storytelling as totally important will prefer the element of Narrative with the same intensity. This suggests that, in an educational context, the gamified content should be presented with clear objectives and description (as in Storytelling) and their tasks should be able to be carried out cooperatively. As a result of this instructional design, the students would also look for their liberty of choice, constructing their own way (as in Narrative); *ii)* other association rule grouped Puzzles, Stats and Storytelling with the same importance as Narrative (=5). This suggests that students who favour Narrative associated with Storytelling also expect mental challenges (Puzzles) and real time inputs (Stats). In instructional design terms, this means that the content should be presented in a challenging way, with a subjective purpose (such as via a story), with clear information about the steps and a logical myriad of options and paths the student could choose to finish the task; *iii)* the group composed by Puzzle, Sensation and Storytelling indicates that it might be possible for the students to benefit from instructional design based on a story that should be told in a certain way to evoke sensations and experiences, while maintaining the challenge and logical order of events coming from the students' choices; *iv)* the group formed by Progression, Puzzles and Storytelling is similar to the previous one, but these students favour their sense of advancing in detriment of

[2] The Consequent Rules - right-hand-side (RHS) - are, in all cases, Narrative=5.

their subjective sensations; and *v)* the group composed by Objectives, Puzzles, Sensation and Storytelling expands the previous analysis and provides us with a possible cause for the uncertain improvement we gain with the use of exclusively structural elements in gamified educational systems. By bringing together the elements of Objectives and Puzzles (structure) with Sensation and Storytelling (content), associated with Narrative, we can infer that students, while wishing to have mental challenges and clear goals to follow, want to feel themselves sensorially and mentally immersed in the task; *vi)* the group composed by Progression, Objectives, Puzzles and Storytelling show us that even in the case in which the students' preference lays with structural game elements (Progression, Objectives and Puzzles), the addition of Storytelling associated with Narrative is equally important in the tailoring of the activity, for a better result.

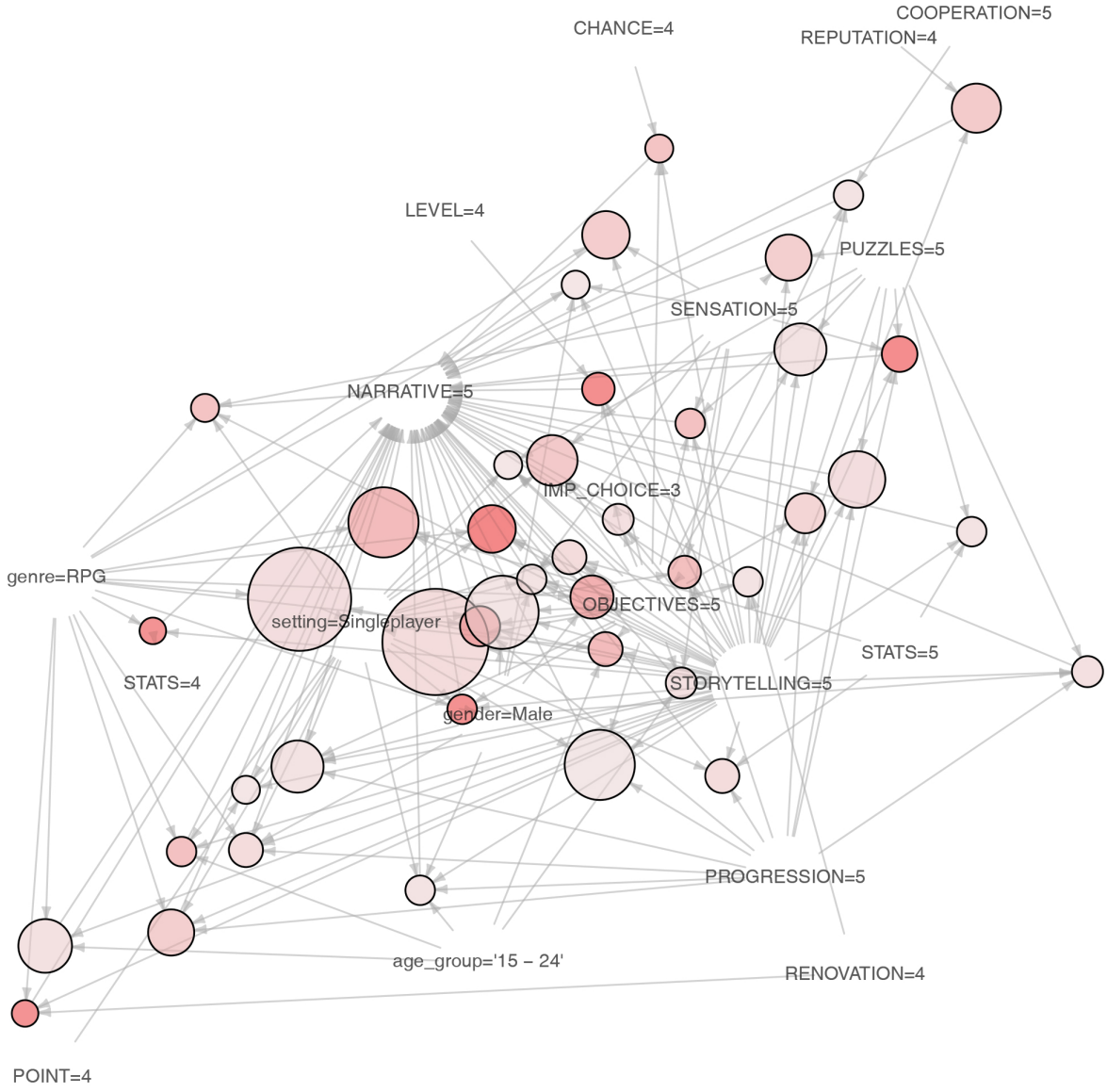


Figure 14 – Graph for 43 Narrative Rules

Table 3 – RHS Narrative Rules

Antecedent Rules - left-hand-side (LHS)	**Sup.**	**Conf.**	**Lift**
{REPUTATION=4, STORYTELLING=5}	0.13	0.95	1.52
{COOPERATION=5, OBJECTIVES=5, STORYTELLING=5}	0.10	0.93	1.50
{OBJECTIVES=5, CHANCE=4, STORYTELLING=5}	0.10	0.95	1.53
{setting=Singleplayer,POINT=4, STORYTELLING=5}	0.10	0.93	1.50
{PUZZLES=5,STATS=5, STORYTELLING=5}	0.10	0.93	1.50
{OBJECTIVES=5, PUZZLES=5, STORYTELLING=5}	0.13	0.93	1.50
{PUZZLES=5, sensation=5, STORYTELLING=5}	0.13	0.94	1.52
{PROGRESSION=5, PUZZLES=5, STORYTELLING=5}	0.14	0.94	1.50
{genre=RPG, STATS=4, STORYTELLING=5}	0.10	0.97	1.56
{LEVEL=4, OBJECTIVES=5, STORYTELLING=5}	0.10	0.97	1.57
{genre=RPG, RENOVATION=4, STORYTELLING=5}	0.10	0.97	1.56
{RENOVATION=4, OBJECTIVES=5, STORYTELLING=5}	0.10	0.93	1.50
{OBJECTIVES=5, IMP_CHOICE=3, STORYTELLING=5}	0.10	0.93	1.50
{age_group='15 - 24',genre=RPG,STORYTELLING=5}	0.14	0.93	1.50
{genre=RPG, OBJECTIVES=5, STORYTELLING=5}	0.16	0.96	1.54
{genre=RPG, sensation=5, STORYTELLING=5}	0.13	0.95	1.52
{genre=RPG, setting=Singleplayer,STORYTELLING=5}	0.21	0.94	1.50
{setting=Singleplayer,OBJECTIVES=5, STORYTELLING=5}	0.22	0.94	1.51
{OBJECTIVES=5, PUZZLES=5, sensation=5, STORY-TELLING=5}	0.10	0.95	1.53
{PROGRESSION=5, OBJECTIVES=5, PUZZLES=5, STORY-TELLING=5}	0.12	0.94	1.51
{setting=Singleplayer, OBJECTIVES=5, PUZZLES=5, STORY-TELLING=5}	0.10	0.93	1.50
{PROGRESSION=5, PUZZLES=5, sensation=5, STORY-TELLING=5}	0.11	0.98	1.57
{gender=Male, PROGRESSION=5, PUZZLES=5, STORY-TELLING=5}	0.10	0.93	1.50
{setting=Singleplayer, OBJECTIVES=5, STATS=5, STORY-TELLING=5}	0.11	0.94	1.51
{setting=Singleplayer, PROGRESSION=5, STATS=5, STORY-TELLING=5}	0.11	0.94	1.51
{age_group='15 - 24', genre=RPG, set-ting=Singleplayer,STORYTELLING=5}	0.10	0.95	1.53
{genre=RPG, PROGRESSION=5, OBJECTIVES=5, STORY-TELLING=5}	0.12	0.96	1.54

{genre=RPG, setting=Singleplayer, OBJECTIVES=5, STORYTELLING=5}	0.13	0.98	1.57
{gender=Male, genre=RPG, OBJECTIVES=5, STORYTELLING=5}	0.12	0.96	1.54
{genre=RPG, setting=Singleplayer, sensation=5, STORYTELLING=5}	0.10	0.95	1.53
{gender=Male, genre=RPG, sensation=5, STORYTELLING=5}	0.10	0.93	1.50
{genre=RPG, setting=Singleplayer, PROGRESSION=5, STORYTELLING=5}	0.13	0.94	1.52
{age_group='15 - 24', OBJECTIVES=5, sensation=5, STORYTELLING=5}	0.10	0.93	1.50
{age_group='15 - 24', setting=Singleplayer, OBJECTIVES=5, STORYTELLING=5}	0.11	0.96	1.54
{setting=Singleplayer, OBJECTIVES=5, sensation=5, STORYTELLING=5}	0.13	0.95	1.52
{setting=Singleplayer, PROGRESSION=5, OBJECTIVES=5, STORYTELLING=5}	0.16	0.93	1.50
{gender=Male, setting=Singleplayer, OBJECTIVES=5, STORYTELLING=5}	0.17	0.93	1.50
{gender=Male, genre=RPG, setting=Singleplayer, OBJECTIVES=5, STORYTELLING=5}	0.10	0.97	1.56
{gender=Male, genre=RPG, setting=Singleplayer, PROGRESSION=5, STORYTELLING=5}	0.11	0.94	1.51
{gender=Male, age_group='15 - 24', setting=Singleplayer, PROGRESSION=5, STORYTELLING=5}	0.10	0.93	1.50
{setting=Singleplayer, PROGRESSION=5, OBJECTIVES=5, sensation=5, STORYTELLING=5}	0.10	0.95	1.53
{gender=Male, setting=Singleplayer, OBJECTIVES=5, sensation=5, STORYTELLING=5}	0.10	0.93	1.50
{gender=Male, setting=Singleplayer, PROGRESSION=5, OBJECTIVES=5, STORYTELLING=5}	0.13	0.93	1.50

The same process was done with the Storytelling element, where we found 66 rules (Table 4)[3], using the same predefined conditions, as can be seen in Figure 15. From this, we can infer that: *i)* The elements of Rarity and Narrative are tied with Storytelling, suggesting that in educational contexts, the tasks should have some kind of collectible reward related to how the students solve the task and the story/content to be learned; *ii)* another group composed

[3] The Consequent Rules - right-hand-side (RHS) - are, in all cases, Storytelling=5.

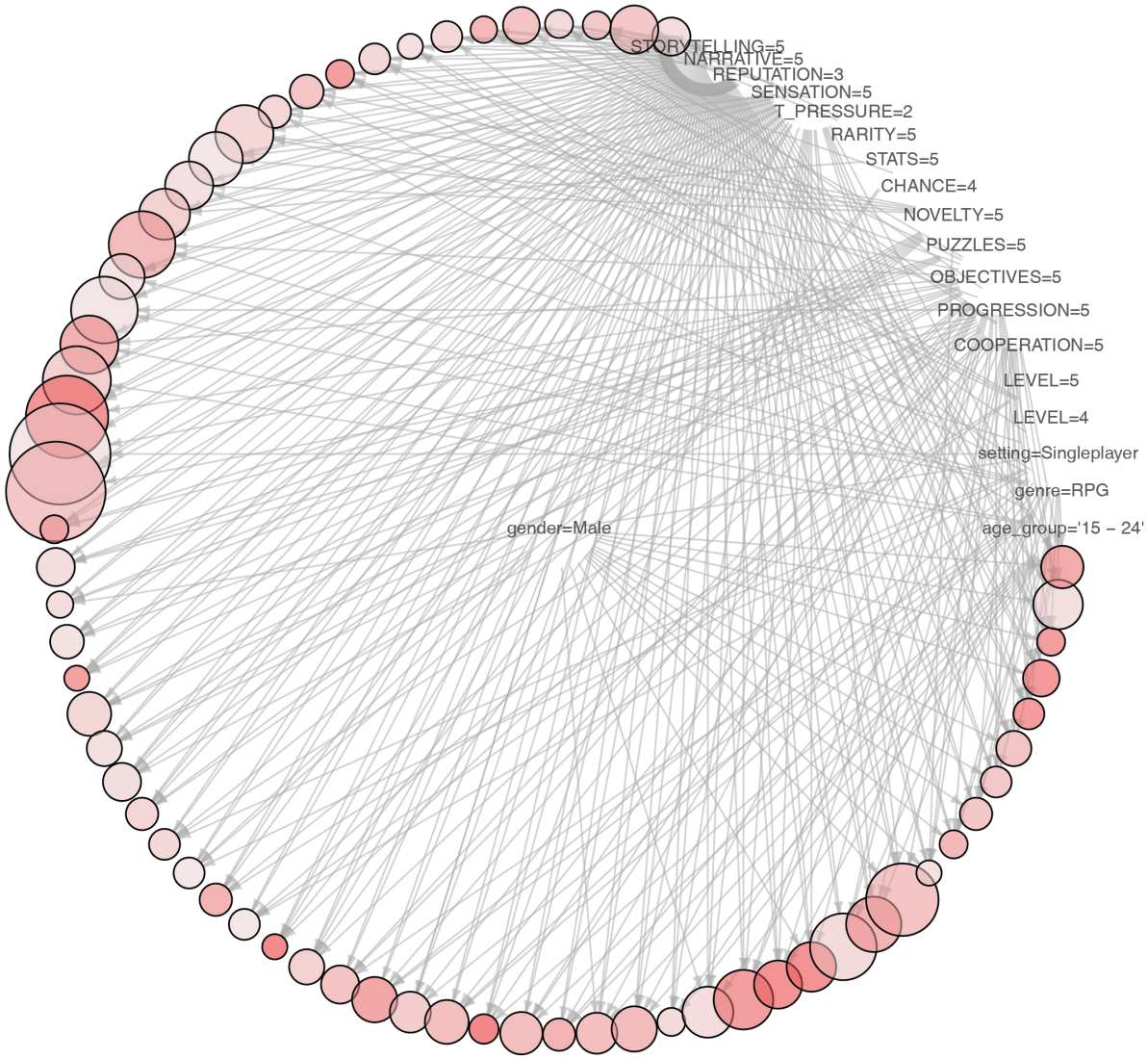


Figure 15 – Graph for the 66 Storytelling Rules

by Progression, Rarity and Narrative, associated with Storytelling, suggests an instructional design based on the previous analysis, but with the addition of the Progression element (*e.g.*, letting the students know where they are in the content; how much they progressed on the task at hand; and how much they still have to do to finish it); *iii)* the group formed by Cooperation, Objectives and Narrative, associated with Storytelling, can be analyzed in the same way as the first analysis on the Table 3's information; moreover, its existence shows that the relation between Narrative and Storytelling is bi-directional (*e.g.*, people who like Narrative also like Storytelling and vice-versa); *iv)* the group composed of Progression, Objectives, Novelty and Narrative adds a new element as a preference, suggesting that users would like the content to be updated and fresh, in order to hold their interest; and *v)* the group formed by Level, Objectives, Sensation and Narrative adds for the first time the Level element, meaning that content and structural elements can co-exist in harmony in gamified educational systems. People from these group favours clear goals and a measure of hierarchical layers present in the environment, as well as the content to

be presented inside a context, arising sensations and, consequently, meaning.

Table 4 – RHS Storytelling Rules

Antecedent Rules - left-hand-side (LHS)	**Sup.**	**Conf.**	**Lift**
{RARITY=5, NARRATIVE=5}	0.12	0.89	1.52
{T_PRESSURE=2, NARRATIVE=5}	0.13	0.92	1.56
{PROGRESSION=5, RARITY=5, NARRATIVE=5}	0.10	0.91	1.56
{COOPERATION=5, OBJECTIVES=5, NARRATIVE=5}	0.10	0.9	1.52
{COOPERATION=5, sensation=5, NARRATIVE=5}	0.11	0.92	1.57
{OBJECTIVES=5, CHANCE=4, NARRATIVE=5}	0.10	0.93	1.59
{setting=Singleplayer, REPUTATION=3, NARRATIVE=5}	0.10	0.90	1.53
{genre=RPG, LEVEL=4, NARRATIVE=5}	0.1	0.89	1.52
{LEVEL=4, OBJECTIVES=5, NARRATIVE=5}	0.10	0.90	1.53
{LEVEL=4, PROGRESSION=5, NARRATIVE=5}	0.10	0.95	1.62
{genre=RPG, NOVELTY=5, NARRATIVE=5}	0.11	0.92	1.57
{age_group='15 - 24', NOVELTY=5, NARRATIVE=5}	0.11	0.90	1.53
{OBJECTIVES=5, NOVELTY=5, NARRATIVE=5}	0.15	0.90	1.53
{NOVELTY=5, sensation=5, NARRATIVE=5}	0.14	0.88	1.50
{setting=Singleplayer, NOVELTY=5, NARRATIVE=5}	0.13	0.89	1.51
{STATS=5, sensation=5, NARRATIVE=5}	0.14	0.91	1.54
{genre=RPG, OBJECTIVES=5, NARRATIVE=5}	0.16	0.93	1.58
{genre=RPG, sensation=5, NARRATIVE=5}	0.13	0.89	1.51
{genre=RPG, PROGRESSION=5, NARRATIVE=5}	0.167	0.88	1.51
{age_group='15 - 24', OBJECTIVES=5, NARRATIVE=5}	0.15	0.94	1.60
{age_group='15 - 24', sensation=5, NARRATIVE=5}	0.16	0.91	1.55
{OBJECTIVES=5, sensation=5, NARRATIVE=5}	0.19	0.96	1.64
{setting=Singleplayer, OBJECTIVES=5, NARRATIVE=5}	0.22	0.88	1.51
{PROGRESSION=5, sensation=5, NARRATIVE=5}	0.22	0.92	1.56
{OBJECTIVES=5, PUZZLES=5, sensation=5, NARRATIVE=5}	0.10	0.93	1.59
{PROGRESSION=5, OBJECTIVES=5, PUZZLES=5, NARRATIVE=5}	0.12	0.89	1.52
{setting=Singleplayer, OBJECTIVES=5, PUZZLES=5, NARRATIVE=5}	0.10	0.89	1.52
{PROGRESSION=5, PUZZLES=5, sensation=5, NARRATIVE=5}	0.11	0.89	1.51
{OBJECTIVES=5, NOVELTY=5, sensation=5, NARRATIVE=5}	0.1	0.95	1.62
{PROGRESSION=5, OBJECTIVES=5, NOVELTY=5, NARRATIVE=5}	0.13	0.90	1.53
{gender=Male, OBJECTIVES=5, NOVELTY=5, NARRATIVE=5}	0.11	0.89	1.51

{PROGRESSION=5, NOVELTY=5, sensation=5, NARRATIVE=5}	0.12	0.89	1.52
{gender=Male, NOVELTY=5, sensation=5, NARRATIVE=5}	0.11	0.90	1.53
{setting=Singleplayer, PROGRESSION=5, NOVELTY=5, NARRATIVE=5}	0.10	0.90	1.53
{gender=Male, setting=Singleplayer, NOVELTY=5, NARRATIVE=5}	0.10	0.88	1.50
{LEVEL=5, OBJECTIVES=5, sensation=5, NARRATIVE=5}	0.11	0.94	1.59
{setting=Singleplayer, LEVEL=5, OBJECTIVES=5, NARRATIVE=5}	0.10	0.88	1.50
{OBJECTIVES=5, STATS=5, sensation=5, NARRATIVE=5}	0.1	0.97	1.66
{PROGRESSION=5, STATS=5, sensation=5, NARRATIVE=5}	0.11	0.90	1.54
{genre=RPG, PROGRESSION=5, OBJECTIVES=5, NARRATIVE=5}	0.12	0.92	1.57
{genre=RPG, setting=Singleplayer, OBJECTIVES=5, NARRATIVE=5}	0.13	0.95	1.61
{gender=Male, genre=RPG, OBJECTIVES=5, NARRATIVE=5}	0.12	0.91	1.55
{genre=RPG, setting=Singleplayer, PROGRESSION=5, NARRATIVE=5}	0.13	0.93	1.58
{age_group='15 - 24', OBJECTIVES=5, sensation=5, NARRATIVE=5}	0.10	0.97	1.66
{age_group='15 - 24', PROGRESSION=5, OBJECTIVES=5, NARRATIVE=5}	0.12	0.93	1.58
{age_group='15 - 24', setting=Singleplayer, OBJECTIVES=5, NARRATIVE=5}	0.11	0.94	1.59
{gender=Male,age_group='15 - 24', OBJECTIVES=5, NARRATIVE=5}	0.12	0.93	1.58
{age_group='15 - 24', PROGRESSION=5, sensation=5, NARRATIVE=5}	0.13	0.93	1.58
{age_group='15 - 24', setting=Singleplayer, sensation=5, NARRATIVE=5}	0.10	0.9	1.52
{gender=Male,age_group='15 - 24', sensation=5, NARRATIVE=5}	0.14	0.89	1.52
{PROGRESSION=5, OBJECTIVES=5, sensation=5, NARRATIVE=5}	0.15	0.95	1.62
{setting=Singleplayer, OBJECTIVES=5, sensation=5, NARRATIVE=5}	0.13	0.96	1.64
{gender=Male,OBJECTIVES=5, sensation=5, NARRATIVE=5}	0.13	0.96	1.64

{setting=Singleplayer, PROGRESSION=5, OBJECTIVES=5, NARRATIVE=5}	0.16	0.9	1.52
{setting=Singleplayer, PROGRESSION=5, sensation=5, NARRATIVE=5}	0.14	0.94	1.59
{gender=Male,PROGRESSION=5, sensation=5, NARRATIVE=5}	0.17	0.92	1.57
{gender=Male,PROGRESSION=5, OBJECTIVES=5, NOVELTY=5, NARRATIVE=5}	0.1	0.89	1.52
{gender=Male, genre=RPG, setting=Singleplayer, OBJECTIVES=5, NARRATIVE=5}	0.10	0.93	1.59
{gender=Male, genre=RPG, setting=Singleplayer, PROGRESSION=5, NARRATIVE=5}	0.11	0.92	1.56
{gender=Male, age_group='15 - 24', PROGRESSION=5, OBJECTIVES=5, NARRATIVE=5}	0.10	0.92	1.56
{gender=Male, age_group='15 - 24', PROGRESSION=5, sensation=5, NARRATIVE=5}	0.11	0.92	1.57
{setting=Singleplayer, PROGRESSION=5, OBJECTIVES=5, sensation=5, NARRATIVE=5}	0.10	0.95	1.63
{gender=Male, PROGRESSION=5, OBJECTIVES=5, sensation=5, NARRATIVE=5}	0.11	0.96	1.63
{gender=Male, setting=Singleplayer, OBJECTIVES=5, sensation=5, NARRATIVE=5}	0.10	0.95	1.62
{gender=Male, setting=Singleplayer, PROGRESSION=5, OBJECTIVES=5, NARRATIVE=5}	0.13	0.89	1.52
{gender=Male, setting=Singleplayer, PROGRESSION=5, sensation=5, NARRATIVE=5}	0.12	0.94	1.61

Other more general insights include the fact that Time Pressure is not considered important by these users, that they favours the RPG game genre and that most of them are males and between 15-24 years old. These are demographic information relevant to plan future instructional designs. In short, whilst different people have different preferences, it possible to identify and cluster these groups to ultimately tailor an educational system to suit these varied tastes. This is one of the reasons why it is necessary to deepen the studies in the recent field of data-driven education, as through this approach it is possible to reach a higher level of specificity and depth regarding these personal preferences of each student.

As far as the technical limitations of this study are concerned, only rules based on two elements and with high limits were considered (since this is a limitation of the ARM algorithm itself). Our sample of students also belongs only to Brazil, and these results have not yet been validated empirically.

This research was published as a full paper on SBIE 2019, under the title: "Exploring Content Game Elements to Support Gamification Design in Educational Systems: Narrative and Storytelling" and can be read in this thesis appendix.

4.2 Narrative Gamification Framework for Education

Following, this section describes the design process and theories used to create the Narrative Gamification Framework for Education. Also, we validate our framework from the perspective of domain specialists, such as teachers (from higher education and high school), game designers (digital and analogical game designers) and psychologists.

4.2.1 Background

Next, we detail the topics covered in this study and works related directly to this research.

4.2.1.1 Gamification in Education

Meta-analysis of the effect of gamification within the educational context show its effectiveness by demonstrating that gamification can affect different learning outcomes (i.e., behavioural and psychological), with its effect depending on several moderators (BAI; HEW; HUANG, 2020; SAILER; HOMNER, 2019). However, unlike in other areas where gamification is applied, it is necessary to consider the desired behaviour and learning gain in education. Thus, too much engagement in parallel with the educational content can hinder the learning process, even if it keeps the student immersed in the environment (KOIVISTO; HAMARI, 2019; LANDERS *et al.*, 2018). There are cases where gamification may be associated with adverse effects (TODA; VALLE; ISOTANI, 2018a), which further support the need for such balance. Many researchers assign these limitations to bad designs (TODA *et al.*, 2019; LOUGHREY; BROIN, 2018), often arguing that using the same game elements and strategies to everyone (i.e., the one-size-fits-all - OSFA - approach). Our research tackles this gap by providing a framework that, to the best of our knowledge, is the first to support the design of gamification strategies based on the narrative and subsequent user experience arising from its use, as well as the storytelling as how the content will be presented, therefore dealing with the students' learning experience. This framework, in essence, uses some important theories, which are described nest.

4.2.1.2 The Hero's Journey

The monomyth, or the "Hero's Journey", is a template derived from various categories of tales and lore that involves a hero who goes on an adventure and, after dealing with a decisive crisis, wins a victory, returning home changed or transformed (CAMPBELL, 2008). Since then, other authors have continued studying this universal epic journey, connecting it to a person's daily life struggles, simplifying and signifying Campbell's original 17 steps (ADAMS, 1981;

CAMPBELL, 2003; VOGLER, 2007). Vogler's 12 Steps were developed based on Campbell's study as a script for creating stories (*e.g.* movies, games, comics, books) and is widely used in occidental cinema (VOGLER, 2007). Its steps are described in Figure 16. In addition, there are other narrative frameworks, such as Propp's Morphology of the Folktale (PROPP, 1968), where the author identifies seven possible roles and 31 steps analyzing magic tales ("*volchébnoi skázki*"). Also, Ricoeur's narrative mimesis is understood as a dynamic activity such as the art of producing or representing something, defining narrative in conceptual frameworks related to humanity's need to deal with time (RICOEUR, 2010).

For this research, we chose to work with Vogler's Hero's Journey 12 steps as it is one of the most used and accepted templates in story creation (ROGERS, 2014; VOGLER, 1985) and, according to Jung, is rooted in humanity's unconscious. However, this framework comes from an anthropological study based mainly on Western societies, not reflecting Eastern society's most common narrative structures. This is a limitation we are aware of, and can be tackled in future works and possible variations arising from this original framework. Nevertheless, as in the case of our definition of narrative for gamification in education, having been based on consolidated theories and not having approached more recent and complex theories such as the concept of transmedia, for example, our framework intends to be the foundation and starting point for further research.

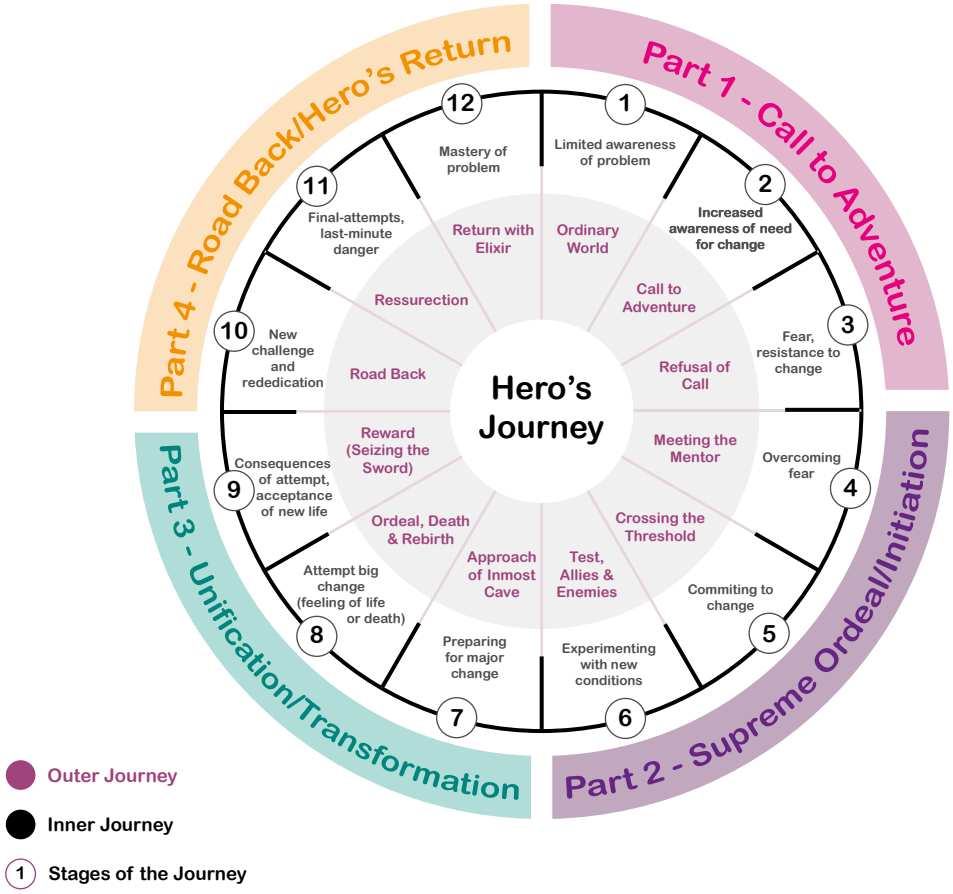


Figure 16 – Hero's Journey's 12 Steps (VOGLER, 2007)

Our framework adapted the Vogler's Hero's Journey to the educational context and includes, in its structure, the Student's Journey.

4.2.1.3 Narrative and User Experience | Storytelling and Learning Experience

Based on our prior research, narrative is defined as "the process in which the users build their own experience through a given content, exercising their freedom of choice in a given space and time, bounded by the system's logic." (PALOMINO *et al.*, 2019b) and is also known as karma system and implicit decisions. This intrinsic concept is the order of events in the game through the user experience. This experience is influenced by implicit choices made by the user. Examples of this are providing the content in different ways for the learner to choose by themselves, creating a branch and consequently a different user experience. (TODA *et al.*, 2019). We can affirm that by these definitions, the student must have several options to do content, but the final goal remains the same: to learn that content.

Considering User Experience (UX) as the set of elements and factors related to the user's interaction with a product, system or service whose result generates a positive or negative perception (NORMAN, 2013), it is possible to use certain UX techniques, such as mapping users' journeys to map narrative, creating milestones for particular tasks where the student can choose one path or another and predicting their behaviour when interacting with the system to present the next step.

In parallel to this, Storytelling deals with "how the context is presented and the plot developed (the story is told) in a particular environment, which can be through text, voice or even sensory" (TODA *et al.*, 2019), and Learning Experience (LX) deals with methods that focus on user learning, making the student protagonist of this process.

These four concepts permeate the whole framework, considering the students' journey in the system and their journey in learning.

4.2.1.4 Gameful Design Heuristics

Gameful Design Heuristics (TONDELLO *et al.*, 2019b), created to be an evaluation method for gameful designs, brought the concept of heuristics from usability engineering (as the general principles or broad usability guidelines that have been used to design and evaluate systems) and developed this set of particular heuristics specifically to inspect gameful designs. Experts use heuristic evaluation to identify usability problems in an existing design as part of an iterative design. Gameful Design Heuristics is the first tool focused specifically on evaluating gameful design through the lens of intrinsic and extrinsic motivational affordances and is originally aimed at enabling evaluators to identify gaps in a gameful system's design. They are organized in three categories and twelve dimensions, as shown in Figure 17.

Our framework uses these heuristics as part of our design iterative cycle, as guidelines of

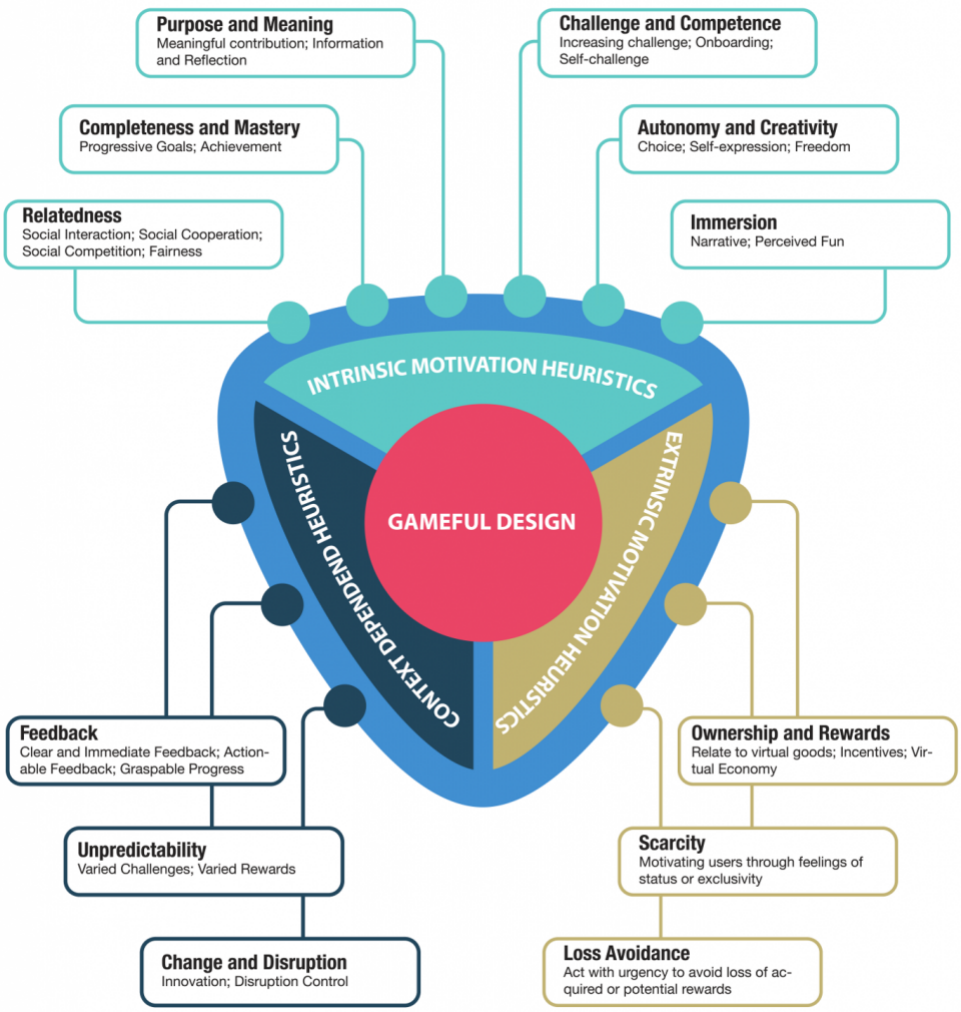


Figure 17 – Gameful Design Heuristics (TONDELLO *et al.*, 2019b)

students' user experience (and not as inspection tools), which the gamification designer should concern themselves with at the moment.

4.2.1.5 Learning Objectives and Learning Activities Types (LATs)

As for the link with learning theories, Bloom's original research, published in 1956, presented a framework to be used by teachers to support the instructional design of their classes (BLOOM, 1956). In 2001 this framework was revised, focusing on a more dynamic iteration (KRATHWOHL, 2002).

In this study, we use Bloom's revised taxonomy (KRATHWOHL, 2002), composed of the statement of a learning objective, where the verb (and the action associated with) refers to the cognitive process, and the object (usually a noun) refers to the knowledge expected the students to acquire. As such, the authors refer to two dimensions: the cognitive process one, categorized in six hierarchical stages (i.e., Remembering, Understanding, Applying, Analyzing, Evaluating, Creating); and the Knowledge Dimension, categorized in factual, conceptual, procedural and

meta-cognitive, as shown in the examples from Table 5.

Table 5 – Revised Bloom's Taxonomy Learning Objectives Example (KRATHWOHL, 2002)

Cognitive Process Dimension	**Knowledge Dimension**			
	Factual The basis that the student must have acquired with a subject.	**Conceptual** The relationships between the basic knowledge that allows them to make sense together.	**Procedural** How to apply knowledge, methods, skills and techniques.	**Meta-cognitive** Knowledge in its broadest form,awareness of the existence of this knowledge.
Remembering: Relevant knowledge from long-term memory.	List	Recognize	Recall	Identify
Understanding Construction of meaning through instructional messages.	Summarize	Classify	Clarify	Predict
Applying Application of a procedure in a given situation.	Respond	Provide	Carry out	Use
Analyzing Distinguish information between different parts.	Select	Differentiate	Integrate	Deconstruct
Evaluating Judging based on criteria and standards.	Select	Determine	Judge	Reflect
Creating Join or organize elements in a new form, pattern or coherent structure.	Generate	Assemble	Design	Create

Bloom's taxonomy of learning objectives was already used in gamification, matching the learning activities gamification designs to a cognitive taxonomy (BALDEóN; RODRÍGUEZ; PUIG, 2016) and is being currently used to map which gamification design users consider the most suitable to help them in performing a particular learning activity (RODRIGUES *et al.*, 2021b).

In our framework they guide the teacher to create the learning content with the right learning stages and the best gamification strategy to improve engagement both with the gameful system and the learning content.

4.2.1.6 Game Elements

Our framework is mainly based on Narrative and Storytelling as game elements. However, optionally, we can add other game elements to enrich the design.

Most gamification strategies are based on the use of the game elements, and there are many different classifications for them. Dignan *et al.* (DIGNAN, 2011) classified 19 concepts found in games; studies by Aparicio *et al.* (FRANCISCO-APARICIO *et al.*, 2013) classify these elements according to Pink's motivational pillars (PINK, 2011) and Tondello *et al.* (TONDELLO; MORA; NACKE, 2017) has been working on this classification for several years, and their most recent research shows 59 elements. However, these classifications do not consider that, in the case of educational environments, in addition to providing the gameful aspect of the elements, it is necessary to maintain the student's focus on learning. A recent study considered both aspects to create a new taxonomy, specifically for use in educational contexts. This taxonomy was created and validated by experts in the field of gamification and games (TODA *et al.*, 2019b). It was used to extract data on the relationship between the use of these elements in sets—through ARM techniques (PALOMINO *et al.*, 2019), as well as in the creation of GES (TODA *et al.*, 2020)—with positive results. It contains 21 game elements grouped into five dimensions (performance, ecological, social, personal and fictional), as can be shown in Figure 18. These dimensions facilitate understanding each game element's main area and can be better related to educational tasks in gamified design.

Our framework is built on the concepts of Narrative and Storytelling arising from our previous research and this taxonomy [4] and therefore can benefit from the addition of some other elements as needed.

4.2.1.7 Intructional Design Frameworks

Instructional frameworks provide a structure of components adaptable to work with different teaching styles, content areas and students' needs. They are designed to provide a step-by-step for teachers to create their learning content with confidence and method. One of the most famous instructional design frameworks is ADDIE, which stands for Analyze, Design, Develop, Implement, and Evaluate (MORRISON *et al.*, 2019) as seen in Figure 19. This sequence, however, does not impose a strictly linear progression through the steps. Teachers, instructional designers, and training developers consider this a practical approach because having clearly defined stages facilitates effective learning content implementation.

Our framework was designed to work together with any instructional design framework, encompassing their process into its own and becoming a robust framework to design gamified educational strategies.

[4] Our Narrative definition (PALOMINO *et al.*, 2019b) was used to define the elements of Narrative and Storytelling in this taxonomy.

Figure 18 – Taxonomy of Gamification Elements for Educational Environments (TGEEE) (TODA *et al.*, 2019)

4.2.2 Method

To build the Narrative Gamification Framework for Education, we used the Design Science Research model, whose main objective is to build knowledge that professionals from its domain can use to create design solutions to their field problems.

The design sciences focus on making choices about what is possible and valuable for creating possible futures rather than what already exists. (HEVNER *et al.*, 2004) state that the main objective of Design Science Research is to gain knowledge and understanding of a problem domain through the construction and application of a designed artifact, therefore being the most suitable research model for the construction of our framework. Design Science Research is divided into six steps that we describe and explain how each of them was applied to our research, therefore designing and evaluating the framework.

1. **Problem identification and motivation:** This step seeks to define the specific research problem and justify the value of a solution. In our cause, the central gap this thesis attacks is that gamification for education, differently from in other areas, has two layers of complexity: the students' engagement with the gameful system and the student's

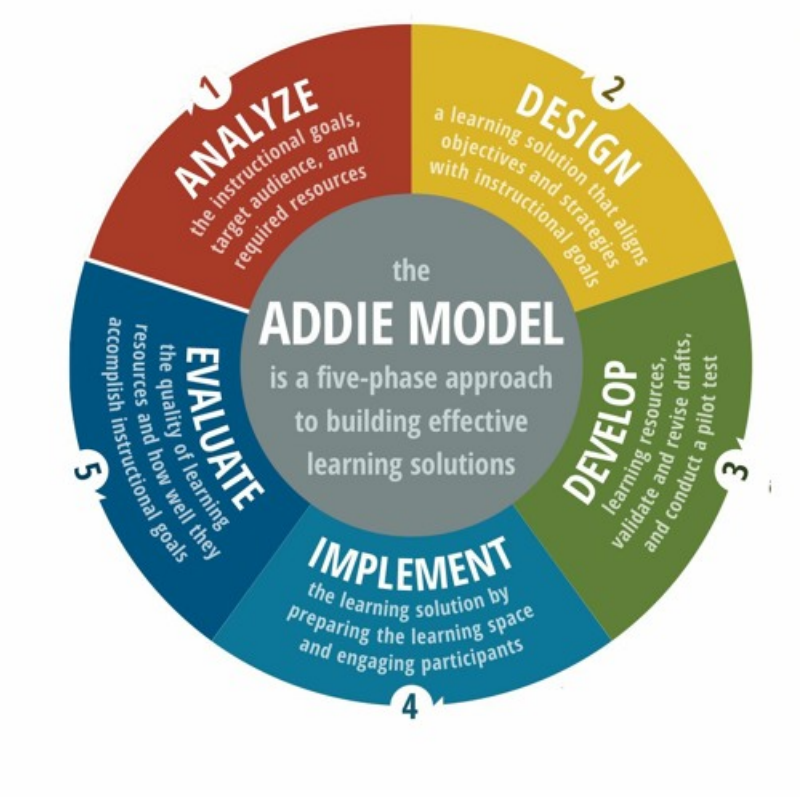


Figure 19 – ADDIE model (MORRISON *et al.*, 2019)

engagement with the learning process. Therefore, the most common game elements used in gamified solutions have little impact on the students' engagement, and when they are effective, they might hinder the learning process in exchange. We hypothesize that content-based elements such as Narrative and Storytelling might be more effective since they might be applied to the content and not to the system's structure. Considering these, we propose the creation of a Narrative Gamification Framework for Education, seeking to answer the following research question: **"How to create a systematic model that allows the creation of interactive narratives for gamification?"**

2. **Objectives of a solution:** In this step, we infer the objectives of a solution from the problem definition. For our research, these would be: "the development, test and validation of a narrative-based content gamification framework to be used in educational systems for higher education students."

3. **Design and development:** this is the step where we create the artifactual solution. Such artifacts are potential, with each defined broadly, constructs, models, methods, or instances (HEVNER *et al.*, 2004).

   We conducted exploratory research on the various theories described in the background section, using brainstorming techniques. The Hero's Journey, representing the personal growth journey, was related to the learning process the student goes through. In this sense, the common world (the hero's universe before and after returning from the journey, in the

first and fourth quadrants of the cycle) is related to the user experience and the special world (second and third quadrants) to the learning experience, so that, through a positive user experience, the student starts and advances to the special world on their learning journey. When they complete these steps, they return to their everyday world (as someone with more knowledge).

The experience on this journey is represented by the user experience supported by Narrative and the learning experience supported by Storytelling.

Therefore, our Learning Journey uses a summarized adaptation of the four quadrants, as follows:

a) **Call to Action:** the first quadrant is related to the UX, and the students first contact with the system and their motivation to start learning.

b) **Trials:** in the second act, the student is in their special world and the start of their learning experience. The stages of Remembering, Understanding and Applying from Bloom's Taxonomy better reflect the pedagogical content they should be studying.

c) **Transformation:** in the third act, the student is already used to the common learning challenges and should be able to transfer their newly acquired knowledge. Bloom's Analysing, Evaluating and Creating steps are more suitable for this arc's pedagogical contents.

d) **Result:** the last quadrant is responsible for evaluating the student's whole journey, what they learned, what they felt and how they changed in the process, and therefore is related to their user experience.

The framework works iteratively and incrementally, i.e., the educational gamification strategy can be implemented by blocks (or modules) in several different cycles, or it can be considered a journey for an entire subject, implementing the content progressively accordingly.

The framework design was done using the brainstorm technique and iterative processes, which started with a very rustic sketch Figure 20, and evolved, using feedback from other researchers in the area, for the versions shown in Figure 21,Figure 22 and finally our latest version Figure 23. In all these stages, based on exploratory research, we sought to relate better the fundamental theories used so that the processor would obtain a complete framework that could be used in various educational contexts, but that it would also be possible to observe in the framework what the journey was. that the student would be going through.

The model in Figure 24 has a double representation: The student's journey in the learning process (the 4 acts and Bloom's taxonomy) and the guidelines that the teacher must follow to implement the strategies (heuristics, instructional design and dimensions).

Figure 20 – Narrative Gamification Framework for Education Sketch - version 1.0

As a framework that considers the use of Narrative and Storytelling game elements a priority, both permeate the entire process and relate to the user experience (whether the student's experience with a gamified system or with the classroom itself), and the learning experience, which differs from the first in that it focuses on learning itself.

The key to using Narrative and relating it to UX is to guide students so they can create their own learning experiences (as a result of their personal choices and understanding of the learning process, as well as their decisions when doing the activities), with freedom of choice but with a clear goal in mind.

The Storytelling game element supports the narrative approach by providing resources to guide the learning experience and strengthen the context, thus strengthening why something should be studied.

Also, the framework supports the use of different frameworks for instructional design (such as ADDIE and Design Thinking) and Bloom's taxonomy, considered in some cases also as an instructional framework.

In this case, however, what we call frameworks for instructional design (represented in the model in the upper area of the circle with ADDIE model steps: Analyze, Design, Develop, Implement and Evaluate) define how the design cycle should be worked, while

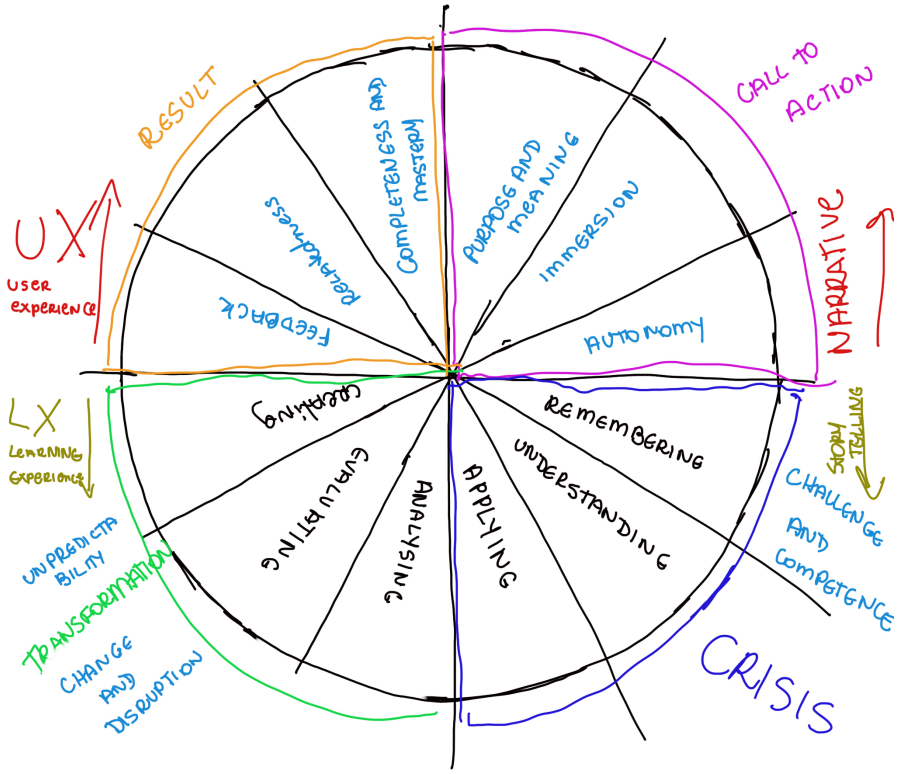


Figure 21 – Narrative Gamification Framework for Education Sketch - version 2.0

Bloom's Taxonomy, represented in the model at the bottom of the circle, in gradients of green (Remembering, Understanding, Applying, Analyzing, Evaluating and Creating), represents the student's learning stages during the learning journey.

4. **Demonstration:** in this step, we demonstrate the efficacy of the artifact to solve the problem. We built a case study based on an HTML and CSS module as an example and wrote complete documentation in accessible language. Then, we recruited domain experts (teachers, instructors, game designers and psychologists) to read the documentation, use it if they wanted and then participate in a semi-structured interview. The framework documentation sent to these experts in English and Portuguese versions can be read in Appendix A.

5. **Evaluation:** in this step, we observe and measure how well the artifact supports a solution to the problem. First, we used Mora's Framework Scale (MORA *et al.*, 2015) to describe, from the experts' perspective, what game design items they could grasp from reading the documentation. Next, their qualitative data were analyzed using Reflexive Thematic Analysis (BRAUN; CLARKE, 2006). After synthesizing the results, we generated the framework's final version, as seen on Figure 25. The detailed validation process can be read in the next section.

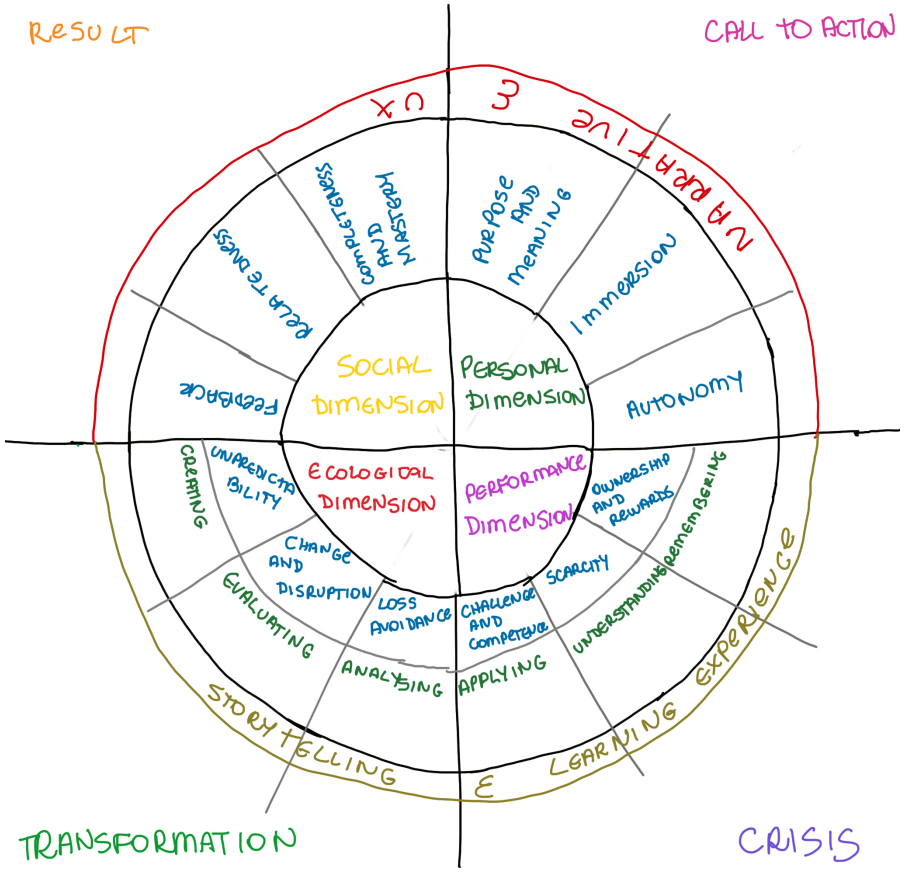


Figure 22 – Narrative Gamification Framework for Education Sketch - version 3.0

6. **Communication:** in this step, we communicate the problem and its importance, the artifact, its utility and novelty, the rigour of its design and its effectiveness to researchers and other relevant audiences. This research generated a full paper that is currently being written.

4.2.3 Framework Validation Results

In this section we describe the process we used to validate our framework from domain experts perspective.

4.2.3.1 Semi-structured Interviews

We recruited participants to receive the framework documentation, read it, optionally use it and then participate in a semi-structured interview. The participants were recruited from teachers, instructors, game designers and psychologists to assess the framework's general sense, ease of use and effectiveness. The interview was divided into three parts: the first, a demographic one; in the second part, they were asked to answer it, in their perspective, the framework presented each one of the 19 game design elements from Mora's Framework Scale Validation (MORA *et*

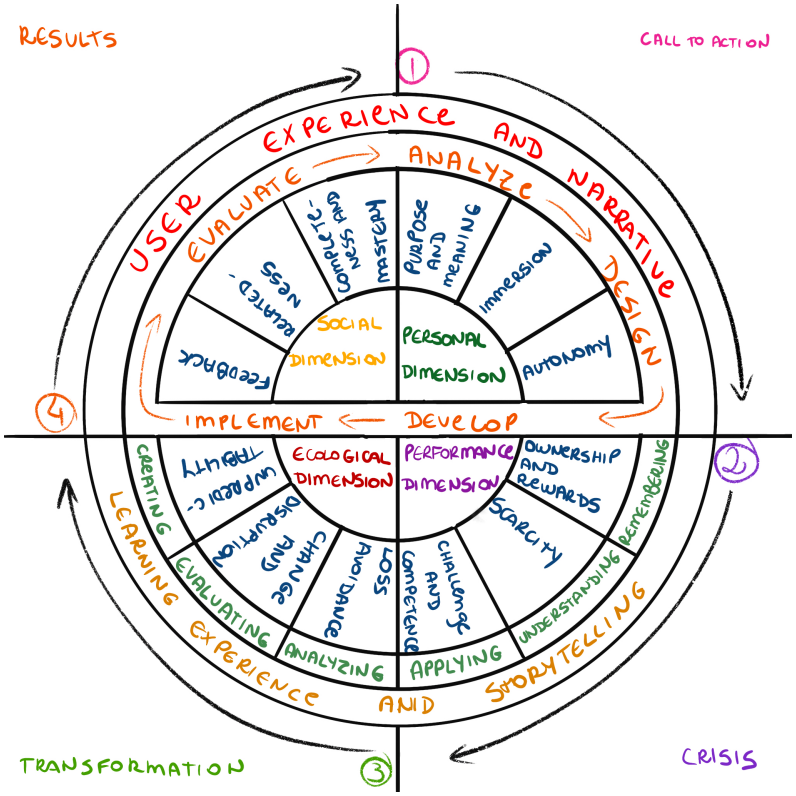


Figure 23 – Narrative Gamification Framework for Education Sketch - version 4.0

al., 2015). In the last part of the interview, they were asked several open questions to assess their opinion on the framework's clarity, usability and effectiveness.

We interviewed 12 Brazilian participants: six lecturers (teachers, professors and instructors); four game designers and two psychologists. Their age ranged from 32 to 49 years old; six were female and six male; only one of them did not play some king of game (analogical of digital); seven had already used some kind of gamified system before; nine of them had already tried to apply gamification in their field work; eight of them had some kind of experience with game design; only one of them did not have any experience with narrative before (as writer, researcher or player) and five of them had some king of knowledge in UX.

4.2.3.2 Framework Scale Validation

(MORA *et al.*, 2015) developed the framework scale to aid in a Literature Review of Gamification Design Frameworks, to provide a summary of the important properties in each framework and better assess their characteristics. We used the same scale to objective assess how the experts considered our framework, in terms of game design.

Mora's framework scale consists of 19 game design elements, clustered and organized into five categories, as follows:

1. Economic:

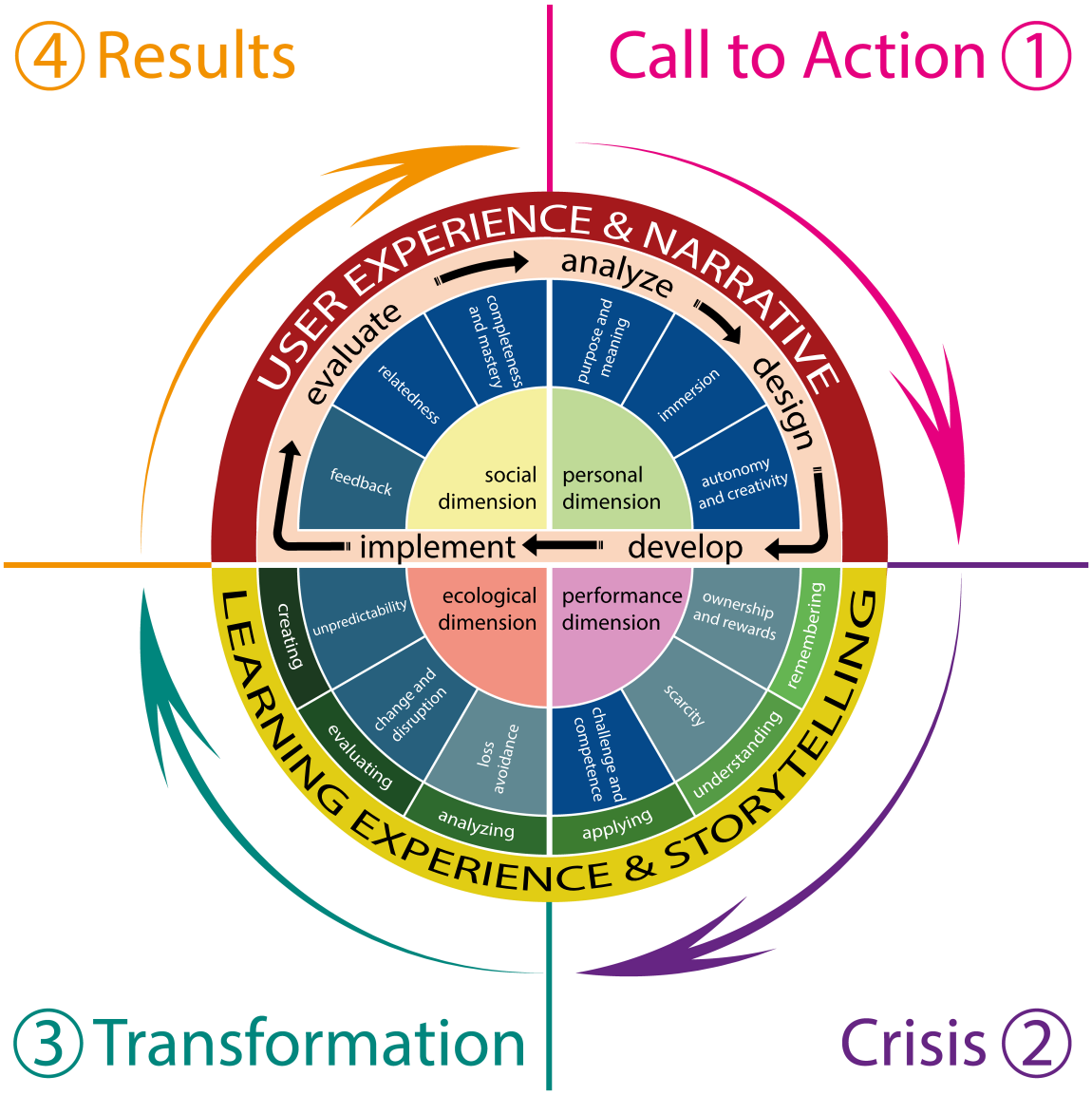


Figure 24 – Narrative Gamification Framework for Education Sketch - version 4.1 - Before Validation

- **Objectives:** are the specific performance goals.
- **Viability:** a previous study, evaluation and analysis of the potential of applying gamification or refuse it.
- **Risk:** a probability or threat of damage, injury, liability, loss, or any other negative occurrence.
- **ROI (Return On Investment):** the benefit to the investor resulting from running a gamified experience.
- **Stakeholders:** a technique used to identify and keep in mind the people who have to interact with the design process.

2. Logic

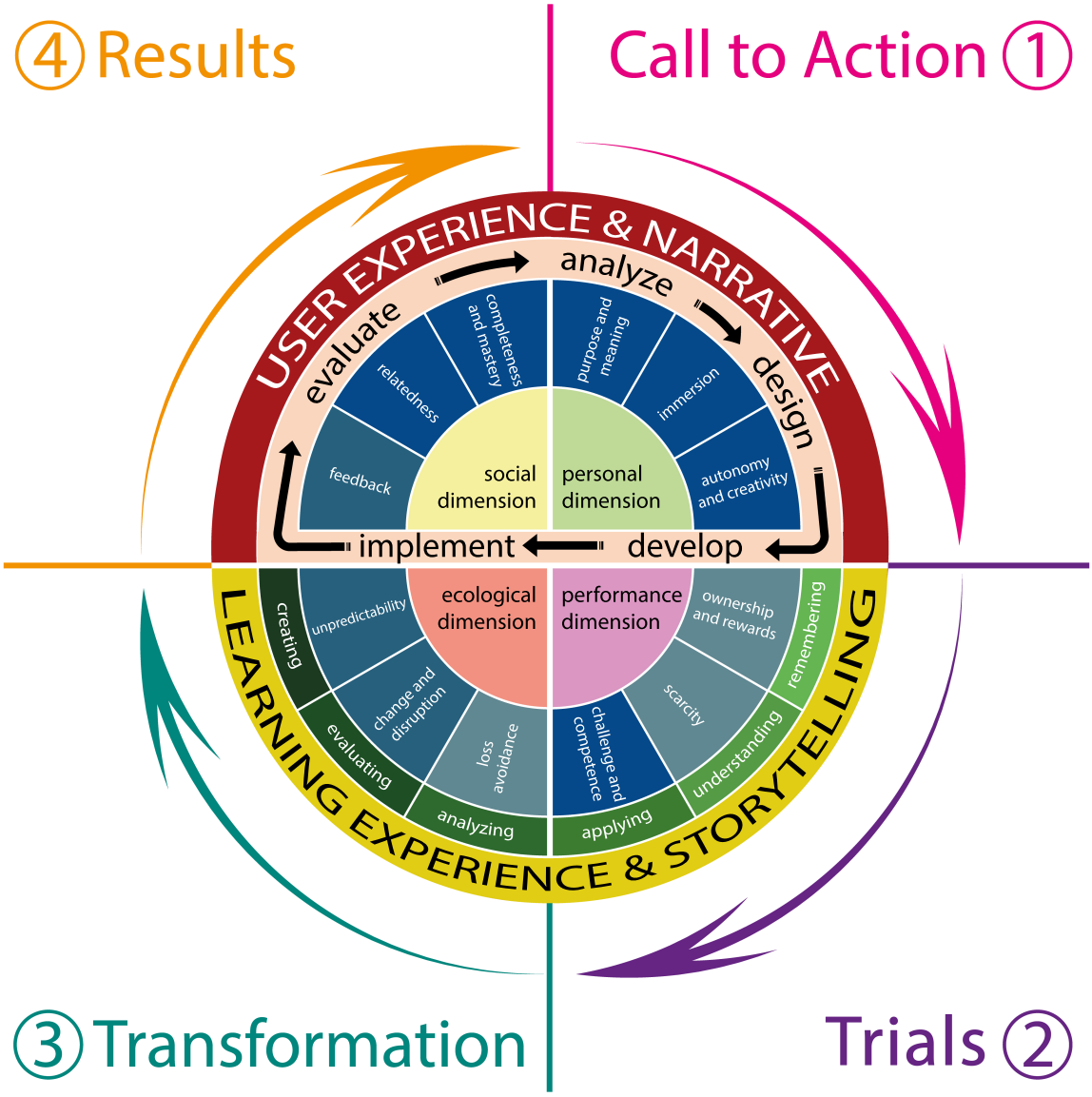


Figure 25 – Narrative Gamification Framework for Education Sketch - version 4.2 - After Validation

- **Loop:** the game mechanics combined with reinforcement and feedback in order to engage the player in the key system actions.
- **End game / Epic win:** a pre-established end of game or glorious victory in the system, usually stretching players to the limits of their abilities.
- **On-boarding:** the way of starting the new participants.
- **Rules:** the body of regulations prescribed by the designer.

3. Measurement

- **Metrics:** the standards of measurement by which efficiency, performance, progress, process or quality.
- **Analytic:** the algorithms and data used to measure key performance indicators.

4. Psychology:
    - **Fun:** the enjoyment or playfulness.
    - **Motivation:** the behaviours which causes a person to want to repeat an action and vice-versa.
    - **Social:** the interaction between players.
    - **Desired behaviours:** the expected response of the players after the interaction.
    - **Ethics:** a branch of philosophy that involves systematizing, defending and recommending concepts of right and wrong conducts.
5. Interaction:
    - **Narrative:** the story and context created by designers.
    - **UI/UX:** refers to everything designed into the gamified system which a player being may interact and the player's behaviours, attitudes, and emotions.
    - **Technology:** the use or need of a software component for development.

These items should be classified into:

- E: explicit, the item has appeared in the framework's definition.
- I: implicit, the item has not appeared explicitly in the framework definition. Inferred by the authors or referred inside an academic work of the author.
- U: unavailable, the item has not appeared anyway.

Table 6 details how each participant described the framework according to this scale.

4.2.3.3 Reflexive Thematic Analysis

Reflexive thematic analysis is an approach to analysing qualitative data to answer broad or narrow research questions about people's experiences, views and perceptions, and representations of a given phenomena (BRAUN; CLARKE, 2019), therefore we choose this technique to analyze our qualitative data from the domain experts perceptions about our framework. We used a mixed methods approach, having deduced four main themes at the beginning of coding: Usability, Efficiency, Hindrances and Improvements. However, other themes were induced during the process: Clarity; Equity; Motivation and Unplugged approach vs System approach.

Table 7 – Quotes supporting themes found in reflexive thematic analysis of interviews data

Theme	Quote
Theme: Usability	

Regarding ease of applying the framework	*You could explore the examples a little more and eventually create examples of different people, via systems, via the classroom, with different people, different teachers, to have a wide variety of examples, to help start in a more simplified way and take some of this first opportunity to fix the content to be able to apply*, (Participant I, Psychologist) *Usability is already put into practice in the document itself*, (Participant E, Game Designer) *I had a bit of difficulty understanding certain things due to the specificity of the terms"* , (Participant K, University Professor)
Theme: Efficiency	
Regarding the framework's efficiency	*For the vast majority of students, this is very likely to apply and have good results*, (Participant G, Game Designer and instructor) *The content we learn while having fun is the content we always learn, I like that idea on the framework, I strongly believe in this*, (Participant F, teacher)
Theme: Hindrance	
Regarding aspects that can hinder the process	*Resistance from students, because they believe that the traditional education system is better*, (Participant K, University Professor)
Theme: Improvements	
Regarding suggestions and upgrades	*The balance between engagement and learning needs to be measured and controlled by the teacher for the framework to be used effectively. It would be nice to have a metric in that sense, so they know if it's leaning one way or the other. Maybe a checklist of explicit and implicit things he can notice and balance*, (Participant J, Game Designer)
Theme: Clarity	
Regarding clarity of understanding	*I found the step by step perfect [...] However, it is thorough, one needs to be very careful when reading* , (Participant E, Game Designer)
Theme: Equity	

Regarding equity in education	*The framework is effective for a classroom without students with autism spectrum. It would not be effective for them, as a more specific view of that student would be needed. [...] If you can do a more in-depth analysis of these students' environments that are different, it would be great, because gamification could help students with special needs to better focus if designed accordingly*, (Participant G, Game Designer and Instructor) *It seems to me that the framework can be used for any age, including children from 7 years old* , (Participant F, teacher)
Theme: Motivation	
Regarding students' motivation	*When talking about the hero's journey, it is necessary to work deeper on the frustration and internal conflicts*, (Participant H, Game Designer)
Theme: Unplugged vs System	
Regarding the use of the framework in an unplugged or digital environment	*The interactive system makes the student more comfortable, with less social pressure to experiment more deeply*, (Participant F, teacher) *When we do something offline, there is an exchange between people and this is very important*, (Participant H, Game Designer)

Table 7 details each theme and shows a quote example from one of the participants.

4.2.4 Discussion

According to our validation, most experts consider the framework's documentation clear and objective; believe more varied examples would significantly improve its understanding; all of them would use it in their respective areas, including outside of education (the two psychologists would like to use it). There is a significant concern about equity, and half of the teachers commented on it, believing the framework needs improvement on this aspect. Some suggested that the documentation if it would be shared widely with teachers, should be even more accessible. They consider that all the sections explaining the framework's creation and theories are not of interest to the people who will use it. In this sense, something more like a straightforward step-by-step would be more helpful.

Our analysis of the framework scale used in the interviews showed the framework clearly demonstrates the game design elements in its build; for most of the answers, the item was explicit in the documentation, secondly, implicit. Few game design elements had a significant answer of unavailable, being relevant in the Risk and Analytic features. This demonstrates that, in general,

Table 6 – Participants' perspective on the Framework according to Mora's Framework Scale (MORA *et al.*, 2015)

FRAMEWORK VALIDATION SCALE	PARTICIPANTS											
ECONOMIC	**A**	**B**	**C**	**D**	**E**	**F**	**G**	**H**	**I**	**J**	**K**	**L**
Objectives	E	E	E	E	E	I	E	E	E	E	E	E
Viability	I	E	E	E	E	E	E	E	E	E	E	E
Risk	U	E	I	I	I	E	U	U	I	E	U	I
ROI (Return On Investment)	E	E	E	E	E	I	I	I	I	U	E	E
Stakeholders	I	E	E	E	I	E	U	I	E	E	E	E
LOGIC												
Loop	E	E	E	E	E	E	E	E	E	I	E	E
End game / Epic win	I	E	I	E	E	E	I	E	E	E	I	E
On-boarding.	I	E	E	E	I	I	E	E	E	E	E	E
Rules	E	E	I	E	E	E	I	E	E	E	E	E
MEASUREMENT												
Metrics	E	E	I	I	E	E	E	E	E	E	U	I
Analytic	E	I	E	I	E	I	I	U	E	U	U	I
PSYCHOLOGY												
Fun	E	E	E	I	E	E	I	I	E	E	I	E
Motivation	I	E	I	E	I	E	E	I	E	E	I	E
Social	E	E	E	I	E	E	E	E	E	E	E	I
Desired behaviours	E	E	E	E	E	E	E	E	E	E	E	E
Ethics	I	I	E	I	E	E	I	I	I	E	E	U
INTERACTION												
Narrative	E	E	E	E	E	I	E	E	E	E	E	E
UI/UX	E	E	E	E	E	I	E	E	E	E	E	E
Technology	I	E	E	E	I	I	I	I	E	E	E	E

the framework was well accepted and understood by the domain experts and therefore suffered two changes, the first, where we exchanged the words of Crisis from the second arc in the Students' Journey for Trials, following a suggestion from one of the game designers, who argued that Crisis did not represent well that stage; and the second, where we deepened the Hero's Journey concepts to deal with the hero's external experience (outer journey, dramatic and ruled by actions) and internal experience (inner journey, psychological and ruled by feelings and inner perceptions) All the other suggestions were categorized as improvements for a future framework upgrade, as they demand in-depth research in areas previously not projected.

This research's limitation is that all of the experts interviewed were Brazilians, and therefore we do not know how well the framework would be received in other cultures.

We also planned to experiment with the framework in real classrooms but had to abort the original schedule because of the COVID-19 situation.

4.3 Chapter Conclusions

This chapter presented the studies conducted to answer the following thesis research questions: **sRQ2: "How to apply narrative in gamification design?"** and **sRQ3: "How to evaluate the benefits of a narrative approach?".** These two questions were answered with the data-driven study that identified the best elements to work with narrative from the users' (the students') perspective and the creation of the Narrative Gamification Framework for Education. The framework validation, from the experts' perspective, through the semi-structured interviews and subsequent thematic analysis, and their views of the framework according to Mora's Framework Scale (MORA *et al.*, 2015) gave us one side of how to evaluate the benefits of a narrative approach. Unfortunately, we could not assess the framework's effectiveness in the classroom due to the COVID-19 worldwide pandemic and the instability it caused in the education domain. We had the design of the experiment ready to run, but we could not execute it.

CHAPTER

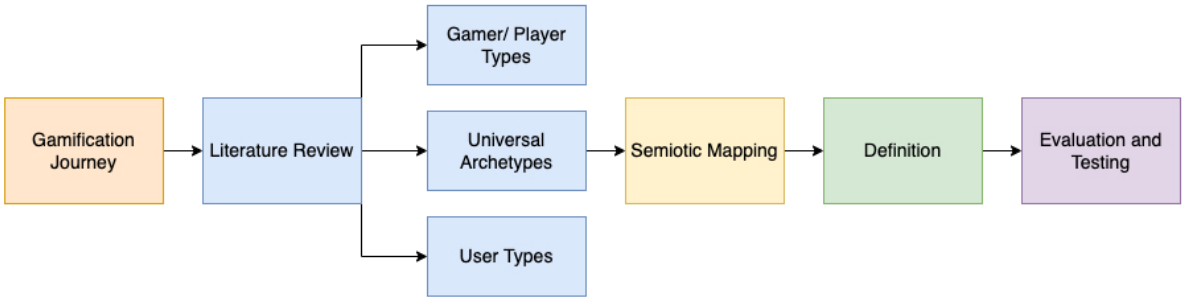
5

GAMIFICATION JOURNEY, A USER TYPE APPROACH FOR EDUCATION

This chapter presents and discusses the results of the studies that sought to create and evaluate a novel user-type approach for personalizing gamification for education, the Gamification Journey, based on symbolic images. This approach is intended to deepen further the concepts presented by the Narrative Gamification Framework and keep the users' as the main focus of this thesis.

The whole process can be summarized as Figure 26 illustrated, consisting of a literature review of related works such as the approaches dealing with gamer or player types and other user-types, as well as universal archetypes. We chose to work with Jung's Archetypes and did a semiotic mapping of each Archetype's characteristics linked to the learning process. Then, we created a high-definition prototype [1] of an example interface where the archetypes' choices would take place from this mapping and used personas to evaluate the interface.

Figure 26 – Gamification Journey User-Type approach - Steps and Methods



The second study that arisen from this research is the empiric evaluation of the method to predict the archetypes and motivational groups using symbolic images through the use of card sorting sessions.

[1] The prototype can be accessed at <https://paulatpalomino.com/gamificationjourney/login_screen.html>

5.1 Predicting Archetypes and Motivational Groups With Symbolic Images

Recent research has shown that using gamification may increase the student's motivation, but it can also decrease their motivation, if the student is not interested in the elements being used, or if the gamification design was not well planned (TODA *et al.*, 2018a; SANTOS; BITTENCOURT; VASSILEVA, 2018). There are studies affirming that people are motivated or demotivated by different game elements according to their "gamer type" (ORJI *et al.*, 2013; ORJI; VASSILEVA; MANDRYK, 2014; MONTERRAT *et al.*, 2015; MASTHOFF; VASSILEVA, 2015). This need for personalisation comes from human diversity, which makes each person have different tastes, coming from cultural aspects, demographic characteristics, psychological and behavioral characteristics (YEE, 2016). However the process of identifying the correct "gamer type" is not intuitive and can be intrusive and time-consuming. This may hinder the student's initial motivation to even begin a task.

Considering that our focus is to provide a great user experience to the students to keep them motivated and focused on learning, we sought to address this gap, aiming to answer the following research question: **"How can we identify a student's user preference in an educational gamified system in a subtle and fast way?"**. For that we proposed an original approach for identifying a gamified educational system (GES) user's preference in a broader and intuitive way. We did not work with the gamer type approach, instead we worked with the 12 Jungian archetypes (JUNG, 2014) in order to create an avatar for the student, who would be their representation in an educational system. The student should choose from a series of pictures related to emotional states and personal preferences, and according to their choices the system would present a given avatar based on one of the 12 Jungian archetypes. From this point on, the GES would present the educational content tailored to that initial preference, using the game elements of narrative and storytelling to guide the student in a 'journey for knowledge', based on Campbell's Hero Journey (CAMPBELL, 2008), following the design of our Narrative Gamification Framework.

Jung's archetypes are universal and are used in psychology (JUNG, 2014), marketing (XARA-BRASIL; HAMZA; MARQUINA, 2018), education (MEZIROW, 2000), design (CHANG; LIM; STOLTERMAN, 2008), anthropology (CAMPBELL, 2008) and social sciences (VOGLER, 2007). Their classification is extensive and complex, but by using Peirce's Triadic Semiosis theory and based on Santaella's adaptation of it in Matrices of Language and Thought (SANTAELLA, 2001), we broke each archetype in keywords and abstract concepts related to the Firstness and Secondness perceptions. These concepts were used to collect and categorize pictures that should evoke these characteristics. Our tests have demonstrated that this approach is coherent and robust and can be easily replicated in other contexts as demonstrated by our second study, the card sorting sessions, that will be described later in this chapter.

5.1.1 Literature Review

This section details the two main concepts used on this study: The 12 Jungian's Archetypes and Peirce's Triadic Semiosis.

According to researches (MARK; PEARSON, 2001) based on Jung's original studies (JUNG, 2014), there are 12 primary archetypes that represent the range of basic human motivations, and each person tends to have one main archetype that dominates their personality. This is part of Jung's classic psychology theory of the human psyche and postulates that these 12 universal and mythic characters archetypes reside within the collective unconscious (JUNG, 2014). These archetypes are briefly summarised as follows:

1. **The Innocent:** characterized by people with positive outlook and happy personalities, who often try to see the good in the world and looks for the silver lining in every situation. Their goal can be summarized as being happy, and they usually fear being punished for doing something wrong. They are too trusting of others, but are people of faith and open-mindedness.

2. **The Sage:** values ideas above all else. They use wisdom and intelligence in order to understand the world and teach others. They fear being ignorant and can take too much time to come to a decision if they think they do not have enough information. People of The Sage are intelligent, curious and carries great wisdom.

3. **The Explorer:** seek to experience as much of life as possible, fearing getting trapped or being forced to a daily boring routine. They often have a hard time to compromise, but are true to themselves.

4. **The Outlaw:** people who want to overturn what they think is not working. They often fear being powerless and can become obsessed with their own ideals, but they have great ideas and are good inspiring people to join in their tasks.

5. **The Magician:** seek to understand the fundamental meaning of the universe, having a true belief in their ideas. They usually see things in a completely different way to other archetypes and use these perceptions to bring transformative ideas and philosophies to the world. However they can become manipulative or egoistical, and they fear unwanted negative consequences for their actions.

6. **The Hero:** They often believe they have a destiny or a mission they must accomplish. Their main objective is to help others and protect the weak, but they fear being perceived as frightened. They can be arrogant, but also competent and courageous.

7. **The Lover:** seek harmony in life, aiming to be in a relationship with people, work or environment they love. They fear being unwanted or unloved, and they desire to please

others can risk them losing their own identity. But they are social people, passionate and diplomatic.

8. **The Jester:** seek to lighten up the world and make others have fun. They fear being perceived as boring by others, and are often frivolous, wasting time and hiding emotions beneath a humorous disguise. But they can see the funny side of everything and are masters of using humor for positive changes.

9. **The Everyman:** dependable and realists, and search for belonging in the world, usually joining many groups and communities in order to find a place they can fit in. Their main goal is to belong (in a broader sense), and they can fear being left out. They are often cynical but also honest and open, pragmatic and realistic.

10. **The Caregiver:** emphatic and compassionate. They fear being considered selfish and seek to help others most of their time. Because of that, they can be exploited by others because of their compassion and generosity.

11. **The Ruler:** seek to create a prosperous community, fearing the chaos and being undermined. They can be authoritarian but also great leaders, bearing a fair share of responsibilities for the others.

12. **The Creator:** create things of enduring value. They fear failing to create something that lasts and are perfectionist people, which often leads them to creative blocks caused by their fear of not being exceptional. Their greatest strength is their creativity and imagination.

These archetypes are also guided by four cardinal orientations, with each group containing three types (JUNG, 2014). These orientations help in understanding one's personality through the lens of the 12 main archetypes, serving as a broader grouping. Each orientation has three archetypes within its group, where the middle archetype has the strongest orientation and the archetypes to its left and right are inside that group but a little more distant from the full orientation. As an example: The Outlaw archetype values much more freedom than the archetypes of the Jester (who is inside the Freedom orientation, but hangs over to the Social orientation) and the Explorer (who is also inside the Freedom orientation, but prizes for the Ego orientation), and so on, as demonstrated by the cardinal wheel on Figure 27.

Jung's studies were used in many areas, one of them being Marketing (as Brand Archetypes) (MARK; PEARSON, 2001; SIRAJ; KUMARI, 2011; XARA-BRASIL; HAMZA; MARQUINA, 2018). This area's researches postulate that there is something about the brands people can connect with, having an affinity with them, many times in an unconscious level. In order to help the brands to understand the collective mind of their audience in creating enduring connections, Mark and Pearson (MARK; PEARSON, 2001) created a framework. In their model, the 12 archetypes are classified according to four human main drivers: *i)* provide structure, *ii)*

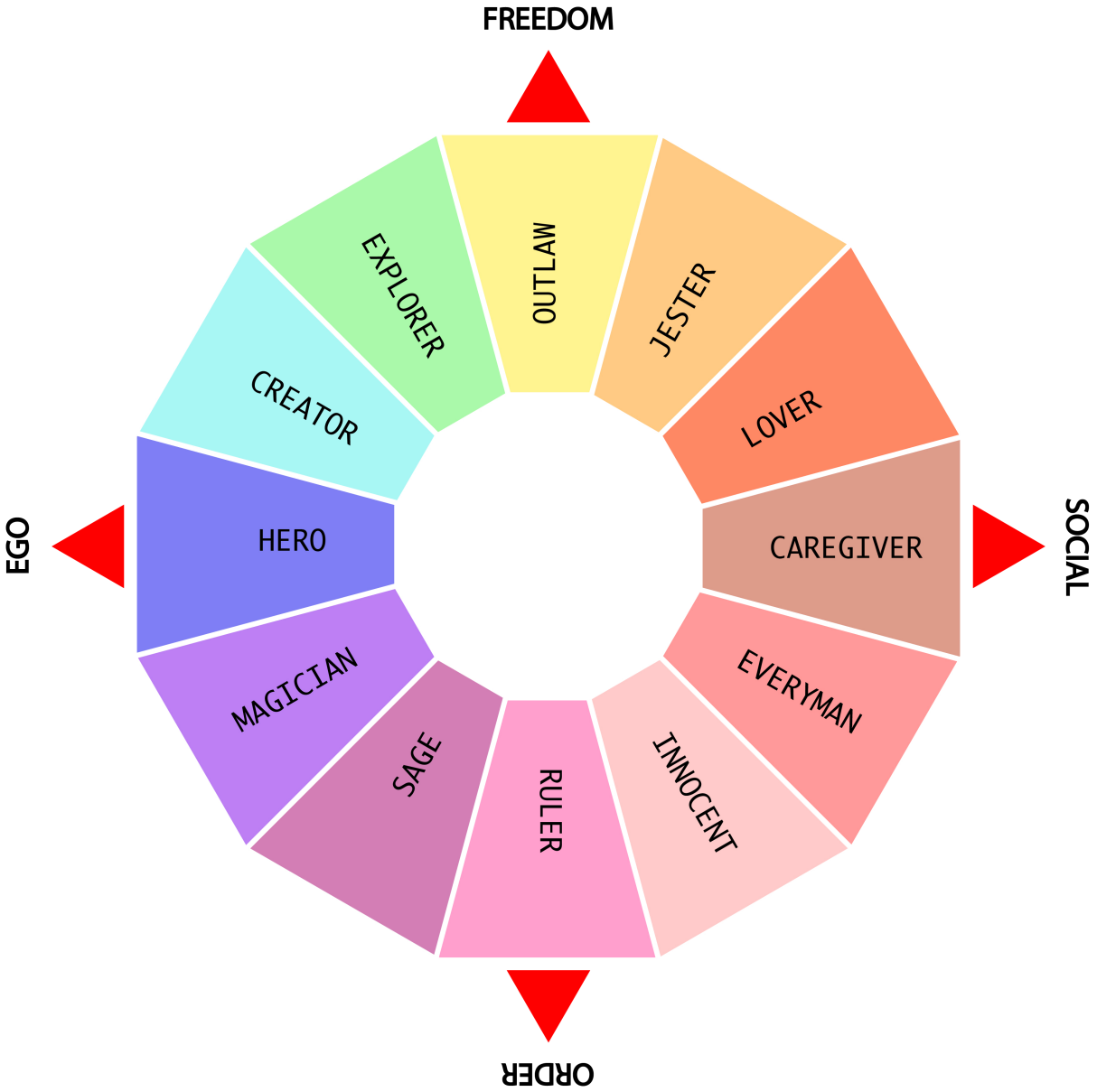


Figure 27 – 12 Jung's personalities archetypes diagram (MARK; PEARSON, 2001)

spiritual journey, *iii)* leave a mark and *iv)* connect to others, as seen in Figure 28. In their model every person has basic human desires that are instinctive and primitive. Each of his 12 archetypes are then connected to one of these main desires: *i)* The Outlaw wants liberation; *ii)* the Magician seeks power; *iii)* The Hero desires mastery; *iv)* the Lover, intimacy; *v)* the Jester, enjoyment; *vi)* the Everyman wants to belong; *vii)* the Caregiver desires to be of service; *viii)* the Ruler wants to control; *ix)* the Creator seeks innovation; while *x)* the Innocent seeks safety; *xi)* the Sage, understanding and finally *xii)* the Explorer seeks freedom. The archetypes are then divided into broader groups related to the focus of each of these desires. So, people from the archetypes of the Innocent, Sage and Explorer seek an spiritual journey (with different focus); The people from Outlaw, Magician and Hero seek to leave a mark in the world (each with their own way of doing that); people from the Lover, Jester and Everyman wants to connect to others (again, with

different reasons and/or focus); and finally, people from the Caregiver, Ruler and Creator (or Artist) seek to provide structure to the world.

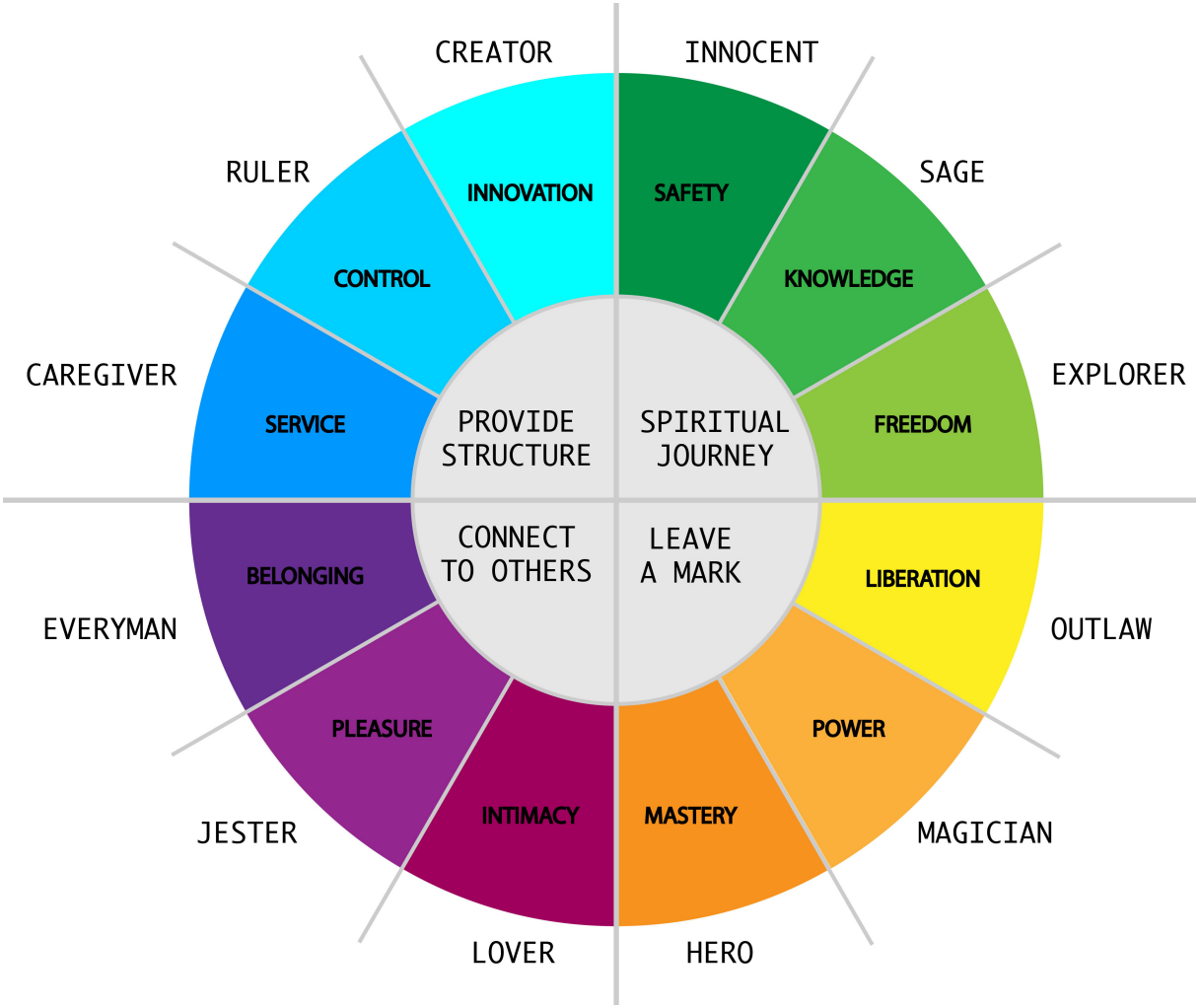


Figure 28 – 12 Jung's personalities archetypes human (MARK; PEARSON, 2001)

In the education domain, Jung's studies were also used since 1978's Mezirow's transformative learning theory, that postulates that the process of perspective transformation has three dimensions *i)* psychological, as in changes in understanding of the self; *ii)* convictional, as in a revision of belief systems and *iii)* behavioral, as in changes in the lifestyle (MEZIROW, 2000; MEZIROW, 2018; BOYD; MYERS, 1988; LAZZERETTI, 2017).

> "Transformative learning is the expansion of consciousness through the transformation of basic worldview and specific capacities of the self; transformative learning is facilitated through consciously directed processes such as appreciatively accessing and receiving the symbolic contents of the unconscious and critically analyzing underlying premises (ELIAS, 1997)".

Finally, to support our proposal of letting the users choose their avatar based on their subconscious personality archetypes, we worked with Peirce's Triadic Semiosis (PEIRCE, 1991).

To the author, sign is something that has a significance, something that is attributed value, meaning the understanding of something, formed through a physical stimulus that generates understanding, happening only through the relationship built between the “I” and the “other/-something”. Whenever there is attribution of meaning, there is the formation of a sign. Every sign consists of two faces: the sensorial aspect, called *significant* and the understandable aspect, called *meaning*. The harmony between perception and understanding, significant and meaning, results in *significance* (CHANDLER, 2007). The author classifies the signs in three types: *i)* The icons, that are signs that bear a relation of similarity to what they represent; *ii)* The symbols, that have no relation of similarity or contiguity with the represented thing, being the relation purely conventional. To understand a symbol, it is needed to learn what it means; and *iii)* The indices, that establish an association of one thing or another with an acquired experience.

The triadic theory is related to the way people perceives and interacts with the world, assigning meaning to their perceptions and personal experiences, in a process Peirce called “semiosis", as seen in Figure 29. The Object is the concrete or mental object, while the Representamen constitutes of the signification, the way of representation. Finally the Interpretant is the signified, the meaning a person does of all of it. These three edges defines what is a sign. When the Object and the Representamen are related via similarity we have an icon. When this relationship is by convention, we have a symbol and when it is by factual relation, we have an index. The appearance of a sign is therefore started by the Representamen, which is the trigger for a mental image formed by the Interpretant of the Object, which then becomes the referent of the Representamen sign. However, none of the possible bilateral relations between these elements can produce this specific triadic perspective. For Peirce, a sign can not be decomposed into something more primitive and still retain its meaning (CHANDLER, 2007).

Peirce relates the Firstness to the iconic aspect, the first impression, this being the quality of immediate consciousness as an invisible impression (quality of feeling), un-analysable and fragile. Everything that is immediately present to one’s consciousness is all that is in their mind at the present moment. Secondness is related to the indicial aspect, from the point of view of the object, constituting itself in the whole of everyday existence, where it continually comes up against facts considered "external", dealing with obstacles, real and feasible things (PEIRCE, 1991).

According to Santaella, to exist is to be in a relationship, to take a place in the infinite myriad determinations of the universe, to resist and react, to occupy a particular time and space. Wherever there is a phenomenon, there is a quality, that is, its Firstness. But quality is only part of the phenomenon, since in order to exist, quality must be incarnated in matter. The fact of existing (Secondness) lies in this material embodiment. Thus, Secondness is when the subject reads with comprehension and depth of its content (SANTAELLA, 2017).

Thirdness is the last concept from the triad and is related to the argumentative or symbolic aspect, that is, the interpretation of the world by a person, corresponding to the layer

of “intelligibility," or thought in signs, through which the world is represented and interpreted. (PEIRCE, 1991).

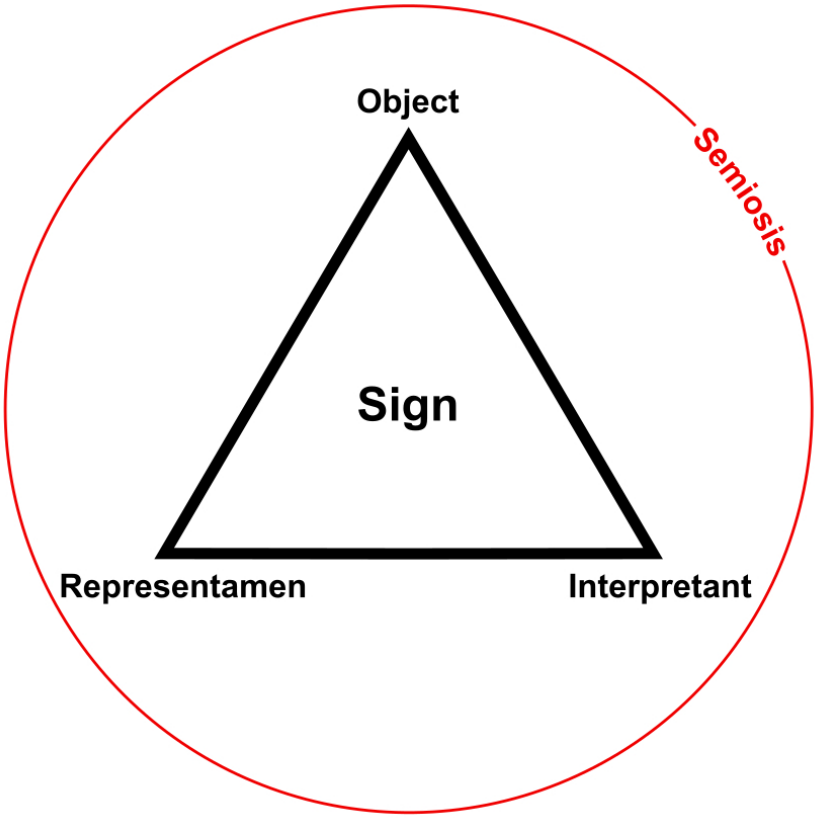


Figure 29 – Peirce’s Sign Triad (PEIRCE, 1991)

Also, Santaella assumes that language is formed and processed according to a sign system that resembles the human way of life. In this way, the language is also subjected to mutations and evolution. To understand how signs are formed and language and meaning combined and mixed, this study establishes three matrices of language and thought: the verbal, which has the property of discourse; the visual; and the sonorous. Each of these matrices have elements categorized in the aspects of Peirce’s Firstness, Secondness and Thirdness, in a very similar way to what was done in this work. Every Secondness presupposes a Firstness and every Thirdness the two preceding categories, be they the matrices themselves or their subdivisions. The more we tend to the universe of the Firstness, the more evocative power, because there is less conventionality. The more we move into Thirdness, on the other hand, the less the interpretive possibilities, because there is a code that must be understood in order to determine the object to which the sign refers (SANTAELLA, 2001). This is a purely theoretical research. However we found in it the bases from which categorize the images using the visual matrix and relate them to the user’s perceptions, culminating in the avatar’s creation.

Based on these concepts and definitions we were able to choose images (as signs) that could better represent Jung’s 12 universal archetypes in a unconscious way, helping the users to choose their avatars in an intuitive, non intrusive and fast way.

5.1.2 Personalized Gamification

Gamification is considered personalized when designers or the system itself choose certain game elements based on user information (TONDELLO, 2019). Most personalization approaches are based on capturing certain users' information and using it to input the system, which tailors the gamified design accordingly. This tailoring is usually based on a given user model designed through literature reviews or based on existing ones (RODRIGUES *et al.*, 2020). Examples of user modelling are present in Tondello *et al.*(TONDELLO *et al.*, 2016a) study, where the authors validated and expanded the original Hexad model, created for use in gamification. This model was designed relating the concepts of Bartle's model (BARTLE, 1996) with theories of human needs and the experience in game design from the original author (MARCZEWSKI, 2015), focusing on classifying the users according to their different motivations and gamer (or non-gamer characteristics). They collect the data through the use of an empirically validated questionnaire.

In addition, Hallifax *et al.*(HALLIFAX *et al.*, 2019) presented a study where they use Brainhex, whose model is based on neurobiological findings that relate players' behavioural characteristics to elements of the nervous system (NACKE; BATEMAN; MANDRYK, 2014) and Hexad (TONDELLO *et al.*, 2016a) to relate the most suitable game elements to user types, personality traits, gender and age.

These approaches have in common that game elements are defined based on a single criterion (KLOCK *et al.*, 2020). However, there is empirical evidence showing that multiple factors affect user preferences and, consequently, gamification efficiency (KLOCK; GASPARINI; PIMENTA, 2019a; DICHEV; DICHEVA, 2017b), which suggests that relying on a single criterion might not be effective as a standalone solution to mitigate possible negative effects (TONDELLO *et al.*, 2019a). A few recent empirical studies corroborate that suggestion. Hallifax *et al.* (HALLIFAX; LAVOUÉ; SERNA, 2020) concluded a two-dimensional personalization is positive, but when compared to random gamification. Then, Rodrigues *et al.* (RODRIGUES *et al.*, 2021b; RODRIGUES *et al.*, 2021a) studied personalization in a multidimensional way, finding empirical evidence of its effectiveness when compared to the one-size-fits-all approach.

Despite the promising findings, the personalization strategies from those studies are mainly driven by gaming-related information.

Thus, while this context suggests multidimensional personalization as the way to further improve gamification, it demonstrates that available strategies do not consider users' broader personalities and, when they do, they lack instruments to identify their categories.

5.1.2.1 Playful Approaches

Regarding user type approaches, the way of collecting user information is usually intrusive and time-consuming, through extensive questionnaires (e.g., (HALLIFAX; LAVOUÉ;

SERNA, 2020; MORA *et al.*, 2018)), hindering the gameful experience and the immersion process within the gamified environment or system.

Existing research demonstrates playful ways on how to obtain this information. For instance, Altmeyer *et al.* (ALTMEYER *et al.*, 2020) show that gameful applications can be used to predict the Hexad user types and that this interaction is usually more fun and immersive than filling out the Hexad questionnaire. However, this study deals with the idea that users need to use the gameful application to get their Hexad profile. In the educational case, we deal with a larger spectrum of profiles, and not every student would want to play something before connecting to a gamified system for the first time. Additionally, the student can not be too focused on the gameful experience at the expense of the learning process (BAI; HEW; HUANG, 2020; SAILER; HOMNER, 2019). As such, a gameful application to collect the user types might not be the best option for a gamified educational system.

Furthermore, it is necessary to worry about how to transport the user to this immersive environment for playful interfaces. In this sense, the visual design must be concerned not only with aesthetics but also with its affordances' meaning, as properties of objects which show users the actions they can take (ALBRECHTSEN *et al.*, 2001). Similar research deals with these aspects, such as Kaptelinin *et al.*, that stated that technology affordances should be considered as possibilities for human action mediated by cultural means and the environment (KAPTELININ; NARDI, 2012). Chen *et al.* conducted a study to explore how users perceive the affordances of an object through perceptual information (CHEN[1]; LEE[1]; TSAI[1], 2007) and Djajadiningrat *et al.* discuss that affordances should not be considered only as items that 'invite the user to the right action,' but also as a tool to communicate of the purpose of an action, giving it meaning (DJAJADININGRAT; OVERBEEKE; WENSVEEN, 2002).

5.1.2.2 Summary

Considering the context presented, further investigating methods to identify user characteristics to facilitate gamification personalization is extremely important in all areas of gamification research. The approach of Altmeyer *et. al* (ALTMEYER *et al.*, 2020) provides an important step towards that need. Still, it requires users to engage with an independent gameful system to generate interaction data to predict their user types. Furthermore, in the educational context, the personalization issue is even more delicate due to the balance that needs to exist between the engagement in the gamified environment and the learning process, which might lead to learning issues if too much focus is given to gaming aspects. We, on the other hand, sought to simplify the process of identifying user types, focusing on the immersion and experience of the user in the system, and expanding the understanding of users beyond their gaming-related profiles. Table 8 summarizes main related work, showing that prior research mainly relies on intrusive methods for user categorization, demanding the use of a different system in the only exception (ALTMEYER *et al.*, 2020), besides reducing users to gaming-related profiles in most cases.

Table 8 – Comparison between this study and main related work.

Work	Categorization method	Within system?	User characteristics
(TONDELLO *et al.*, 2016a)	Questionnaire	No	Hexad
(HALLIFAX *et al.*, 2019)	Questionnaire	No	Hexad
(ALTMEYER *et al.*, 2020)	Gameful system usage	No	Hexad
(RODRIGUES *et al.*, 2021b)	Questionnaire	No	Demographics and gaming habits/preferences
This one	Image sorting	Yes	Jung's archetypes and motivational group

5.1.3 Development

The study was designed and executed in five steps following the design thinking methodology as seen in Figure 30 (BROWN *et al.*, 2008). Next, we describe and introduce how we implemented each step of this methodology:

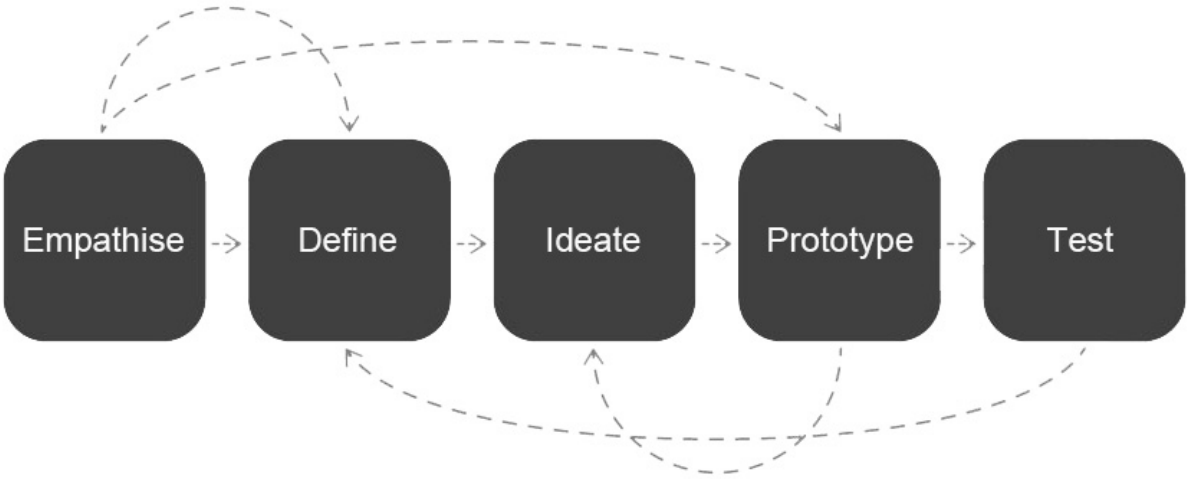


Figure 30 – Design Thinking Steps (BROWN *et al.*, 2008)

1. Empathize: The main objective of this step was to understand the problem being worked on, identifying the needs of the target users and the issues surrounding the problem. Our gap was the fact that the existent approaches (such as the "gamer type" ones) for tailoring GES can be intrusive and/or time-consuming (working with materials such as long surveys, for example) and can not address subtle details from a human psyche, being based mostly on studies focusing on gamer's behaviours in certain types of digital games (such as MMO in BrainHex) (NACKE; BATEMAN; MANDRYK, 2014). As such, we wanted a subtle and broader approach to identify the users preferences in a GES for the creation of their avatars, and our main objective was to devise an intuitive and fast solution, suitable for the educational context.

2. Define: In this step we defined a set of pillars we would work with: *i)* Jung's 12 universal archetypes (JUNG, 2014) would be our avatars, as they represent and categorize in a detailed way the universal human psyche, intrinsic motivations and view of the external world ; *ii)* Peirce's Triadic Theory (PEIRCE, 1991) for choosing the sequence of images that should be chosen in order to generate the avatar of one of Jung's Archetypes; and *iii)* The Narrative Gamification Framework for presenting the educational content to the student.

3. Ideate: The main objective of this step was to propose alternative interfaces to explain and illustrate the potential design space. For that we worked with sketches and wireframes to explore and refine our idea. These concepts were based on Buxton's (BUXTON, 2006) sketches and prototype differences table, as it can be seen on Table 9. We created a couple of sketches (Figure 31 and Figure 32) and wireframes[2] (Figure 33 and Figure 34) looking for these alternatives and decided to prototype the following process: The user would be presented with four initial images, each representing in an abstract way (using the concept of Peirce's Firstness) one of the four human main drivers: provide structure, spiritual journey, leave a mark and connect to others. When this first step is concluded, the interfaces closed the other three images and opens up to 3 new images, directly connected to the previously chosen one. Each of these images represents one of the 12 archetypes, in a subtle way. It is expected that the person chooses these images looking only for what pleases them the most. With the avatar chosen, the user is ready for the next step, the materialization of their sensations (or the Secondness). From now on, during their journey through the content, the user is creating his Thirdness view of the world and the educational content.

Table 9 – Sketches from Prototypes According to Intent (BUXTON, 2006)

Sketch	**Prototype**
Invite	Attend
Suggest	Describe
Explore	Refine
Question	Answer
Propose	Test
Provoke	Resolve
Tentative, non committal	Specific Depiction

4. Prototype and evaluation plans: In this step we created a series of mock-ups for the avatar creation screens, as showed on Figure 35 and Figure 36. After that we carried out the

[2] The process of wireframing is a way to design interfaces at the structural level and is commonly used to sort content and functionality, taking into account the users perspective. They are used to define the basic structure before visual design and content is finally added (PREECE; ROGERS; SHARP, 2015).

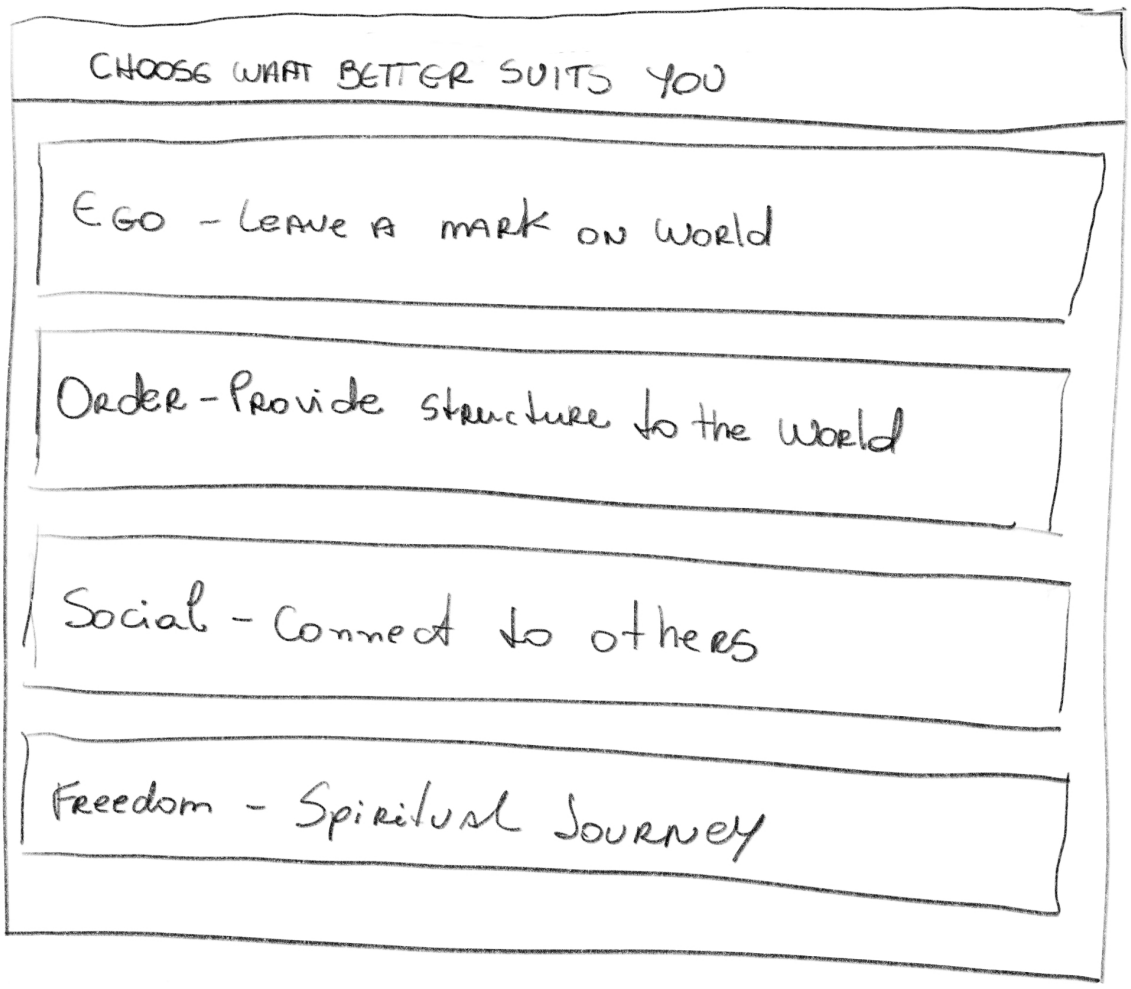


Figure 31 – First Interface Sketch

implementation of a horizontal high-fidelity prototype [3] of the idea designed in the previous phases. Our evaluation plan was designed with the use of personas [4] as it can be seen on Table 10 and Table 11.

5. Test: In this part of the study we executed the evaluation of the horizontal high-fidelity prototype (NIELSEN, 2016) implemented, according to the evaluation plan presented in the previous part, using the persona's technique (PREECE; ROGERS; SHARP, 2015). Four specialists embodied the role of each of the two personas and sought to interact with the images, making sense of them and interacting with the prototype. The reports showed

[3] According to Nielsen (**??**), there are two dimensions of prototypes, the horizontal one that provides a broad view of the entire system or subsystem, focusing on user interaction and low-level system functionality and the horizontal prototype, that is a complete elaboration of a single function or subsystem, being useful to obtain detailed requirements. These dimensions can be of low-fidelity such as wireframes of high-fidelity such as mock-ups.

[4] Personas are fictional characters templates, created based on target users to represent the different user types that might use a service, product, software or brand. Their objective is to help the designers understand the user's experiences, needs, behaviours and goals. According to Nielsen (NIELSEN, 2013), they need to be goal-directed, role-based, engaging and fictional.

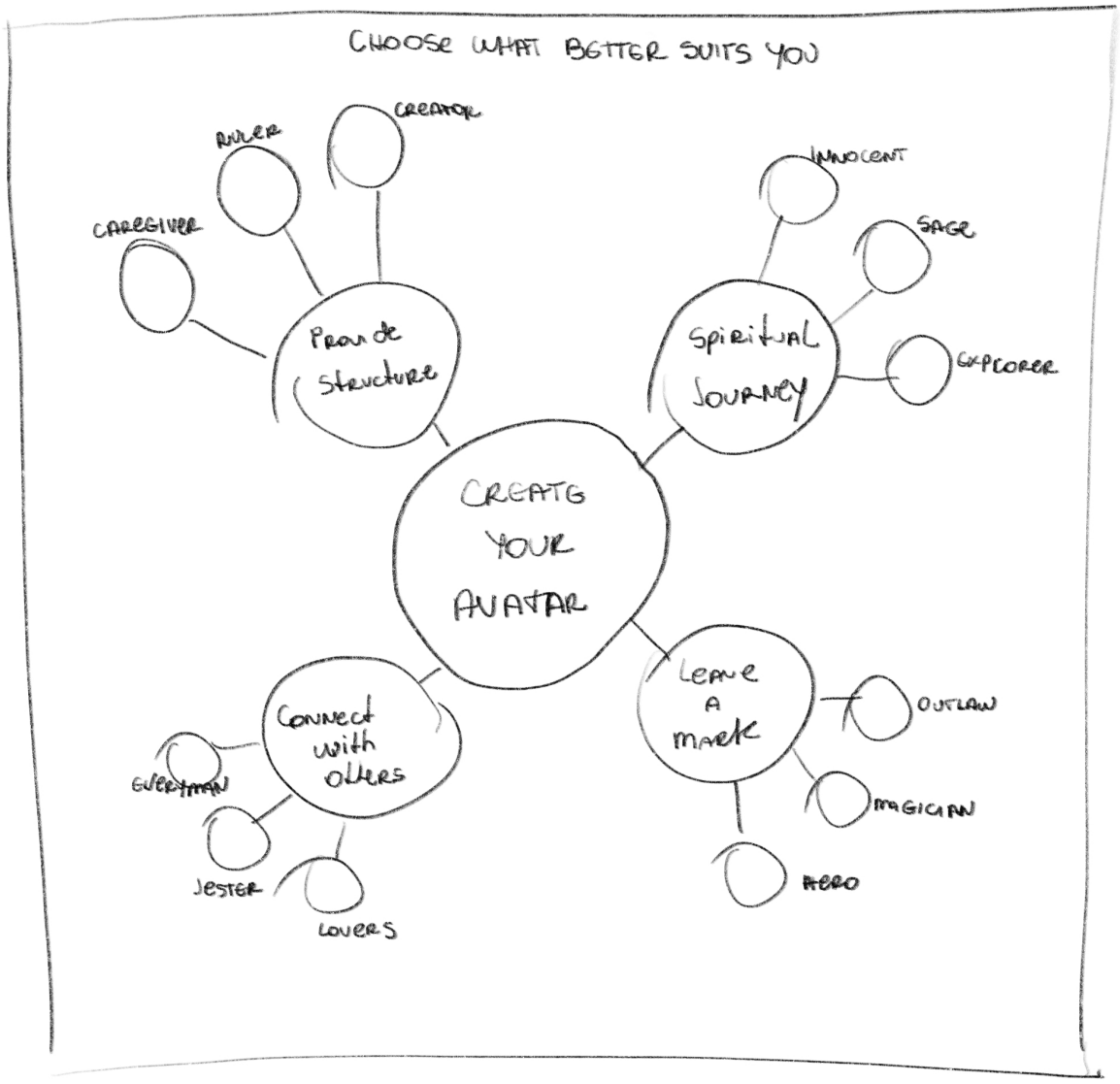


Figure 32 – Final Interface Sketch

Table 10 – User Persona - Higher Education Student (non-gamer)

SOFIA	
Background	- Sophomore at University - Works part-time in a drugstore - Plays in one university sports team
Demographics	- 20 years old - Female - Makes <$800 a month - Lives in the college city in a kitnet - She is the oldest of three children
Identifiers:	- Unruffled demeanor - Charismatic - Always using her phone in Whatsapp - Very busy, have few time for her hobbies

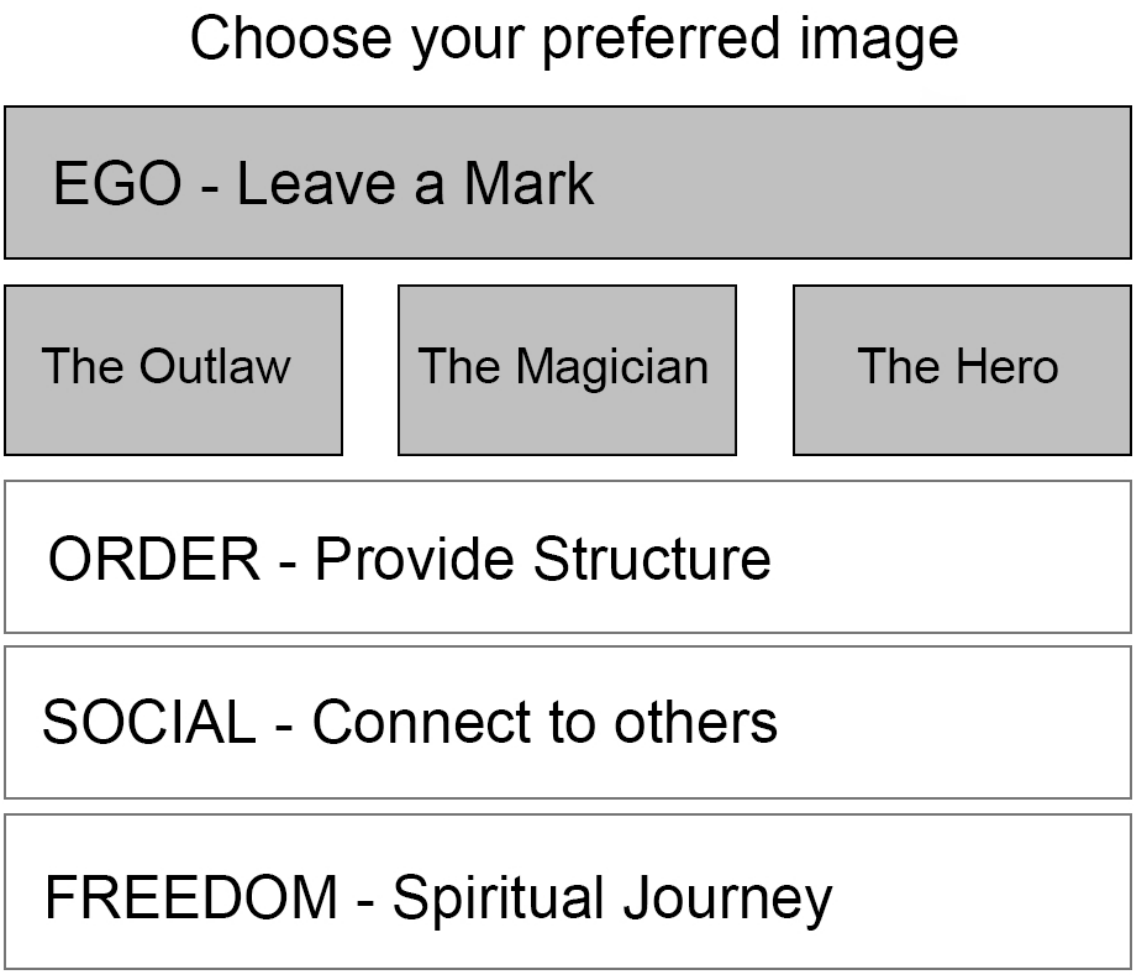


Figure 33 – First Interface Wireframe

that the gamer user persona found the process much easier then the non-gamer persona. However both persona types understood the tasks and did the process easily and quickly, being satisfied at the end, when the avatar was presented.

5.2 Symbolic Images Card-Sorting Experiment

From the notion that the significance derived from the Firstness is abstract, internal and primal, and the Secondness is to materialize the Firstness significance through a real action, we sought to map the concepts related to each of Jung's archetypes to these two edges of Peirce's triad. At the moment, we did not work with Thirdness because, being a significance that comes from the personal experience of each one, it would be impracticable to represent it through images (Thirdness enters this process through the final significance that the students themselves make of the set of their choices of images, and is subjective to it).

With these concepts mapped, as shown in Table 12, we sought to gather images related

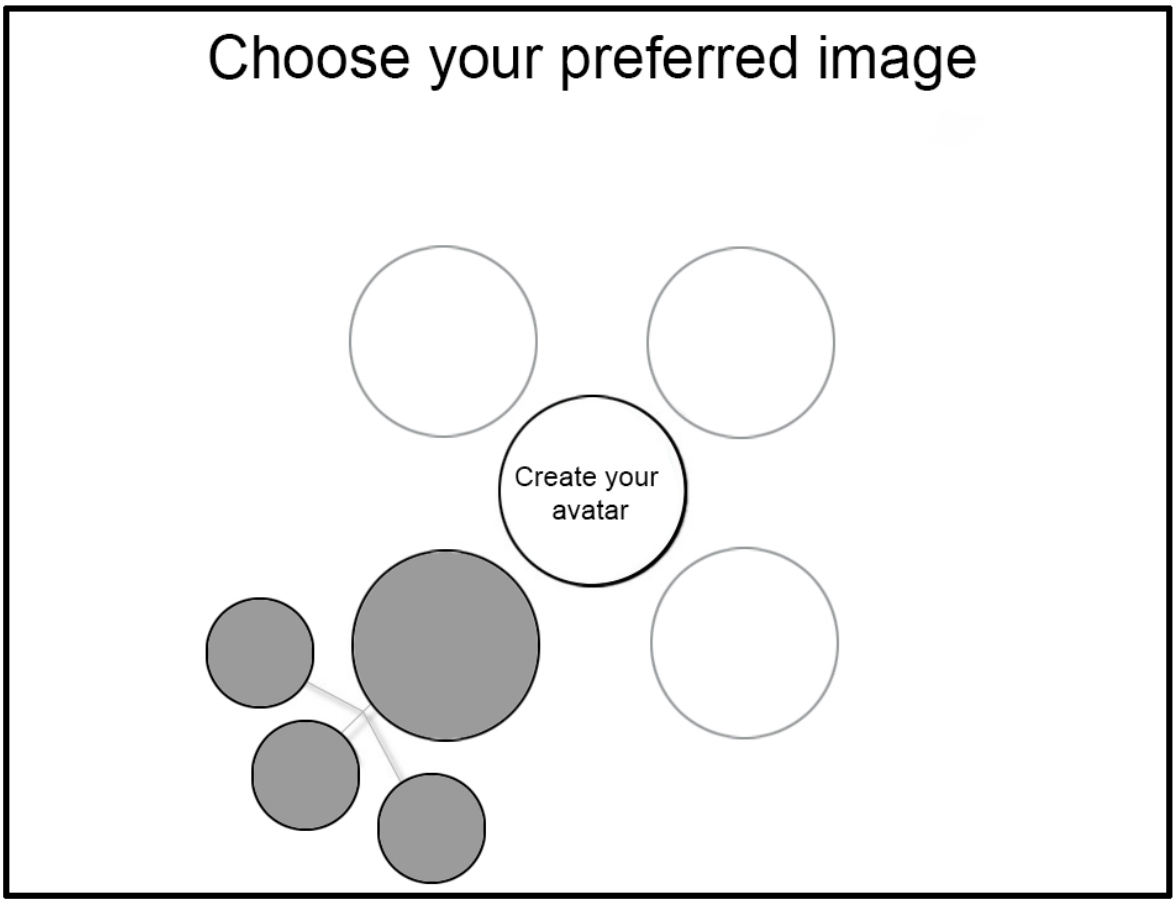


Figure 34 – Final Interface Wireframe Choice

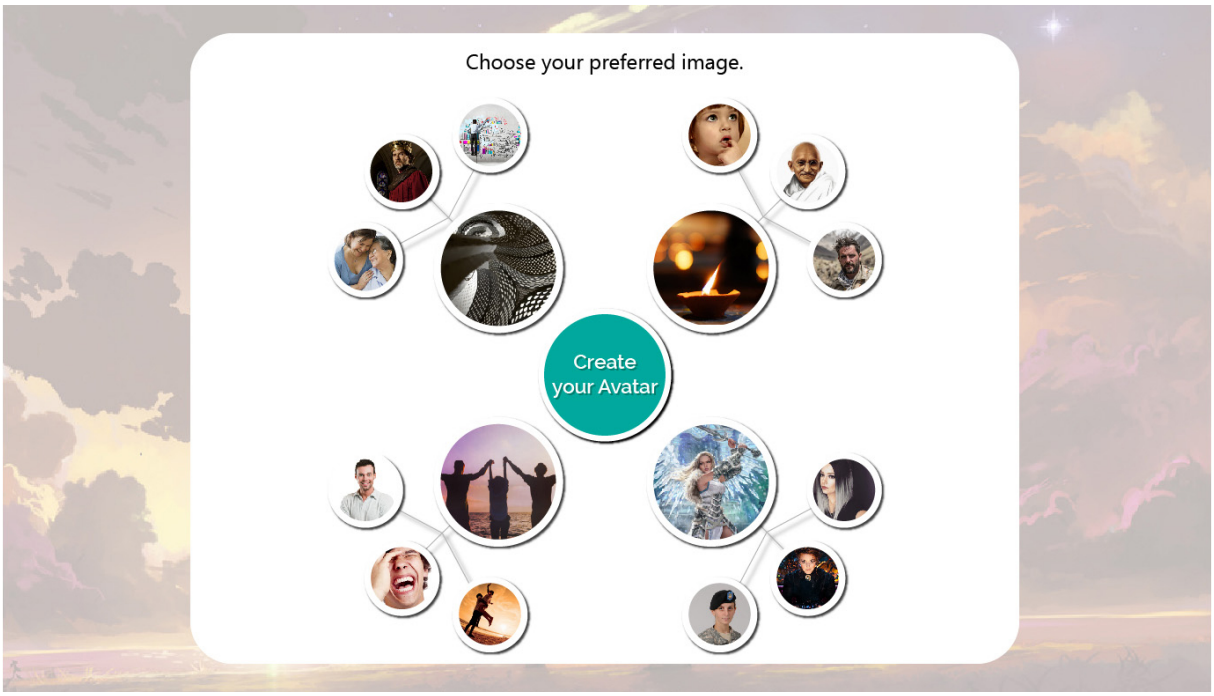


Figure 35 – Avatar creation screen mock up

Figure 36 – Avatar creation result example mock up

Table 11 – User Persona - Higher Education Student (gamer)

CARLOS	
Background	- first year at University - works as a laboratory assistant and receives a funding - plays League of Legends and other online games
Demographics	- 18 years old - Male - Makes <$500 a month - Lives in the university students dormitory - He is an only child
Identifiers:	- Introvert demeanor - Intelligent and is a good student - Always using his phone to play mobile games - Can separate time to study and to his hobbies very well

to these moments (from free image banks), working with the Firstness in the first choice (of the four basic intrinsic motivations of the archetypes), and the Secondness in the choice of the own archetype. The idea is that the user could choose in a subjective but effective way, what would be the best approach to study from there. However, one of the limitations of it lies in the fact that because one chooses the images simply for the sake of taste and at that moment, it is possible that the chosen avatar is suitable for that very moment, but in another day it does not make as

Table 12 – The 12 Archetypes and their relations to The Sign Triad (Firstness and Secondness)

Archetype	Firstness	Secondness
The Innocent	freedom, happiness and naiveness	aim to do things right and fear doing things wrong
The Sage	wisdom, intelligence and meticulous	aim to find the truth and fear being misled
The Explorer	autonomy, ambition and inner emptiness	aim to experience a fulfilling life and fears conformity
The Outlaw	outrageousness, idealism, radical freedom	aim to overturn what isn't working and fears being powerless
The Magician	make things happen, manipulation, determination	aim to understand the laws of universe and fear negative consequences
The Hero	competence, courage and arrogance	aim to expert mastery in a way that improves the world and fear weakness
The Lover	passion, gratitude, commitment and weak identity	aim to be in a good relationship and fear being alone or unwanted
The Jester	joy, frivolity, playfulness	aim to have a great time and fear being bored
The Everyman	realism, empathy and lack of pretense	aim to belong and fear to be left out
The Caregiver	compassion, generosity and martyrdom	aim to help others and fear ingratitude and selfishness
The Ruler	responsibility, leadership and authoritarism	aim to create a prosperous community and fear chaos
The Creator	creativity, imagination and perfectionism	aim to realise a vision and fear mediocre execution

much sense anymore.

Because of this, we sought to evaluate the approach and conducted card-sorting sessions to verify if our images mental models were corresponding to the users mental models (NORMAN, 2004).

5.2.1 Method

This research's main goals are *to assess the identification of user archetypes through image symbology* and *to assess the compatibility between our approach and the users' mental model*. To achieve those goals, we seek to answer the following RQs:

- **RQ1:** How to use image symbology to classify user types?
- **RQ2:** To what extent our design model correctly predicts users' (a) Jung's archetypes and (b) motivational groups?
- **RQ3:** Which semiotic perception stage is more easily identified by the user through the images as (a) Jung's archetypes and (b) Motivational groups?

- **RQ4:** What are users' perceptions about the card sorting tasks?

To our best knowledge, no research has operationalized how to classify user types based on image symbology, we sought to answer **RQ1** to enable our primary objective. **RQ2** aims to reveal the overall agreement between our design model and participants' user model. **RQ3** contributes to further understanding **RQ1**'s answer. It reveals which of the three figures, each connected to a different aspect of Peirce's semiotic triad, were more or less effective in predicting archetypes/motivational groups. While **RQ2** and **RQ3** are based on quantitative data, **RQ4** relies on qualitative insights. It aims to provide information on participants' difficulties and improvement suggestions to enhance the images classification process. To answer those RQs, replicating our original approach for selecting images based on their semiotic meaning (PALOMINO *et al.*, 2019a), images were distributed into two card-sorting sessions, where the participants should sort them according to specific groups (12 groups for the first study and four groups for the second one).

5.2.1.1 Procedure

We conducted two online studies at OptimalWorkshop [5], an online platform-specific for creating card-sorting sessions. The only requirements were that the participants should have a basic understanding of English and be students from undergraduate or graduate courses due to this thesis being focused on these groups of students. The study has been reviewed and received ethics clearance through the University of Waterloo Research Ethics Committee (ORE#42392).

The participants were recruited through emails shared by universities to the students. After giving informed consent, the participants were asked to categorize 36 images into 12 pre-determined groups (Jung's Archetypes) in one card-sorting study (N=35) and repeat the same procedure in another card-sorting experiment (N=19), sorting 12 images into four pre-determined groups (Jung's motivational groups). They were asked demographic questions and could provide their feedback in open questions at the end of the experiment. The complete procedure took approximately 10-15 minutes to complete. Because of platform limitations, the study was divided into two different links. As a result, part of the participants only answered in the first link (Jung's 12 Archetypes) and not in the second. This is the reason the number of participants is different from one study to another.

5.2.1.2 Participants

From the first study of Jung's 12 Archetypes (N=35), the participants' ages were between 17-24 years (45.7%), 25-34 years (40%) and 35-44 years (14.3%). See Figure 37. Of those, 31.4% are males, 62.9% are female, and 5.7% preferred not to say. See Figure 38. Forty percent are from Brazil, 37.1% from Canada, 14.3% from China, 2.9% from Germany, 2.9% from Russia

[5] <https://www.optimalworkshop.com/>, last accessed 08 August 2021

and 2.9% from the United States. See Figure 39. Eighty percent of the participants answered that they usually play games, while 20% are not used to playing games. See Figure 40. Only 2.9% of them already knew Jung's Archetypes, while 97.1% never heard of it before. See Figure 41.

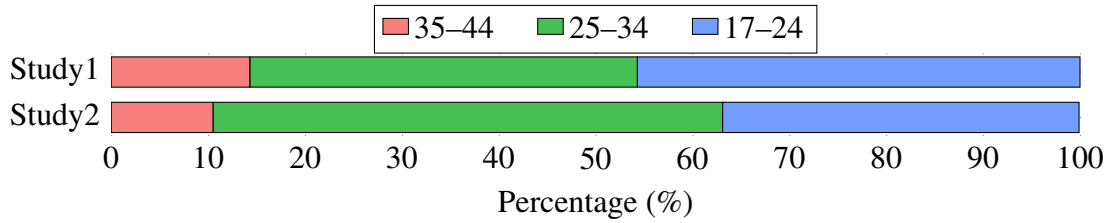


Figure 37 – Participants' ages from study one and study two

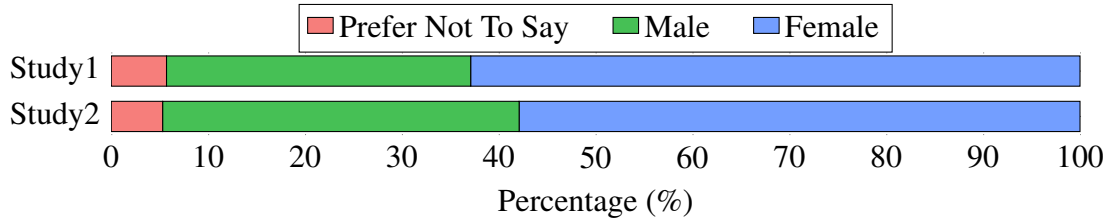


Figure 38 – Participants' gender from study one and study two

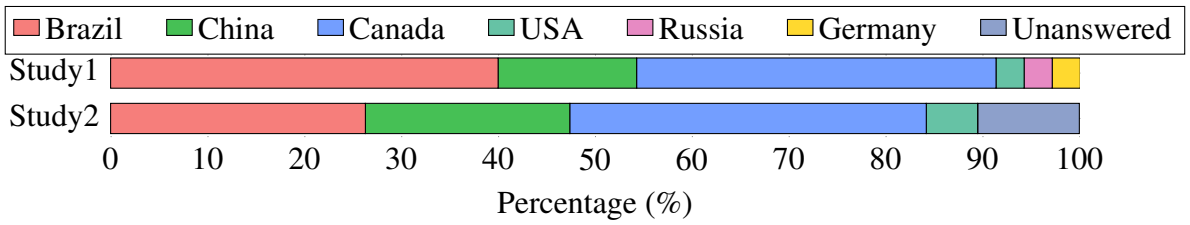


Figure 39 – Participants' countries from study one and study two

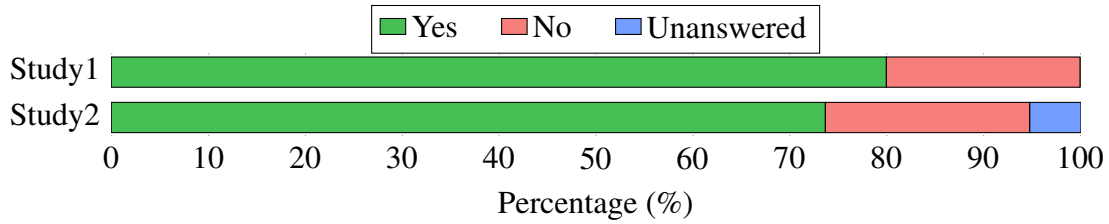


Figure 40 – "Are you used to playing games?" for study one and study two

From the second study of Jung's motivational groups (N=19), the participants' ages were between 17-24 years (36.8%), 25-34 years (52.6%) and 35-44 years (10.5%). See Figure 37. Of those, 36.8% are males, 57.9% are female, and 5.3% did not answer the question. See Figure 38. Most of them (36.8%) are from Canada, 26.3% from Brazil, 21.1% and 5.3% from the United States; 10.5% of the participants did not answer the question. See Figure 39. Most participants (73.7%) affirmed to play games in their daily lives, 21.1% said they did not, and 5.3% did not

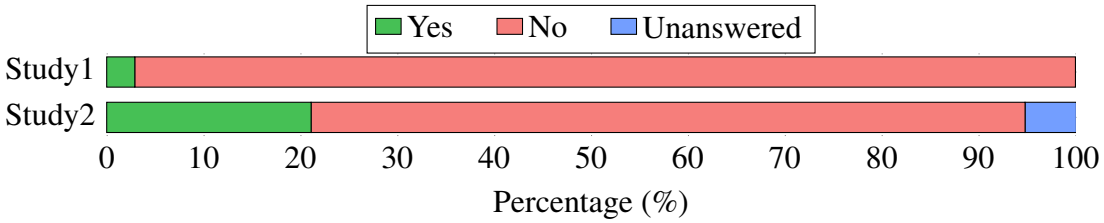


Figure 41 – "Did you know Jung's archetypes?" for study one and study two

answer the question. See Figure 40. Regarding Jung's 12 archetypes, 21.4% said they already knew of them and 73.7% never heard of it before; 5.5% left the question unanswered. See Figure 41.

5.2.1.3 Instruments

In this study, we used images as instruments for predicting one's Archetype/Motivational group. Specifically, we collected a total of 48 images from the Freepik database [6], 36 for Jung's 12 Archetypes study (first study), and 12 for Jung's Four Motivational Groups study (second study). Our approach for such prediction through images is based on Peirce's semiotic triad (PEIRCE, 1991). Hence, we analyzed Freepik's databases searching for three images for each archetype/motivational group and then matched one image to each semiotic **meaning**. To ensure selected images represented archetypes/motivational groups, we replicated our original process (PALOMINO *et al.*, 2019a), and searched for images that illustrated these concepts, matching them with Peirce's triad. Figure 42 shows two of the 48 images, which represent **The Hero on the Thirdness** and **The Caregiver on the Secondness**. All images are available in the supplementary material.

Figure 42 – Sample images used as instruments for the experiment

Furthermore, we used a survey to collect demographics and additional information about users' perceptions of the task. In terms of demographics, the survey collected information described in the Participants section. For the additional information, the survey asked the following open questions: *Did they have any difficulty sorting the images?*; *Did they have any*

[6] <https://www.freepik.com/>

feedback or suggestions for better image categorization?. This survey was shown to participants at the end of each card-sorting session.

5.2.1.4 Data Analysis

We applied the following process for both studies: to achieve our goal, we needed to test whether participants' sorted the pictures into the expected archetypes/motivational group. Therefore, we created confusion matrices, which show the extent to which *actual* labels match *predicted* ones. In this study, *actual* labels are those we defined through the image semiotic mapping design, whereas *predicted* ones are participants' selections.

A confusion matrix shows correct matches (in our case, an image being sorted into the expected archetype/motivational group) in the main axis (diagonal), so the higher these cells' values, the higher the agreement between the user model and ours. Additionally, cells that are not in the main axis provide information on where the mismatches were. Thus, by using confusion matrices, we show how many user selections agree with our expectations, besides informing *how* user model differed from ours (e.g., users' sorted image X as Y instead of Z).

To understand the overall agreement of the participants' sorting with what we expected, we used Cohen's Kappa, which is used to measure the agreement between two raters. In our case, the first rater, which we consider the ground truth (i.e., the *actual* labels), is the archetype/motivational group we consider an image to represent based on our design process. As the second rater, we consider our whole sample because our goal is to check to what extent a sample of people perceives the images to represent Jung's archetypes/motivational groups as we hypothesized. In that cases, using Fleiss' Kappa would be misleading because it calculates the overall agreement between several raters. Thus, it would reveal the overall agreement within participants, while our goal is to understand the agreement between the sample and our semiotic model. Therefore, using Cohen's Kappa, we measure how much users' perceptions replicate the assignments from our design model. Those values range from -1 to 1, with 1 meaning perfect agreement and 0 meaning random choice agreement. Thus, Cohen's Kappa extends information provided by strictly descriptive confusion matrices by measuring agreement while handling chance choice agreements.

To identify which images were more easily related to their archetypes and which levels of perception were more easily understood in the symbology of the images, we used results and popular placements matrices generated by OptimalWorkshop itself to show these individual results.

For the qualitative analysis, data were coded by one researcher using deductive thematic analysis (BRAUN; CLARKE, 2006) with the themes of *i)* difficulties in sorting images; *ii)* improvements and suggestions of new images or meanings and *iii)* personal experience in dealing with the images and archetypes. These themes were selected considering our research questions to aid in our general understanding of the user's mental model regarding our design.

Thus, we complemented our quantitative data with insights on how to improve our semiotic model and inform possible confounde (e.g., technical issues while using the system) of our main results.

5.2.2 Results

In this section, we present the results of predicting Gamification Journey's user types based on the image sorting and findings related to the users' perceptions of them.

5.2.2.1 RQ2: To what extent our design model correctly predicts users' (a) Jung's archetypes and (b) motivational groups?

For study one (Jung's archetypes), the overall agreement between participants and our design model was 55.2%. From all images participants sorted, 55.2% of them were assigned into the archetype our design model expected. The analysis revealed a Cohen's Kappa of 0.512, which can be considered a moderate agreement (MCHUGH, 2012). Table 13 details those results through a confusion matrix.

It shows that Jester's images were sorted 57 times in agreement, while the Innocent ones were sorted 68 times in agreement. According to that matrix, the highest agreements were for **Lover** (79), **Explorer** (72), and **Caregiver** (70). In contrast, **Creator** (30) was the one with the highest disagreement.

Additionally, the matrix reveals how mismatches happened through cells that are not on the main axis. For instance, we can see 9, 9, and 1 in the second, third, and fourth columns in the first row, respectively. This demonstrates that Jester's images (first column and row) were sorted into the Innocent archetype nine times, nine times into the Magician, and one time into the Sage. The same rationale applies to other columns and rows, revealing the mismatches between our design model and our participants' user model and showing to which archetype an image was sorted to when it was not attributed to the one our model expected. Accordingly, mistakes regarding Jester's images were mostly attributed to **Creator** (20). In contrast, most disagreements for the Innocent archetype were attributed to **Lover** (10).

The analysis for study two (motivational groups) is similar. The overall agreement between participants and our design model was 60.1% and, according to Cohen's Kappa, those also had a moderate agreement (0.468) (MCHUGH, 2012). Table 14 shows study two's confusion matrix. Accordingly, it shows 'Spiritual Journey' group yielded the highest agreement, followed by 'Provide Structure,' 'Connect to Others', and 'Leave a Mark.' Additionally, the matrix shows that most mismatches for 'Connect to Others' were attributed to 'Provide Structure,' and those for 'Leave a Mark' were mostly assigned to 'Connect to Others.' Mismatches for 'Provide Structure' were mostly attributed to 'Connect to Others' and 'Leave a Mark, whereas unexpectedly, assignments for 'Spiritual Journey' were mostly attributed to 'Leave a Mark.'

Table 13 – Jung 12 Archetypes Confusion Matrix (study one)

	Jes	Inn	Mag	Sag	Her	Exp	Out	Cre	Car	Rul	Lov	Ever
Jester	57	9	9	1	0	1	2	20	0	1	1	4
Innocent	9	68	0	1	0	6	0	2	7	0	10	2
Magician	7	1	52	14	0	6	2	17	2	4	0	0
Sage	2	1	7	53	0	4	3	12	11	6	1	5
Hero	2	2	2	3	68	4	8	5	5	3	0	3
Explorer	2	0	1	7	1	72	5	1	0	10	0	6
Outlaw	3	2	1	2	1	8	45	34	4	2	0	3
Creator	5	3	12	9	5	8	13	30	0	12	3	5
Caregiver	4	6	1	2	3	0	0	8	70	1	8	2
Ruler	2	0	1	24	10	1	5	5	0	46	1	10
Lover	3	1	1	0	2	1	0	1	16	1	79	0
Everyman	2	7	1	1	2	1	3	8	8	10	6	56

Acronyms Meaning: Inn = Innocent; Sag = Sage; Exp = Explorer; Out = Outlaw; Mag = Magician; Her = Hero; Lov = Lover; Jes = Jester; Ever = Everyman; Car = Caregiver; Rul = Ruler; Cre = Creator.

In Agreement Matches (N)	0	10	30	50

Table 14 – Jung Four Motivational Groups Confusion Matrix (study two)

	Connect to Others	Leave a Mark	Provide Structure	Spiritual Journey
Connect to Others	27	6	18	6
Leave a Mark	15	23	6	13
Provide Structure	9	9	37	2
Spiritual Journey	1	5	1	50

In Agreement Matches (N)	0	10	30	50

In summary, these results reveal archetypes and motivational groups wherein our design model matches that of users and demonstrates what archetypes/motivational groups the participants sorted images in disagreement with our model.

5.2.2.2 *RQ3: Which semiotic perception stage is more easily identified by the user through the images as (a) Jung's archetypes and (b) Motivational groups?*

In this subsection, we present the results of the third research question using matrices of popular placements and results generated by the platform Optimal Workshop used for the experiment.

5.2.2.2.1 Popular Placements Matrix

Each image were labelled from *archetype 01* to *03,* representing each one of them the Firstness, the Secondness and the Thirdness perception stages. In Table 15 and Table 16 we can see the popular placements of the images from the first and second studies respectively. Some archetypes were easier to identify on their three images, as is the case of the Innocent, the Explorer, the Hero, the Lover and the Caregiver. Others were identified through two of their three images, such as the Sage, the Magician, the Jester, the Everyman and the Ruler. Two archetypes were clearer more difficult to sort, the Outlaw and the Creator, with only one of their images as popular placement for each.

As for the motivational groups, the popular placements matrix is similar to the first study, with each group being identified by at least two of their original selected images and the Spiritual Journey group being identified by all of its images.

5.2.2.2.2 Results Matrix

In Table 17 and Table 18 we can see how many users sorted each image to each group. In the first study, pictures Explorer 2 and 3 were easily identified, with 28 and 30 participants sorting them into the Explorer group. Other images chosen by most of the participants to their correspondent group are Sage 02, Hero 02, Lover 02, Everyman 02 and Caregiver 01. As we can see, this occurs mostly with images identified as 02, that is, the ones selected to represent the archetype in their most objective way, as in the Secondness perception. This corroborates with Pierce's semiotic theory that on the Secondness the conscious perception is more objective. In general, the images users had more difficulty sorting were images marked as 03 because they involve their own experience and perception of life to attribute meaning to these symbols. Moreover, the abstract concept, the images representing the Firstness perception, were in the middle of it, with users having little to no difficulty interpreting them and others with more difficulty in this process.

In the second study, however, we can see that images marked as 03 (the Thirdness ones) were categorized into their respective groups by a more significant number of participants. This might occur because, in this second study, we deal with people's motivations, as in their reasons to seek something. Therefore, users found it easier to access their own experiences and perceptions to categorize the images into groups. At the same time, the images marked as 01 were the second ones categorized into their groups by a large group of participants. This corroborates with Jung's theory that these groups are more abstract and challenging to materialize than the archetypes, which, by their very definition, give a 'face' or an avatar to a set of behavioural patterns and characteristics.

Table 15 – Jung 12 Archetypes Popular Placements Matrix (study one)

	Inn	Sag	Exp	Out	Mag	Her	Lov	Jes	Ever	Car	Rul	Cre
Innocent 03	77%	00%	06%	00%	00%	00%	00%	06%	00%	06%	00%	06%
Innocent 02	74%	00%	00%	00%	00%	00%	00%	14%	03%	09%	00%	00%
Innocent 01	43%	03%	11%	00%	00%	00%	29%	06%	03%	06%	00%	00%
Sage 02	00%	83%	03%	03%	03%	00%	00%	00%	00%	00%	06%	03%
Sage 03	03%	63%	03%	03%	14%	00%	00%	03%	03%	00%	06%	03%
Magician 02	00%	37%	03%	06%	20%	00%	00%	00%	00%	06%	00%	29%
Ruler 01	00%	31%	03%	00%	03%	06%	03%	00%	23%	00%	23%	09%
Explorer 03	00%	06%	86%	03%	03%	00%	00%	00%	03%	00%	00%	00%
Explorer 02	00%	00%	80%	00%	00%	00%	00%	03%	14%	00%	03%	00%
Explorer 01	00%	14%	40%	11%	00%	03%	00%	03%	00%	00%	26%	03%
Outlaw 01	06%	00%	17%	60%	00%	00%	00%	03%	03%	09%	00%	03%
Magician 01	03%	03%	00%	00%	66%	00%	00%	20%	00%	00%	00%	09%
Magician 03	00%	00%	14%	00%	63%	00%	00%	00%	00%	00%	11%	11%
Creator 01	03%	06%	14%	17%	31%	14%	06%	03%	00%	00%	03%	03%
Hero 02	00%	00%	00%	03%	00%	80%	00%	00%	03%	14%	00%	00%
Hero 01	06%	03%	06%	09%	00%	60%	00%	06%	00%	00%	03%	09%
Hero 03	00%	06%	06%	11%	06%	54%	00%	00%	06%	00%	06%	06%
Lover 02	00%	00%	00%	00%	00%	06%	80%	03%	00%	11%	00%	00%
Lover 03	03%	00%	03%	00%	03%	00%	74%	06%	00%	06%	03%	03%
Lover 01	00%	00%	00%	00%	00%	00%	71%	00%	00%	29%	00%	00%
Jester 01	06%	03%	00%	00%	06%	00%	03%	71%	00%	00%	03%	09%
Jester 02	11%	00%	03%	06%	09%	00%	00%	69%	03%	00%	00%	00%
Everyman 02	00%	00%	00%	06%	00%	00%	00%	03%	80%	06%	00%	03%
Everyman 03	03%	00%	03%	00%	00%	03%	14%	00%	57%	17%	00%	03%
Caregiver 01	03%	00%	00%	00%	00%	03%	06%	03%	00%	83%	00%	03%
Caregiver 02	11%	00%	00%	00%	00%	03%	03%	09%	03%	66%	00%	06%
Caregiver 03	03%	06%	00%	00%	03%	03%	14%	00%	03%	51%	03%	14%
Sage 01	00%	06%	06%	03%	03%	00%	03%	03%	11%	31%	06%	29%
Ruler 02	00%	03%	00%	03%	00%	23%	00%	03%	03%	00%	63%	03%
Ruler 03	00%	34%	00%	11%	00%	00%	00%	03%	03%	00%	46%	03%
Creator 03	00%	20%	03%	20%	00%	00%	03%	03%	11%	00%	31%	09%
Everyman 01	17%	03%	00%	03%	03%	03%	03%	03%	23%	00%	26%	17%
Creator 02	06%	00%	06%	00%	03%	00%	00%	09%	03%	00%	00%	74%
Jester 03	09%	00%	00%	00%	11%	00%	00%	23%	09%	00%	00%	49%
Outlaw 02	00%	06%	03%	29%	00%	03%	00%	00%	03%	03%	06%	49%
Outlaw 03	00%	00%	03%	40%	03%	00%	00%	06%	03%	00%	00%	46%

Acronyms Meaning: Inn = Innocent; Sag = Sage; Exp = Explorer; Out = Outlaw; Mag = Magician; Her = Hero; Lov = Lover; Jes = Jester; Ever = Everyman; Car = Caregiver; Rul = Ruler; Cre = Creator.

In Agreement Matches (%)	0	10	30	50

Table 16 – Jung Four Motivational Groups Popular Placements Matrix (study two)

	Connect to Others	Leave a Mark	Provide Structure	Spiritual Journey
Connect to Others 03	3	1	10	5
Connect to Others 02	9	2	8	0
Leave a Mark 02	15	3	0	1
Provide Structure 02	5	8	4	2
Leave a Mark 03	9	6	2	2
Leave a Mark 01	1	9	0	9
Provide Structure 03	0	5	14	0
Provide Structure 01	7	4	6	2
Connect to Others 01	2	0	17	0
Spiritual Journey 03	1	3	0	15
Spiritual Journey 02	0	2	0	17
Spiritual Journey 01	0	0	1	18

In Agreement Matches (N)	0	10	15	20

5.2.2.3 RQ4: What are users' perceptions about the card sorting tasks?

The themes that originated the codebook can be seen on Table 19 and the results from analyzing open questions' answers using deductive thematic coding are as follows. The complete thematic analysis can be seen in the supplemental material.

In the first study, from the 35 participants, 23 declared they had some sort of difficulty to sort the images such as *"I didn't find any really suited the description of outlaw"* and *"so I really struggled with putting it as Jester and only did so after having sorted most of cards."* (P22), 19 reported some personal view or experience during the session such as *"Magician seems more abstract than Sage"* (P16) and *"The one with two masks looks like the classic symbol for drama - tragedy and comedy masks"* (P22), eight reported not having any difficulty at all, seven thought there was no need for improvements in the process such as *"I think these were pretty good ones"* (P19). Seven participants gave feedback on how to improve it, such as *"I think abstract art would work well for the Creator"* (P34) and *"The Jester should be something that is light-hearted and conveys pleasure not a mix"* (P22).

In the second study, from the 19 participants, five declared they had some difficulty sorting the images, such as *"It required some time to assimilate the image with the belonging group"* (P1) and *"I found it really hard to do a 'leave a mark one',perhaps something with paint brushes/creator-style images might help?"* (P16), eight reported some personal view or experience during the session, such as *"Add structure reminds me of sorting things. The building metaphors could easily also go in leave a marking"*(P6) and *"I think that the images with one focal point were easier to group. For example, the woman underwater, or people putting together a puzzle."* (P13), 10 reported not having any difficulty at all, five thought there was no need

Table 17 – Jung 12 Archetypes Results Matrix (study one)

	Inn	Sag	Exp	Out	Mag	Her	Lov	Jes	Ever	Car	Rul	Cre
Everyman 01	6	1	0	1	1	0	0	1	0	0	9	6
Everyman 02	0	0	0	2	0	1	1	1	8	2	1	1
Everyman 03	1	1	1	0	0	0	0	0	28	6	0	1
Lover 01	0	0	0	0	0	1	5	0	20	10	0	0
Lover 02	0	0	0	0	0	0	25	1	0	4	0	0
Lover 03	1	0	1	0	1	2	28	2	0	2	1	1
Jester 01	2	1	0	0	2	0	26	25	0	0	1	3
Jester 02	4	0	1	2	3	0	1	24	1	0	0	0
Jester 03	3	0	0	0	4	0	0	8	3	0	0	17
Hero 01	2	1	2	3	0	21	0	2	0	0	1	3
Hero 02	0	0	0	1	0	28	0	0	1	5	0	0
Hero 03	0	2	2	4	2	19	0	0	2	0	2	2
Magician 01	1	1	0	0	23	0	0	7	0	0	0	3
Magician 02	0	13	1	2	7	0	0	0	0	2	0	10
Magician 03	0	0	5	0	22	0	0	0	0	0	4	4
Outlaw 01	2	2	6	21	0	0	0	1	1	3	0	1
Outlaw 02	0	0	1	10	0	1	0	0	1	1	2	17
Outlaw 03	0	0	1	14	1	0	0	2	1	0	0	16
Caregiver 01	1	0	0	0	0	1	2	1	0	29	0	1
Caregiver 02	4	0	0	0	0	1	1	3	1	23	0	2
Caregiver 03	1	2	0	0	1	1	5	0	1	18	1	5
Creator 01	1	2	5	6	11	5	2	1	0	0	1	1
Creator 02	2	0	2	0	1	0	0	3	1	0	0	26
Creator 03	0	7	1	7	0	0	1	1	4	0	11	3
Ruler 01	0	11	1	0	1	2	1	0	8	0	8	3
Ruler 02	0	1	0	1	0	8	0	1	1	0	22	1
Ruler 03	0	12	0	4	0	0	0	1	1	0	16	1
Explorer 01	0	5	14	4	0	1	0	1	0	0	9	1
Explorer 02	0	0	28	0	0	0	0	1	5	0	1	0
Explorer 03	0	2	30	1	1	0	0	0	1	0	0	0
Innocent 01	15	1	4	0	0	0	10	2	1	2	0	0
Innocent 02	26	0	0	0	0	0	0	5	1	3	0	0
Innocent 03	27	0	2	0	0	0	0	2	0	2	0	2
Sage 01	0	2	2	1	1	0	1	1	4	11	2	10
Sage02	0	29	1	1	1	0	0	0	0	0	2	1
Sage 03	1	22	1	1	5	0	0	1	1	0	2	1

Acronyms Meaning: Inn = Innocent; Sag = Sage; Exp = Explorer; Out = Outlaw; Mag = Magician; Her = Hero; Lov = Lover; Jes = Jester; Ever = Everyman; Car = Caregiver; Rul = Ruler; Cre = Creator.

In Agreement Matches (N)	0	10	20	30

for improvements in the process and four participants gave feedback on how to improve it, such as *"Connect to others should involve people.* (P6)" and *"I would look for something more*

Table 18 – Jung Four Motivational Groups Results Matrix (study two)

	Connect to Others	Leave a Mark	Provide Structure	Spiritual Journey
Connect to Others 03	79%	16%	00%	05%
Connect to Others 02	47%	11%	42%	00%
Leave a Mark 02	47%	32%	11%	11%
Provide Structure 02	37%	21%	32%	11%
Leave a Mark 03	05%	47%	00%	47%
Leave a Mark 01	26%	42%	21%	11%
Provide Structure 03	11%	00%	89%	00%
Provide Structure 01	00%	26%	74%	00%
Connect to Others 01	16%	05%	53%	26%
Spiritual Journey 03	00%	00%	05%	95%
Spiritual Journey 02	00%	11%	00%	89%
Spiritual Journey 01	05%	16%	00%	79%

In Agreement Matches (%)	0	40	60	80

Table 19 – Quotes supporting tags found in the thematic analysis of participants answers

Tag	Subtheme	Quote
Theme: Difficulties in sorting images		
Demands significant time	Time	*It required some time to assimilate the image with the belonging group*, P1
Interpretation	Symbolic	*I didn't find any really suited the description of outlaw[..]*, P22
Sorting	Symbolic	*[...] so I really struggled with putting it as Jester and only did so after having sorted most of cards*, P22
Theme: Improvements and suggestions of new images or meanings		
Images	Representation	*Connect to others should involve people*, P6
Images	Clarity	*think that the images with one focal point were easier to group*, P13
Theme: Personal experience in dealing with the images and archetypes		
Opinion	Meaning	*[...]I think some of these pictures were less straightforward than others which makes them good*, P35
Experience	Tasks	*there were a couple images that could have been in multiple groups* , P13

'permanent' for 'Leave your mark on the world' because sand is so temporary - but, it was easy to sort so maybe permanence doesn't matter (P11)."

These results show that considering both studies, over 65% of the participants had some issue (i.e., difficulty to sort the images or a perception that the process could be improved) during the task. For instance, they suggested **a couple more interpretations of the symbolism of the**

archetypes that we can take into consideration in the future, such as the case of Jester, which was considered to be something fun (in their imagination) and not having a myriad of emotions. Thus, informing the design of automatic user type identification through image sorting. All of the participants' open answers can be found in the supplemental material.

5.2.3 Discussion

This section presents our overall findings, why they are positive and how they differ from the existing literature, presenting their implications and discussing their limitations.

5.2.3.1 Overall Findings

Our results show that our model proved to be feasible in their approach for identifying user types through symbolic images, considering the moderate agreement between ours and users' mental models for both Jung's archetypes as well as motivational groups (**RQ2**). This finding advances the HCI literature in three directions that we discuss next.

First, the empirical support of our approach confirms the value of our proposed guideline (**RQ1**) to optimize the use of questionnaires. Also, regarding the participants' view of card-sorting tasks themselves (**RQ4**), we found that more than half of the participants had no difficulty, and some reported having enjoyed the experiment. This information is important because at no time have we worked on this experiment with a playful interface. The idea here was to validate the image classification approach. As such, we can argue that even without a ludic interface, the process of dealing with symbolic images is by itself playful and provides a good experience. In an interactive system, for example, once the images are chosen for data collection, they would need to be designed with their respective affordances within a playful interface, so that users could have fun and immerse themselves in the system at their first interaction with it, while choosing the images. Once the data collection is completed, the system would present the user's archetype, and from there, the presentation of pedagogical content would follow the characteristics of this archetype. For example, an intelligent system would identify student behaviour changes during educational tasks, dynamically changing its archetype and presented content. Such findings are similar to results regarding other playful methods to collect data, such as Altmeyer *et al.* (ALTMEYER *et al.*, 2020) research. Hence, supporting our proposed guideline's value for using image symbology to identify user types in a playful, non-intrusive way.

Second, by empirically validating the feasibility our approach to correctly identify user types (**RQ2**), we provide a way to apply personalization beyond gaming characteristics. In comparison to Tondello's (TONDELLO, 2019), and Hallifax's (HALLIFAX, 2020) research, our approach differs from types based on gamer or non-gamer characteristics to a broadly psychological classification, also used in Psychology, to understand the user in its current moment. That is important because of the particularities of educational contexts. Despite that, it was impossible to personalize gamified designs to broader psychological aspects, such as

Jung's archetypes/motivational groups, because there was no validated approach to identify them feasibly. Thus, we advance the literature by providing empirical evidence on the viability of identifying such user types through a playful, non-intrusive method.

Third, our results advance the literature with considerations on how different stages of semiotics contribute to identifying people's archetypes/motivational groups (**RQ3**). We found that, for the participants in the experiment, there was considerable variation in the perception of images concerning the stages of human perception described by Peirce (HARTSHORNE *et al.*, 1958): The Firstness, The Secondness and The Thirdness. For some participants, the archetypes were constantly identified through images that represented the Firstness and The Secondness, which was expected since these two levels of perception are more easily predictable in conceptual terms. However, in the second card-sorting study, where the preexisting groups were motivational, most most of the images classified in common agreement belonged to the Thirdness. One of the possible causes for this result is that motivational groups are less defined (as they encompass archetypes more broadly) than archetypes themselves, thus containing a wider range of possible interpretations that relate to how a person sees the world (i.e., their life experience). This result sets a precedent that perhaps if the concept mapped into symbolic images is less objective, images that deal with the Thirdness may be adequate. Hence, we advance the literature with theoretical considerations to be investigated in the future, which might lead to advances in the automatic identification of Jung's archetypes, motivational groups, and other user typologies, such as Hexad.

5.2.3.2 Summary of Implications

Our findings reveal practical implications and demonstrate that: *i)* traditional questionnaires can be adapted to more immersive and playful solutions; *ii)* symbolic images can be used to predict behavioural and personality characteristics; *iii)* it is possible to design systems using images not only from an aesthetic and usability perspective, but also as a form of data collection. From a theoretical perspective, our work implicates that: *i)* Other research related to the categorization of gamers or user types may replicate our method to create more playful and immersive ways of collecting data; *ii)* Peirce's semiotic studies can be used as a form of categorization, which was also explored in Sowa's (SOWA, 2016) and Santaella's (SANTAELLA, 2001) research.

Our results show that it is possible to predict a person's preferred user type using solely symbolic images. However, it is essential to discuss the difference in our approach for classifying user types from Jung's 12 archetypes from the approaches used in other areas, especially in Psychology. While in psychology, the archetypes are used to understand human consciousness (and sometimes unconsciousness), in the approach presented in this study, we are dealing only with characteristics that are possibly related to the learning process and the educational environment. As such, these archetypes in this context can be considered as symbolic

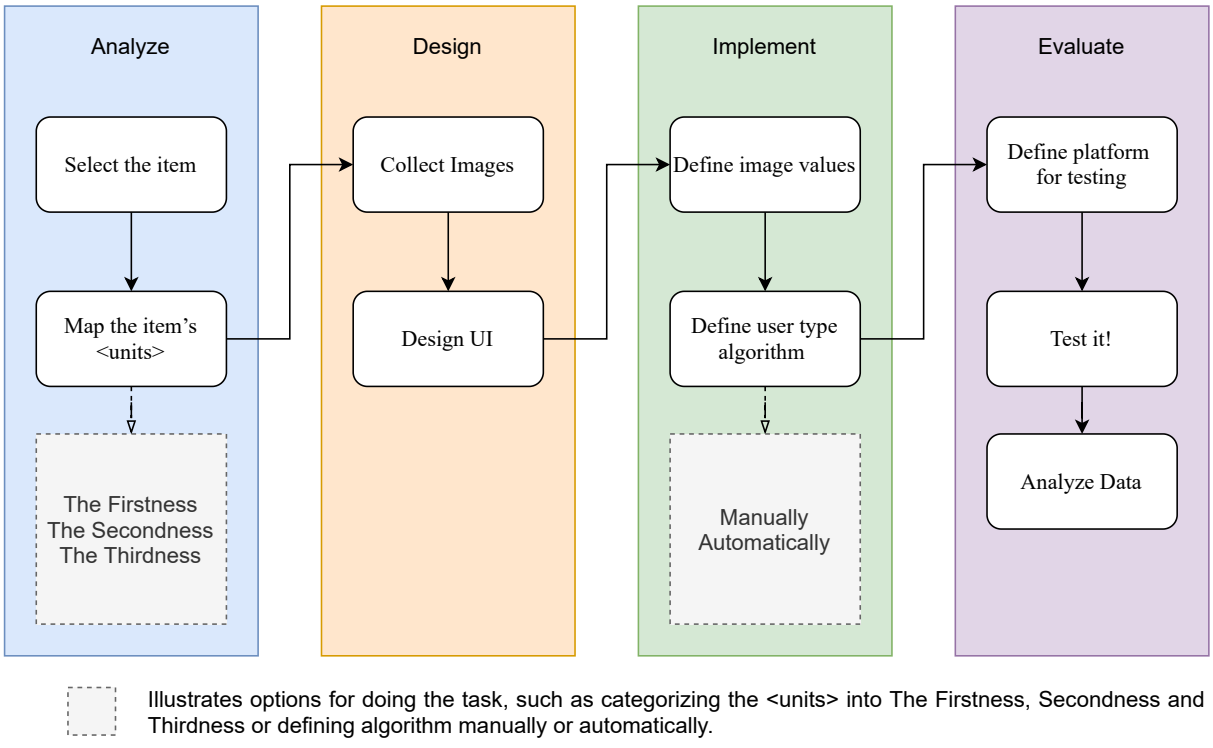
representations of a person's avatar (RATAN, 2013), that is, how a person wants to behave and be in that moment. It is not our intent to affirm to classify human's deep and complex consciousness with this approach but to provide a new way to tailor their experience in a given educational system at that given moment.

From the HCI perspective, these archetypes are affordances that can guide the user on how to interact with the system, and at the same time, act as guidelines for instructional designers to present the learning content accordingly. As such, we tackle the archetype's characteristics only at the level we can represent it in a system through affordances or systems intelligent behaviours.

5.2.3.3 Guidelines on How to Identify User Types using Image Simbology

Considering the important but challenging nature of using image symbology, in this section, we present a guideline if one desires to apply these concepts to another gamer/user type approach. Figure 43 illustrates the process.

Figure 43 – Guidelines Diagram



1. Select the item to be represented by the image. It can be a final classification or even a question from the approach's questionnaire.

2. Map this <unit> three levels of perception: The Firstness (the abstract meaning of the <unit>; the Secondness, the objective meaning of the <unit> and the Thirdness, the final expression of that <unit>. In some cases, it will be impossible to map or predict the

Thirdness because this perception stage usually derives from one's personal experience and world viewing.

3. Collect at least one image for one perception stage (this is important because each person has different ways to perceive their surroundings. For example, some people attribute more significant meaning to their feelings (abstract, related to the Firstness), others to their reality (concrete, related to the Secondness) and others to their own experience (personal, related to the Thirdness).

4. Design an interface for the user to choose from these images. Be careful to expose the images with the necessary affordances to understand who needs to choose and why.

5. Define each image value for the user type prediction.

6. Define and calculate the logic behind the initial user type based on the user's choices (this can be done manually or automatically via system algorithms). For example: To consider an user from user type X, they need to choose Y images from Z categories.

7. Choose what platform to use for testing, such as Optimal Workshop, HTML and others.

8. Test the approach and analyze data.

As an example, we follow the guidelines to apply our method to the **Free Spirit** user type from HEXAD (TONDELLO *et al.*, 2016a). Considering that the people from the Free Spirit user type are usually *autonomous, want to create and explore and, according to the authors look for easy fun, branching choices and customization* we need to map these characteristics to Peirce's semiotic triad.

1. **The Firstness:** wide spaces and landscapes, people having fun;

2. **The Secondness:** crossroads, people happy and free (smiling with arms wide open, for example);

3. **The Thirdness:** travel, people creating and discovering things.

From then on, we should collect images that match these descriptions, find similar themes and then apply them to a ludic interface (if the intent is to create the UI for identifying the user type) or to a card-sorting session or other similar technique (if the intent is to validate the user's mental model with our mapping).

Following these steps, it is possible to replicate this study experiment for other approaches and develop new playful interfaces for collecting data.

5.2.3.4 Limitations and Recommendations to Future Research

Our research successfully demonstrated that it is possible to use symbolic images to predict user types without further data collection. However, even if it is possible to predict a person's preferred archetype with this method, this study alone can not affirm it is the best one for the user to learn the content. As such, we would need an intelligent semantic system to work on this limitation, observing the student's behaviour and having groups of suitable activities for each determined archetype, dynamically changing the archetypes if needed. Also, as our approach (PALOMINO *et al.*, 2019a) still did not compare our results to a Jung archetype validated questionnaire, it is difficult to affirm this approach would be better or equal to collecting data through traditional questions. Therefore, we can only affirm it can, with a moderate agreement, collect this data.

As future research, we envision *i)* the creation of more interfaces based on this method; *ii)* the approach evaluation in a real educational system; *iii)* this method's replication for other gamer or user typologies and *v)* studies comparing different approaches (such as Hexad's questionnaire data collection method and Gamification Journey). In this sense, we expect the guidelines presented in this study to be a milestone for future research and directions regarding user types data collection.

This study generated two full papers, the first published at SBGames 2019 under the title of: "Gamification Journey: A Novel Approach for Classifying Gamer Types for Gamified Educational Systems", and can be read at the appendix. The second one is under review at Entertainment Computing journal, under the title of: "Predicting User Types with Symbolic Images: An empirical validation based on two card-sorting studies".

5.3 Chapter Conclusions

This chapter presented the creation, evaluation and testing of a novel approach for identifying students' profiles to personalize gamification strategies, the Gamification Journey. It sought to answer the thesis research question of **sRQ4: "How to personalize user experience in a gamified educational system using a narrative approach?"** As an artifact that works in parallel with our Narrative Gamification Framework for Education, we believe it can improve the user experience of students when using a GES and work towards a more equitable instructional gamification design.

CHAPTER

6

AN ONTOLOGY FOR MODELLING STUDENTS PROFILES IN GAMIFICATION FOR EDUCATION

As our final artifact to support the creation of gamified strategies based on content and learning engagement, we designed a lightweight ontology that connects all of our previous work and can be expanded as research in the area advances in the following years. This chapter describes the ontology creation process, and evaluation using the FOCA methodology (BANDEIRA *et al.*, 2016).

6.1 Gamification for Education Ontology

Gamification in education uses two design processes: gamification itself and instructional design. As such, the domain deals with another complexity layer because, besides concerning personalization, the design needs to consider the learning content and how each game element can impact the student's performance (RODRIGUES *et al.*, 2021b). Therefore, it is necessary to have a knowledge model that links and organizes all of these aspects to facilitate the design process.

To address the issue of personalization for education, we proposed an approach to model user types (in this case, the students) based on Jung's 12 archetypes (PALOMINO *et al.*, 2019a). And although there are several frameworks and guidelines developed to support the planning and implementation of gamification (DICHEV; DICHEVA, 2017a; MORA *et al.*, 2017b), which are vital to providing systematic steps to support the gamification design, there are few frameworks focused on the education domain (MORA *et al.*, 2017b; TODA *et al.*, 2018). Alongside this, most of these frameworks focus on providing a *one-fits-all* gamification approach containing specific game elements in specific contexts (MORA *et al.*, 2017b; OLIVEIRA; BITTENCOURT;

VASSILEVA, 2018) and use structural game elements, such as the PBL triad (Points, Badges and Leaderboards). Furthermore, there are few studies considering content-based frameworks that work with subjective game elements such as narrative, storytelling, and sensation (KAPP, 2012a; MORA *et al.*, 2017b), which are essential elements when concerning the educational domain (PALOMINO *et al.*, 2019b).

Therefore, this study sought to address the following research questions:

RQ1: How can we connect the concepts related to Jung's intrinsic motivations of archetypes to pedagogical aspects?

RQ2: What is the knowledge representation that would serve as the basis for the development of a content gamification framework for educational purposes?

We chose to create, from our original personalization approach, a lightweight ontology (*i.e.,* a model representation of concepts and their relationships (MIZOGUCHI, 2003)) and then develop it in OWL, which is a semantic web language designed to represent rich and complex knowledge models (ISOTANI; BITTENCOURT, 2015). In addition to providing a visual representation of knowledge that can be understood and used by non-computer specialists (such as teachers, for example), this ontology also provides a model of knowledge representation that can be used in the development of intelligent semantic systems (NOY; MCGUINNESS *et al.*, 2004; ISOTANI; BITTENCOURT, 2015). We evaluated this ontology using FOCA, which is a methodology for assessing ontologies, based on a correspondence between the roles of knowledge representation with the main quality criteria for ontology assessment (BANDEIRA *et al.*, 2016).

We considered yet another theory regarding personality traits and deepened our Gamification Journey study by correlating Jung's archetypes to the Big Five Personality Traits model (also known as the OCEAN model), used in the last decades with most personality tests, which all have recurring themes classified by the Big Five approach (MCCRAE; COSTA, 1987). While personality is a set of characteristics that represents a relatively stable pattern of behaviour in response to people's own experiences (JUNG, 2014), traits distinguish personal characteristics that make up an individual's unique personality (MCCRAE; COSTA, 1987).

As for the instructional design of the learning activity type (LAT) and content that should be presented to the student to facilitate and guide the learning process, based on their user types, we choose to work with Bloom's Revised Taxonomy to categorize and organize the LAT and its contents (KRATHWOHL, 2002), in the same way our Narrative Gamification Framework for Education already does.

Therefore, we summarize our contributions as:

- Presenting a lightweight gamification ontology developed from a semantic perspective that

designers and teachers can use to support the personalized instructional design of gamified classes;

- Providing a knowledge representation of the domain "gamification applied to education" that could be used to implement several different gamification strategies further;
- Explaining and clarifying subjective concepts of complex semantic mapping;
- Providing an OWL ontology that can be used to create gamified educational systems (GES).

6.1.1 Ontologies and Gamification

Concerning related works on ontologies in gamification, we can mention three recent works, namely the OntoGamif (BOUZIDI *et al.*, 2018), OntoGaCLeS (CHALCO; ISOTANI, 2019) and GaTO (DERMEVAL *et al.*, 2019) ontologies. The first work deals with a modular ontology for the gamification domain, covering the users, organizational structures, ethical issues, and psychological factors. They are organized as seven linked modular sub-ontologies that can also be used independently to support the work of gamification designers implementing personalized gamified solutions (BOUZIDI *et al.*, 2018). This ontology is also linked to the upper-level domain ontology SUMO [1]. The second ontology formalizes the representation of gamification concepts and explains how they affect motivation in collaborative learning contexts (CHALCO; ISOTANI, 2019). The third ontology connects concepts of gamification with concepts of intelligent tutoring systems (ITS), allowing automated reasoning to enable interoperability and the creation of awareness about theories and good practices for the designers of gamified ITS (DERMEVAL *et al.*, 2019).

Although the last two ontologies deal specifically with gamification in education, they do not address the issue of personalization, which is the main focus of this study.

Therefore, we developed an ontology for gamification applied to education that covers the definition of the users' type and the game elements that can be used in a gamified design to improve the users' experience, considering their learning objectives and presenting learning activities according to their preferences and learning performance, in order to keep the student engaged and focused on learning.

6.2 Study

This research's goal is to **provide an ontology to represent relationships between the use of Bloom's Taxonomy and the personalization of gamified designs through Jung's archetypes and game elements** to create educational strategies supported by a gamification

[1] <http://www.adampease.org/OP/>

taxonomy for education. To develop that ontology, we used the Simple Knowledge-Engineering Methodology (Ontology 101) (NOY; MCGUINNESS *et al.*, 2004), which consists of an iterative approach to ontology development, starting with a rough sketch of the ontology and then revising and refining it, filling in the details. We opted for this methodology because it is an agile method, widely accepted by the academic community (GOBIN, 2014; ISOTANI; BITTENCOURT, 2015). We also opted to create an ontology because of its practical use in intelligent semantic systems and as a way to formalize the knowledge in those three fields. The complete study procedure can be seen in Figure 44.

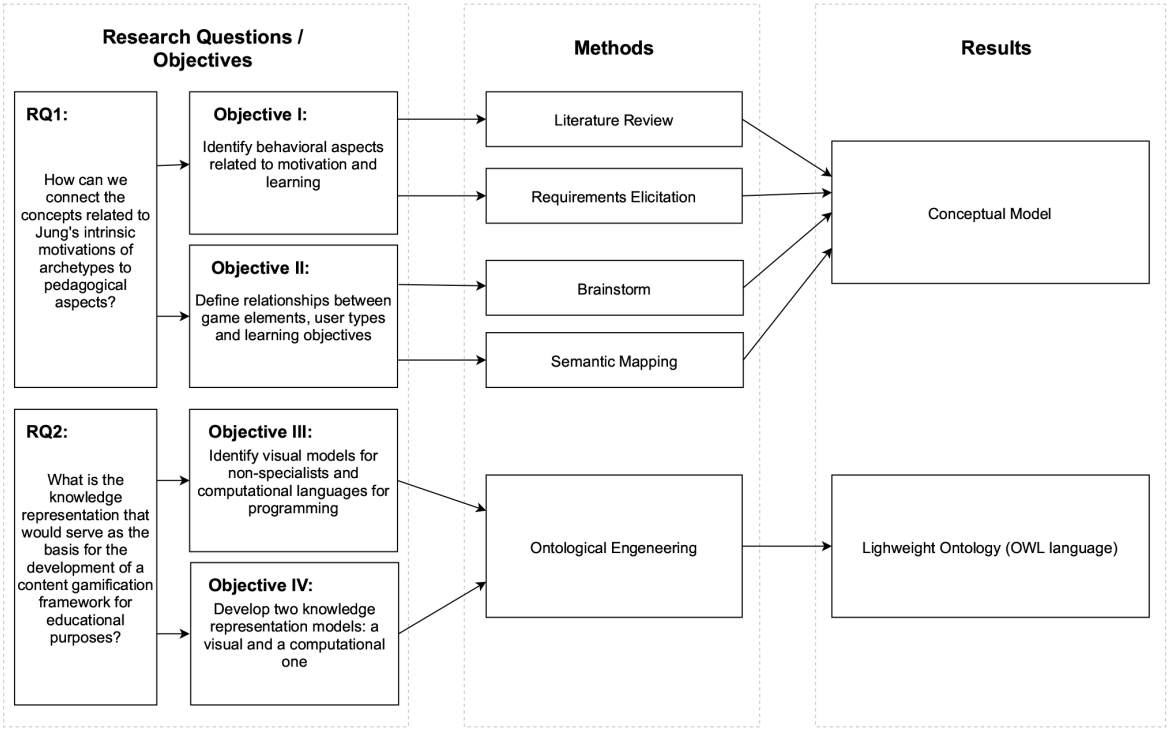


Figure 44 – Study Procedure

To conduct this study, we related three main concepts: *i)* Jung's Archetypes from Gamification Journey; *ii)* Gamification Taxonomy for Educational Purposes (TGEEE) and *iii)* Bloom's Revised Taxonomy; mapped their parts and then specified their attributes and how they could be instantiated. The conceptual map of the lightweight ontology and its complete OWL version can be seen in the supplemental material.

First, we used the TGEEE, containing 21 game elements that were mapped and distributed in five-game dimensions (ecological, social, personal, fictional and performance) (TODA *et al.*, 2019). Second, these dimensions were semantically instantiated to Jung's 12 archetypes (also distributed into four motivational groups), which were then mapped and related to parts and attribute through semiotics techniques (PEIRCE, 1991; SANTAELLA, 2017). Finally, we used the revised version of Bloom's Taxonomy to instantiate the archetypes to the pedagogical aspects through its cognitive and knowledge dimensions. The six hierarchical learning objectives

were related to learning activities types, and the four dimensions of knowledge (KRATHWOHL, 2002). From then on, we related some digital tools as suggestions for the applicability of the instructional designs (CHURCHES, 2010).

The primary purpose of this ontology is to enable the reuse of the domain knowledge and make the domain assumptions explicit. As such, this ontology should help other instructional designers and teachers reuse these instances, supporting their classes and providing support for future works developing frameworks based on these relationships.

For the final OWL ontology, we also related the 12 Jung's archetypes to the Big Five Personality Trait model (DIGMAN, 1990). Also, the way we built the ontology allows the expansion of related concepts in the future, adding other gamers/user types approaches (not built initially with educational focus), such as Hexad and other gamification taxonomies, relating them to the educational aspect through Bloom's Taxonomy and other instructional designs. Therefore, this work can stagger to become an ontology for gamification applied to education, providing several different ways to create these strategies.

6.2.1 Ontology Design

The seven iterative steps necessary to build an ontology, according to the Simple Knowledge-Engineering Methodology (NOY; MCGUINNESS *et al.*, 2004) are:

Determine Scope: In this step, we established the domain of interest, the main goal and specific objectives of the ontology, the scope and the competency questions, as follows:

The domain of interest is the creation of a Gamification Framework applied to Educational Systems; the goal is to develop a knowledge model that helps education specialists to understand how to use Jung's 12 Archetypes to personalize GES, based on the TGEEE and Bloom's Taxonomy for Learning Objectives. The specific objectives are to provide a semantic basis in which to develop personalized gamification strategies for education; to derive and build a lightweight ontology (as in abstract form) for review purposes and to be shared with non-experts; to develop its OWL version that can be used to develop GES and to validate the ontology using FOCA methodology. For the scope, we defined the semantic relationship between the characteristics related to the archetypes, gamification educational Taxonomy and Bloom's revised taxonomy and as competency questions:

- What characteristics belong to each archetype, and how can they be related to the Big Five Personality Model?
- What game element dimension can be related to each archetype motivation group?
- How are these characteristics related to Learning Objectives and Learning Activities Types?

- How can these characteristics be used for personalizing educational contexts and activities?

Consider reuse: For the stage of this study, we are working with our ontology. However, in future works, we intend to link it to the existing OntoGamif Modular Ontology (BOUZIDI *et al.*, 2018) [2].

Enumerate terms: We used requirements elicitation methods to collect and filter information, as stated on BABOK methodology for business analysis (BRENNAN *et al.*, 2009). We enumerated the terms through the brainstorming technique, one of the nine methods presented in this methodology. We chose this technique because it has a better cost-benefit than the others and is more suitable for the type of ontology we are creating, based on innovation and semantic relationships.

Define classes, properties, restrictions and create the instances: These next four steps, related to the initial structuring and formalization, were done using semantics and semiotic techniques (PÁSTOR *et al.*, 2018; PEIRCE, 1991; SANTAELLA, 2017), where we mapped the concepts into their respective objects and attributes. These steps were executed first by creating a conceptual map of the classes and then establishing their properties, restrictions and instances relating to each other as it can be seen on Figure 45[3].

6.2.2 Ontology Evaluation

This section presents the methodology used to evaluate the ontology and the reason behind such a choice. The task of modelling an ontology is complex and time-consuming and as such, the worse the quality of the ontology, the lesser its re-usability. That is why it is essential to use a sound methodology for the construction of the ontology, as well as using a method to validate whether what has been done is within specific quality criteria or not (BANDEIRA *et al.*, 2016). Besides, the evaluation process needs to be accessible to domain experts, who are not always specialists in ontologies. As such, for evaluating the ontology presented in this paper, we choose to use FOCA methodology (BANDEIRA *et al.*, 2016), which takes into account three main principles and presents a step-by-step tutorial on how to evaluate ontologies for non-specialists:

1. it is based on the Goal, Question, Metric (GQM) approach for empirical evaluations from Basili *et al.* (BASILI, 1992);

2. it has the goals of the methodologies based on the five roles of knowledge representation from Davis (DAVIS; SHROBE; SZOLOVITS, 1993) and its metrics based on evaluation criteria proposed by Vrandečić (VRANDEČIĆ, 2009);

[2] <https://data.mendeley.com/datasets/6gx487xb4c/5>
[3] The conceptual map of the ontology can be seen on the supplemental material

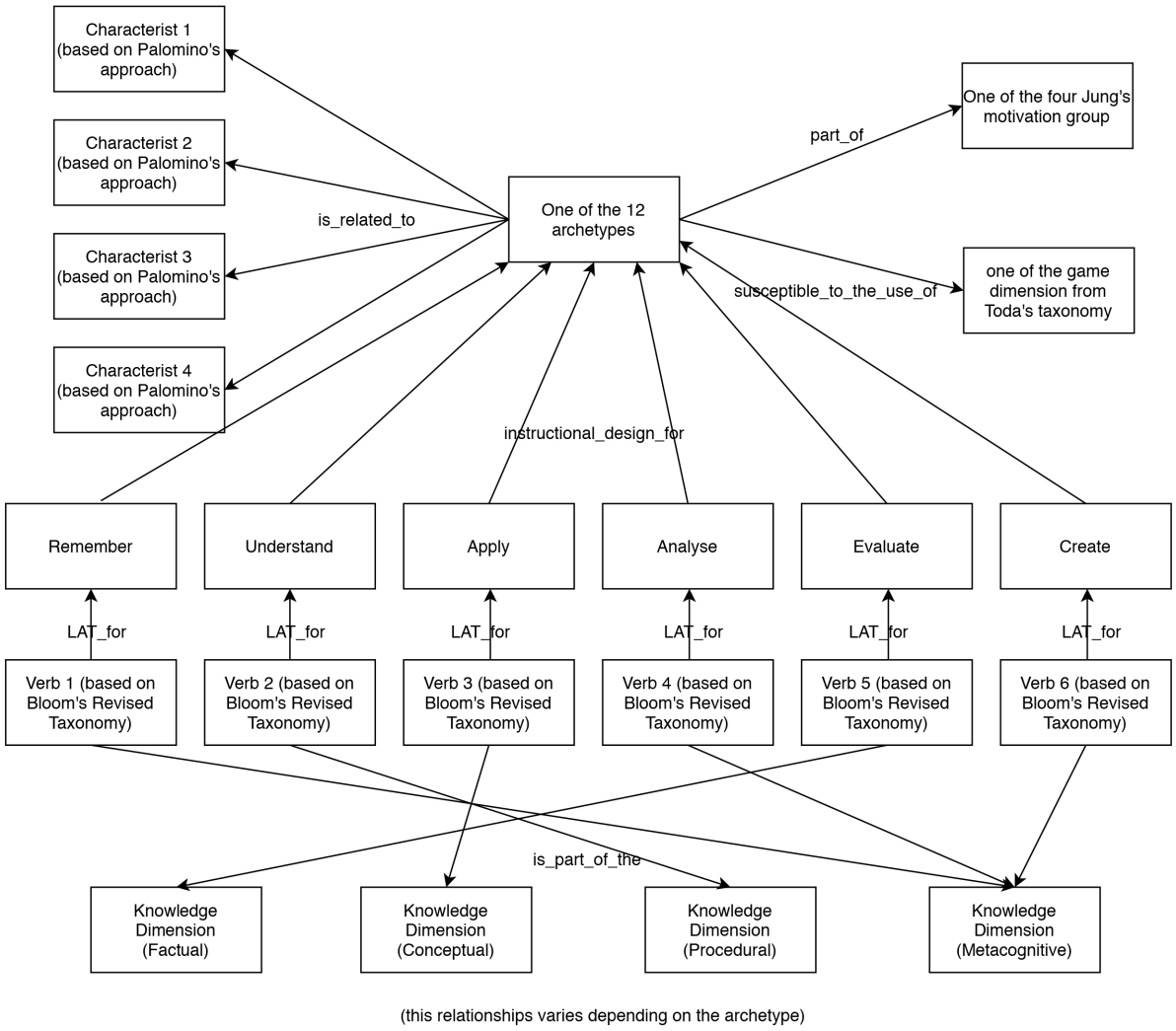


Figure 45 – Modelling Graph template for each archetype relationships in the ontology

3. it considers each evaluation according to the type of the ontology defined by Guarino (GUARINO, 1998).

The FOCA methodology GQM can be seen in Table 20.

The steps for the evaluation can be resumed as such: the evaluator defines the ontology type and then iteratively perform the GQM approach. After that, the ontology's quality is calculated based on the metrics established by the methodology. For this research purpose, the ontology was evaluated by three domain specialists in gamification applied to education. Next, we present each step executed to evaluate our ontology.

1. **Ontology Type Verification:** As an ontology that describes concepts that depend on a particular domain and is intended for application purposes, all three specialists defined that its type is type two, an Application ontology, and as such, question 5 from FOCA's GQM should not be verified.

Table 20 – The FOCA methodology GQM (BANDEIRA *et al.*, 2016)

Goal	Question	Metric
1. Check if the ontology complies with Substitute.	Q1. Were the competency questions defined?	1. Completeness.
	Q2. Were the competency questions answered?	1. Completeness
	Q3. Did the ontology reuse other ontologies?	2. Adaptability
2. Check if the ontology complies Ontological Commitments.	Q4. Did the ontology impose a minimal ontological commitment?	3. Conciseness.
	Q5. Did the ontology impose a maximum ontological commitment?	3. Conciseness.
	Q6. Are the ontology properties coherent with the domain?	4. Consistency.
3. Check if the ontology complies with Intelligent Reasoning.	Q7. Are there contradictory axioms?	4. Consistency.
	Q8. Are there redundant axioms?	3. Conciseness.
4. Check if the ontology complies Efficient Computation.	Q9. Did the reasoner bring modelling errors?	5. Computational efficiency
	Q10. Did the reasoner perform quickly?	5. Computational efficiency.
5. Check if the ontology complies with Human Expression.	Q11. Is the documentation consistent with modelling?	6. Clarity.
	Q12. Were the concepts well written?	6. Clarity.
	Q13. Are there annotations in the ontology that show the definitions of the concepts?	6. Clarity.

2. **Questions Verification:** In this step, all of the 13 questions, except question 5, were answered by the evaluators, establishing a grade for each question as seen on Table 21.

3. **Quality Verification:** In this step, the quality of the ontology was validated in two ways: total quality and partial quality in the roles of Substitute, Ontological Commitments, Intelligent Reasoning, Computational Efficiency and Human Expression, as seen on Table 22. These grades are a weighted linear combination of the different goals and calculated according to the existing formula in FOCA methodology (BANDEIRA *et al.*, 2016).

Although the methodology provides metrics for the attribution of grades for Human Expression, this goal does not have variables for calculation input in the formula. According to the authors, there are two reasons for this: the ontological reason, which assumes that human expression is embedded in other roles, and the mathematical reason, since they obtained the formula after carrying out an experiment that validated the methodology (BANDEIRA *et al.*, 2016).

6.3 Results

This section details the ontology classes, object properties, data properties and instances, and the evaluation results.

The ontology developed and presented in this article is an Application Ontology that describes concepts depending on a particular domain or task, often consisting of specializations of a domain or top-level ontology (BANDEIRA *et al.*, 2016). In this study, the general domain

Table 21 – GQM Grading

G.	Q.	SQs.	Grade			Question Grade Mean			Goal Grade Mean		
			E1	E2	E3	E1	E2	E3	E1	E2	E3
1	Q1	SQ1.1	100	100	100						
1		SQ1.2	100	100	100	100	100	100			
1		SQ1.3	100	100	100				66,667	66,667	66,667
1	Q2		100	100	100	100	100	100			
1	Q3		0	0	0	0	0	0			
2	Q4		100	75	100	100	75	100	100	87,5	100
2	Q6		100	100	100	100	100	100			
3	Q7		75	75	100	75	75	100	87,5	75	100
3	Q8		100	75	100	100	75	100			
4	Q9		100	100	100	100	100	100	100	100	100
4	Q10		100	100	100	100	100	100			
5	Q11	SQ11.1	100	100	100	75	100	87,5	58,333	91,666	58,333
5		SQ11.2	50	100	75						
5	Q12		100	100	100	100	100	100			
5	Q13		0	75	0	0	75	0			

G. = Goal; Q. = Question; SQs. = Sub Questions; E = Evaluator.

Table 22 – Ontology Quality Evaluation Final Grades

E	Total Quality	Substitute	Ontological Commitment	Intelligent Reasoning	Computational Efficiency	Human Expression
E1	0.998	0.826	0.826	0.607	0.826	0.391
E2	0.997	0.826	0.787	0.576	0.826	0.391
E3	0.998	0.826	0.826	0.636	0.826	0.391

E = Evaluator.

of this application ontology is education, and our particular task is to personalize gamification designs for educational purposes. Furthermore, this is a knowledge modelling of a specific way of personalizing gamification, dealing with behavioural profiles, the educational context, and its content. As such, our work can be linked to existing ontologies on the field of gamification (such as OntoGamif (BOUZIDI *et al.*, 2018)) and education.

There are three different cores connected into this modelling process:*i)* Jung's approach to personalize gamified educational environments (PALOMINO *et al.*, 2019a); *ii)* TGEEE (TODA *et al.*, 2019) and *iii)* Bloom's Revised Taxonomy (KRATHWOHL, 2002). The ontology's classes are the courses that are to be taught, the lecturer and the student as shown on Figure 46. The object properties describe the relationships between two or more classes, and as such, for this modelling are the actions the actors can execute, such as '*teach*' and '*study*.' Data properties describe the relationships between instances, individuals or other data properties. In our ontology, they are the core of our model, relating Jung's 12 archetypes and which motivational group

they belong to (*i.e.* as the search for a Spiritual Journey, the need to leave a mark in the world, the necessity of connecting to other people and providing structure); what characteristics are related to them (what people from these archetypes seek, value, and how they behave); what game dimensions from TGEEE taxonomy (*i.e.* the ecological, social, personal, fictional, and performance dimensions) they are more susceptible to, and how Bloom's revised taxonomy knowledge and cognitive dimensions can be instantiated to each archetype in a class instrumental design or to personalize a GES, for example.

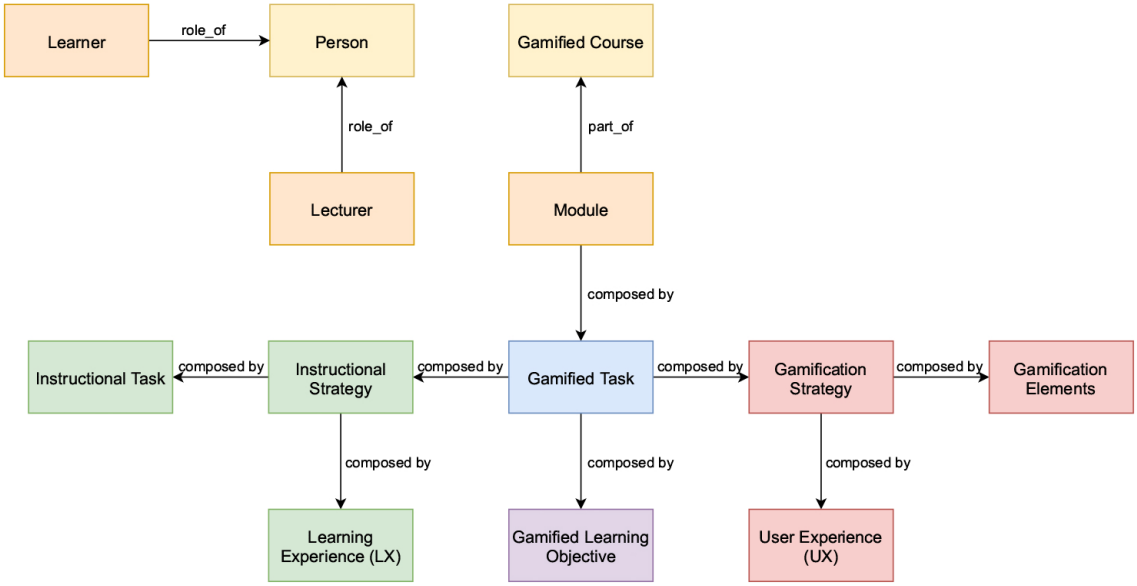


Figure 46 – Classes and subclasses from the ontology

These attributes have their sub-properties described as the characteristics of the archetype (the concepts used in this ontology are the ones extracted from Palomino *et al.*'s (PALOMINO *et al.*, 2019) study, based on semiotic mapping); which of the Big Five Personality Model they are related and each of the individual game element; each LAT related to the learning objectives and the knowledge dimensions (the verbs and digital tools examples used in this mapping are based on Bloom's revised taxonomy instances extracted from Krathwohl *et al.* (KRATHWOHL, 2002) and Churches *et al.* (CHURCHES, 2010)). The full OWL version can be seen in the supplemental material. Next, we present detailed results based on the specific objectives of this ontology.

6.3.1 What characteristics belong to each archetype and how can they be related to the Big Five Personality Model?

The relationship between the archetypes and the Big Five Personality Model can be seen at Table 23.

Table 23 – Relationship between Jung's Archetypes, our semantic mapping of archetypal traits and the OCEAN model traits

Archetype	**Archetypal traits**	**OCEAN traits**
The Everyman	Empathy	Agreeableness
	Realism	Conscientiousness
	Lack of Pretense	Emotional Stability
	Belonging	Extraversion
The Jester	Joy	Agreeableness
	Pleasure	Emotional Stability
	Frivolity	Extraversion
	Playfulness	Openness to Experience
The Lover	Weak Identity	Agreeableness
	Intimacy	Conscientiousness
	Gratitute	Emotional Stability
	Commitment	Extraversion
	Passion	Openness to Experience
The Hero	Mastery	Agreeableness
	Competence	Conscientiousness
	Arrogance	Emotional Stability
	Courage	Extraversion
		Openness to Experience
The Magician	Manipulation	Agreeableness
	Determination	Conscientiousness
	Power	Emotional Stability
		Extraversion
		Openness to Experience
The Outlaw	Freedom	Conscientiousness
	Liberation	Emotional Stability
	Idealism	Extraversion
	Outrageousness	Openness to Experience
The Caregiver	Service	Agreeableness
	Martyrdom	Conscientiousness
	Generosity	Emotional Stability
	Compassion	Extraversion

The Creator	Imagination Creativity Innovation Perfeccionism	Agreeableness Conscientiousness Emotional Stability Extraversion Openness to Experience
The Ruler	Authoritarism Leadership Responsability	Conscientiousness Emotional Stability Extraversion Openness to Experience
The Explorer	Autonomy Inner Emptiness Ambition Freedom	Agreeableness Conscientiousness Emotional Stability Extraversion Openness to Experience
The Innocent	Safety Freedom Hapiness Naiveness	Agreeableness Conscientiousness Emotional Stability Extraversion Openness to Experience
The Sage	Meticulous Intelligence Knowledge Wisdom	Agreeableness Conscientiousness Emotional Stability Extraversion Openness to Experience

Our ontology indicates that archetypes The Everyman, The Jester, The Lover, The Hero, The Magician, The Caregiver, The Creator, The Explorer, The Innocent, and The Sage, are more prone to the Agreeableness trait, reflecting individual differences in general concern for social harmony, which is measured in a scale, the personality being more agreeable or disagreeable. From the learning perspective, these archetypes reflect people who like social interaction and group activities.

The archetypes The Everyman, The Lover, The Hero, The Magician, The Outlaw, The Caregiver, The Creator, The Ruler, The Explorer, The Innocent, and The Sage are related to the Conscientiousness trait, being a tendency to display self-discipline, act dutifully, and strive for achievement against measures or outside expectations. These students need challenge and pressure to measure their performance and have personal goals.

The Emotional Stability trait refers to a person's ability to remain stable and balanced, and on the other side of the scale, this transforms to neuroticism. The archetypes related to

this trait are The Everyman, The Jester, The Lover, The Hero, The Magician, The Outlaw, The Caregiver, The Creator, The Ruler, The Explorer, The Innocent, and The Sage. From a learning perspective, this is a trait related to balancing the experience. Tasks should have a good challenge level but not too much for the student to get frustrated. In addition, the learning environment should be an affective and safe place so the user can focus on learning.

The Extraversion trait is defined by pronounced engagement with the external world, and the archetypes more prone to it are The Everyman, The Jester, The Lover, The Hero, The Magician, The Outlaw, The Caregiver, The Creator, The Ruler, The Explorer, The Innocent, and The Sage. Students with this trait need places to talk and discuss with other colleagues, such as forums, chats and discussion groups.

Finally, the archetypes related to the Openness to Experience trait are The Jester, The Lover, The Hero, The Magician, The Outlaw, The Creator, The Ruler, The Explorer, The Innocent, and The Sage, being more prone to a general appreciation for art, emotion, adventure, unusual ideas, imagination, curiosity, and variety of experience. From a learning perspective, people with this trait can engage in complementary content and new challenges.

6.3.2 What game element dimension can be related to each archetype motivation group?

In our ontology, we analyzed and mapped what motivation group would be more prone to what game element dimension, from Toda's TGEEE's taxonomy (TODA *et al.*, 2019b), and these relationships can be seen in Figure 47.

The 12 archetypes are divided into four motivational groups, or from Jung's perspective, the archetype's greatest mission or universal human motivation (JUNG, 2014). In our user type approach (PALOMINO *et al.*, 2019a), they consider these groups as intrinsic motivation ones (*i.e.* what is a person's deepest desire that would motivate them to do something). The first group deals with the necessity to connect with others (and contains the Everyman, Jester, and Lover). People from this group long to connect, compare each other with themselves, be part of something, and as such, can be related to the performance dimension (which contains the elements of Progression, Level, Point, Stats, and Acknowledgement). The group formed by people who wish to leave a mark in the world is composed of the archetypes of the Hero, Magician, and Outlaw, and are people concerned with impressing their peers, being known in a place, and leaving a name. They are related to the social dimension and the elements of Reputation, Cooperation, Competition, and Social Pressure. Next, people who wish to provide structure and meaning to the world, represented by the archetypes of the Caregiver, Creator, and Ruler, are concerned with the environment surrounding them, how can they control and make it better, and are related to the ecological dimension and the game elements of Time Pressure, Chance, Imposed Choice, Economy, and Rarity. Finally, people who have a holistic view of

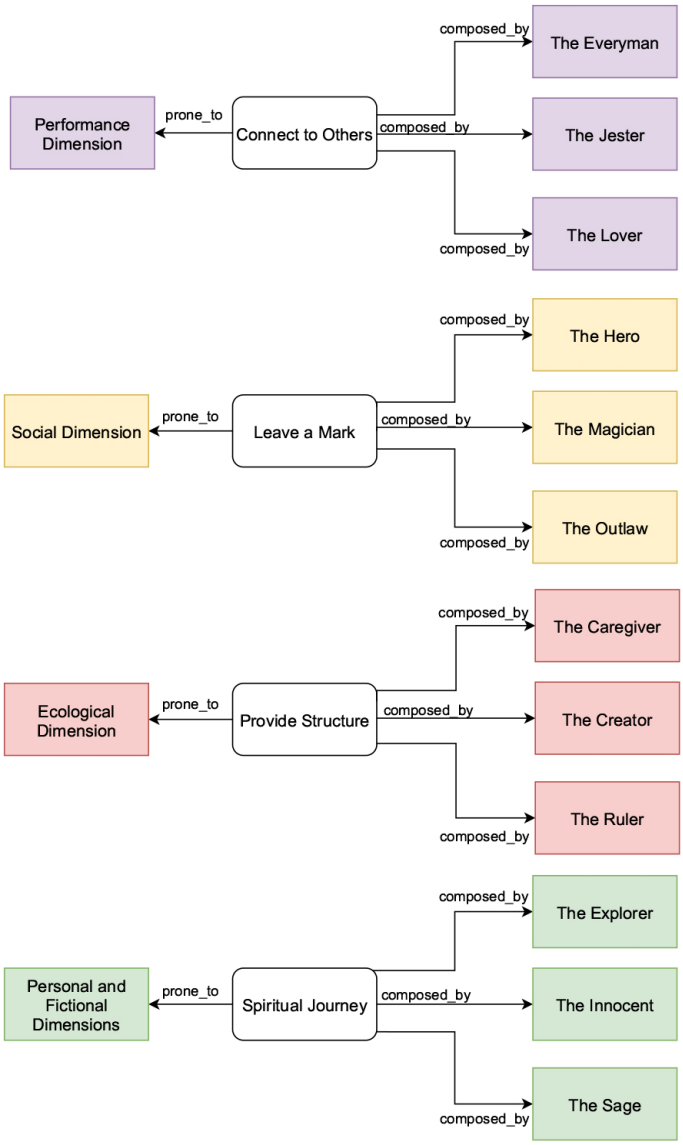


Figure 47 – Relationships between Jung's motivational groups and TGEEE's dimensions

life, who are worried about their inner journeys and spiritual experiences, are related to the personal and fictional dimensions as those who work with game elements related to the self and the context (meaning) of an environment. The fictional dimension includes the subjective game elements of Narrative and Storytelling, while the personal dimension contains the elements of Sensation, Objective, Puzzle, Renovation, and Novelty.

6.3.3 How these characteristics are related to Learning Objectives and Learning Activities Types?

The ontology also related the archetypes to each of the six Bloom's learning objectives, learning activities, and their verbs (representing the action) (KRATHWOHL, 2002; CHURCHES, 2010) that would be more suited for each behavioural profile, as it can be seen on Table 24.

Table 24 – Bloom's Learning Objectives (LO) and their relation to learning activities type (LATs) based on Jung's Archetypes

Archetype	LO	LAT	Archetype	LO	LAT
Innocent	Create	Create	Everyman	Create	Assemble
	Evaluate	Select		Evaluate	Determine
	Analyze	Differentiate		Analyze	Integrate
	Apply	Use		Apply	Respond
	Understand	Classify		Understand	Clarify
	Remember	Recognize		Remember	Identify
Sage	Create	Design	Jester	Create	Design
	Evaluate	Reflect		Evaluate	Judge
	Analyze	Differentiate		Analyze	Deconstruct
	Apply	Respond		Apply	Carry out
	Understand	Predict		Understand	Summarize
	Remember	List		Remember	Recognize
Explorer	Create	Assemble	Lover	Create	Generate
	Evaluate	Select		Evaluate	Reflect
	Analyze	Select		Analyze	Differentiate
	Apply	Provide		Apply	Use
	Understand	Classify		Understand	Predict
	Remember	Identify		Remember	Recall
Outlaw	Create	Design	Creator	Create	Create
	Evaluate	Determine		Evaluate	Select
	Analyze	Deconstruct		Analyze	Deconstruct
	Apply	Respond		Apply	Provide
	Understand	Clarify		Understand	Classify
	Remember	List		Remember	Identify
Magician	Create	Create	Ruler	Create	Generate
	Evaluate	Select		Evaluate	Determine
	Analyze	Select		Analyze	Differentiate
	Apply	Carry out		Apply	Use
	Understand	Clarify		Understand	Classify
	Remember	Identify		Remember	List
Hero	Create	Assemble	Caregiver	Create	Assemble
	Evaluate	Determine		Evaluate	Reflect
	Analyze	Integrate		Analyze	Integrate
	Apply	Carry out		Apply	Provide
	Understand	Summarize		Understand	Clarify
	Remember	Recall		Remember	Recognize

These relations were established based on the ones already existing in learning objectives, the action verbs of Bloom's revised taxonomy (KRATHWOHL, 2002; CHURCHES, 2010), and its cognitive and knowledge dimensions. These relationships were further developed by stipulating the most plausible verbs to be used with each of the 12 archetypes using semantics, and semiotic techniques (PÁSTOR *et al.*, 2018; PEIRCE, 1991; SANTAELLA, 2017).

6.3.4 How can these characteristics be used for personalizing educational contexts and activities?

Our results propose the first guideline that can be used to create a gamified design for educational strategies relating to Jung's universal archetypes and personality traits. The ontology allows different instances, such as relating the learner to their archetype and drifting from this primary relationship, all personalized gamified strategies. Most personalization approaches are based on establishing the user/player profile and what game elements can be used for each profile. Our research goes further by presenting a way of personalizing the learning experience from the beginning to the end of the process, dealing with different levels of abstraction and reasoning when working with Bloom's taxonomy as an instructional design framework.

Ontology application

This section presents an example of the application of ontology in a real scenario, *i.e* an instance, as it can be seen in Figure 48.

Based on this example, we can detail an instance (as an application of the ontology in a proposed scenario) such as personalizing an educational task for people from the Creator archetype. These people yearn to provide structure and are innovative, creative, imaginative, and perfectionists. They could be asked *(i)* to identify strategies for retaining information using searching engines as digital tools (remembering); *ii)* to classify these strategies using bullet pointing tools (understanding); *iii)* to provide these strategies in a group networking (applying); *iv)* and to deconstruct one of these strategies using reverse engineering concepts (analyzing) and*v)* to select the best option among these concepts (evaluating) with which *vi)* they can create a brand new strategy for retaining information on top of that (creating). The gamification of this instructional design could be: the student has 30 minutes to identify the strategies and one week to devise a new one (Time Pressure game element). At this time, they cannot map all world strategies and are subject to the chance element of what they are going to find through the search engine in a 30 minutes time limit (Chance game element). They need to choose between these strategies for the one they will deconstruct (Imposed Choice) and finally propose something new that is rare in itself (Rarity element), and that can be distributed with the best cost-benefit to the other students (Economy element).

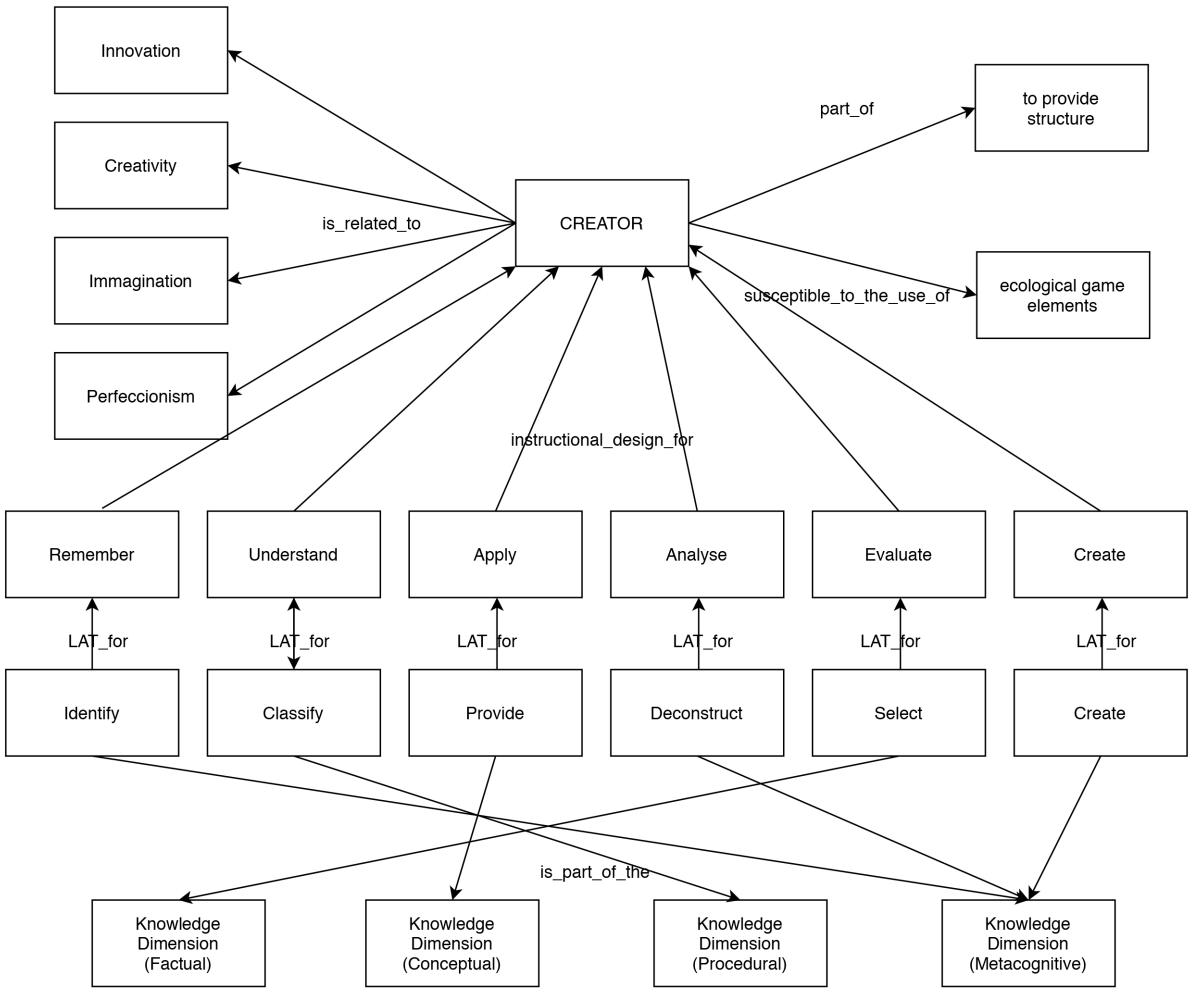


Figure 48 – Visual representation of the ontology's instance referring to the Creator archetype

6.4 Discussion and Limitations

As explained in the previous section, the ontology quality evaluation was done in phases, and the results demonstrated we have a regular Substitute, mainly because we still did not connect the ontology to others, reusing their models. However, its ontological commitments are maximized, meaning the ontology is **concise and objective**. It has a good score on Intelligent Reasoning and Human Expression, meaning it **has no redundancies and is well documented**. The OWL version had maximum grades in computer efficiency, meaning it is **ready to be used in computational tasks** (which is one of the long-term objectives of dealing with GES).

Through this study, we materialized how these concepts are related to each other, that is, how one archetype is related to its properties, the intrinsic motivation group and is more susceptible to the game elements of a particular game dimension, the instrumental design for this archetype thus must be carried out considering following the six learning objectives and their respective LATs, represented by verbs related to each of these instances, which is part of one of the knowledge dimensions. With this model, teachers can design gamified strategies for their

classes and for designers and developers to apply these same strategies in GES design.

Gamification design with a focus on education has some challenges to be overcome, from the student's perspectives, the teacher and the gamified systems. From the student's perspective: *i)* how can we provide a gameful experience that keeps the student engaged, without losing focus on the learning itself; *ii)* how to facilitate learning and *iii)* how to present the content appropriately for their profile. These challenges are one of the biggest reasons why gamification in education becomes such a specific area, and general gamification strategies cannot always solve these problems. For us (PALOMINO *et al.*, 2019b), one way to deal with this issue is to work with more subjective game elements, such as Narrative and Storytelling, to create the context and reason why the student should remain engaged, but focused on learning (that is, the reason for engagement needs to come from the learning process itself, thus making the instructional design of activities to be intrinsically linked to the design of gamification strategies). For Altmeyer *et al.* (ALTMEYER *et al.*, 2021) and Mora *et al.* (MORA *et al.*, 2018), it is necessary to personalize the strategies, to account for interpersonal differences in the perception of gameful design. Even so, these user types should not be absolute, as a person will not necessarily fit into a single type (TONDELLO *et al.*, 2019a). However, it is not enough to know the student's behaviour profiles. It is necessary to present the appropriate content for that profile. Hallifax *et al.* (HALLIFAX *et al.*, 2019) states that there is a lack of studies that relate the aspects of personalization to educational content or activity. Rodrigues *et al.* (RODRIGUES *et al.*, 2021b) research are one of the most recent studies that follow this path, personalizing the context and not the user, and according to Klock (KLOCK *et al.*, 2020), it is necessary to consider several factors simultaneously when personalizing the gameful experience of the students.

From the teacher's perspective, the challenges lie in: *i)* how to gamify classes; *ii)* how to deal with two initially distinct design processes (gamification design and instructional design) and *iii)* how to measure the effectiveness of gamification. Although there is a great interest on the part of teachers in gamification strategies (DERMEVAL *et al.*, 2019), some aspects influence its adoption, such as the lack of knowledge and the lack of resources (MARTÍ-PARREÑO; SEGUÍ-MAS; SEGUÍ-MAS, 2016). Toda *et al.* research design strategies to help teachers gamify their classes and deal with the double design process (TODA *et al.*, 2018b) and recent studies are using data mining techniques, and association rules to measure gamification effectiveness in education (BARATA; GAMA, 2014; PALOMINO *et al.*, 2019; TODA *et al.*, 2020).

From the systemic perspective: *i)* How to provide a meaningful and valuable user experience and *ii)* How to adapt the gamification design in real-time. Research in the area of UX relating it to gamification has emerged in recent years, such as that of Klock *et al.* (KLOCK; GASPARINI; PIMENTA, 2019b) who developed a user-centred framework taking into account personal, functional, psychological, temporal, playful, implementable, and evaluative properties and Tondello *et al.* (TONDELLO *et al.*, 2019b), who, concerned with the evaluation of gameful systems, developed the Gameful Design Heuristics. Other research focuses on real-time adaptive

gamification, such as Böckle *et al.*, who proposed a design framework for the development of adaptive gamification applications, and Dermeval *at al.*, who proposed an ontology for adaptative gamification for educational purposes (DERMEVAL *et al.*, 2019).

This ontology was created aiming to deal with all the challenges presented previously. From the student's perspective, the fact that a personalized gamification design can be created already linked to the different objectives and learning activities types that are more suited to that profile favours and maintains the engagement during learning. Knowing which learning objective one wants to achieve and which activities and tools would be more suitable also facilitates the learning itself. The existence of the archetypes, which are universal and not absolute (*i.e.* allowing the change of profile during the process), brings a personalized experience in real-time. From the teacher's perspective, the ontology unites the two design processes in a single framework, thus directly enabling the gamification of classes, just following the relationships presented. Finally, from a systemic point of view, the ontology allows one to think of richer user experiences by providing user preferences clearly and objectively. Also, its OWL version allows the creation of intelligent semantic systems that can switch between the archetypes (and their related contents), following the user's own behaviours changes, thus providing adaptive gamification that respects the student's emotional state and psychological aspects throughout the learning process.

Some other important insights generated by this study are: *i)* the need to execute more in-depth studies on how to integrate gamification design with instructional design in the education domain, taking into account the properties and range of domains existing within the field of education (*i.e.* the same structure that applies to Math classes cannot be used for Arts) and *ii)* from the GES perspective, it is necessary to think about other elements less used in gamification to improve the user experience (*i.e.* narrative) (PALOMINO *et al.*, 2019b). Thus, we expect that this ontology may, in the future, help both the advancement of other theoretical and applied research, as well as being useful outside the academy in the context of teaching.

Based on this ontology, for future works, we intend to *i)* empirically validate the ontology through long-term experiments in digital courses; *ii)* expand the ontology range connecting other instructional designs framework options (such as ADDIE (BRANCH, 2009) and design Thinking (BROWN; KATZ, 2019)), as well as other gamification taxonomies (such as Marczewski's Periodic Table (MARCZEWSKI, 2015)) and gamer/user types (such as Hexad (TONDELLO *et al.*, 2016b)) so that it is possible to measure the effectiveness of the strategies specifically for education in comparison to other general gamification strategies, as well as to further adapt these well-used approaches to the educational context; and *iii)* to develop a content-based gamification framework, whose base is the context and user experience, and should apply this ontology as a whole.

As limitations of this study, we point out the own concepts' abstractions and the fact that the ontology is not yet linked to other ontologies of higher domains. Besides, there was an evaluation by experts (using FOCA methodology (BANDEIRA *et al.*, 2016)), but there was no

application of the ontology in a real learning environment. In future works, it is necessary to apply it in a classroom or in a GES, for example, to obtain empirical validation.

This study generated a full paper submitted to Research and Practice in Technology Enhanced Learning journal, currently being reviewed, under the title of: "An Ontology for Modelling Users' Profiles and Activities in Gamified Education".

6.5 Chapter Conclusions

This chapter presented our last artifact, the Gamification in Education lightweight ontology. This research answered the last research question from the thesis: **sRQ5: "What model can represent a gamified learning process for developing purposes?"** Even though our ontology is lightweight, it can be used as a base to create advanced educational systems and can be expanded, embracing other research and being a knowledge model for the application of the gamification domain in education.

CHAPTER

7

FINAL REMARKS

This thesis sought to answer the main research question: "How to embed narrative in the gamification design of educational environments so that the user experience is affected in a positive way?" We believe in having answered parts of this question, addressing five sub-questions in different studies, each with other sub-research questions. Based on what we learned from this research, we believe that the gamification design based on subtle game elements and gameful experiences has much yet to be discovered and tested, and one of the possible paths for this is to address gamification based on what kinds of gameful experiences can we provide to users and not specifically in what game element to use in the design.This vision can potentially change the current paradigm of gamification by shifting the focus from treating gamification as a tool for specific purposes and considering it as a way of providing gameful experiences in environments originally outside of games, blurring the threshold of the concept itself, which allows for a broadening and deepening of its use. Furthermore, by considering the types of gamified experiences and not each game element in isolation, we believe it can enrich the users' experience as a whole, and, in the case of education, relating gameful experiences to learning design (KOPER, 2006).

Another important aspect we came across during this Ph.D. is that gamification for education has many differences from the use of gamification in other areas. It is important, in future research, not to lose sight of the fact that, for educational purposes, the gamification strategy must consider the content and the learning process.

Furthermore, the COVID-19 pandemic, which took place during this research between 2020-2022, also drastically changed the global education landscape, exposing significant problems such as equity and the use of technology. Therefore, we believe that we are contributing to new research avenues that have emerged due to this situation.

Finally, our overall conclusion is that gamification design for education must be transparent, ethical and meaningful.

Ethics Committee approved our research at **Plataforma Brasil** under the project "Impacto do uso da Gamificação no Ensino" and the card sorting experiment was approved by the University of Waterloo Ethics Committee (ORE#42392).

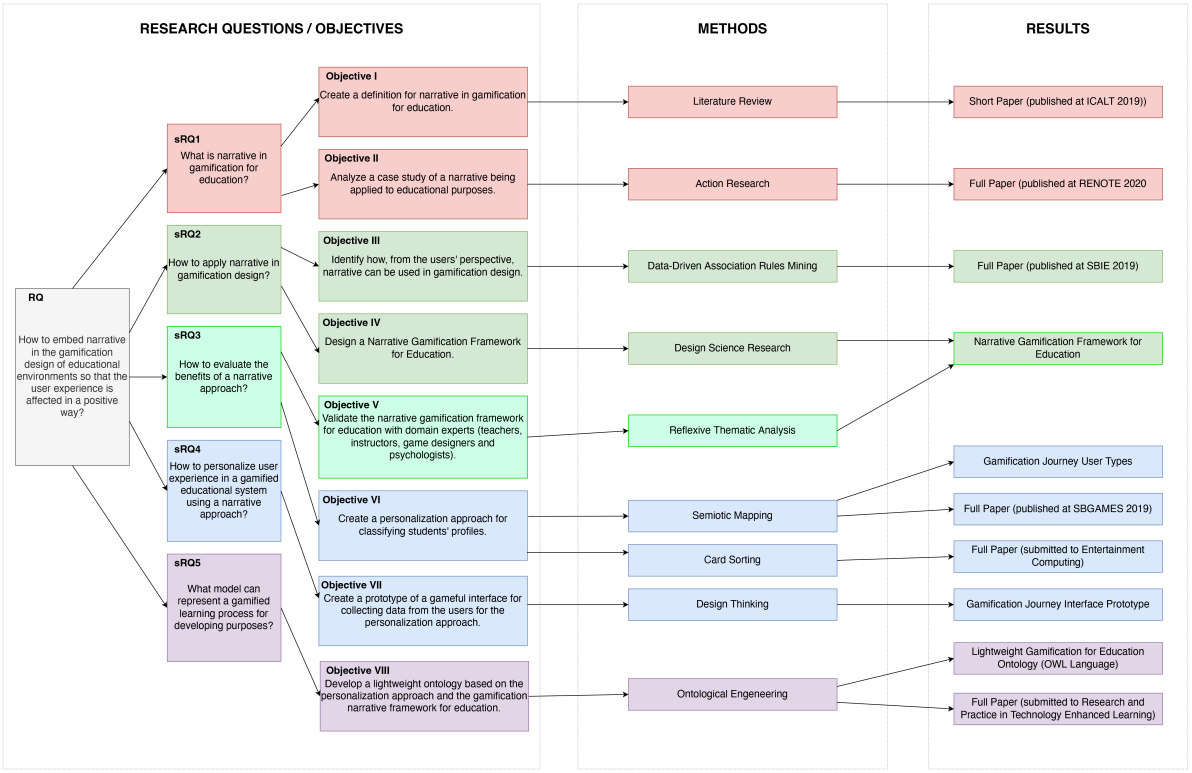
7.1 Overall Contributions

This thesis presented four main contributions for computers in education, specifically in gamification. First, our literature review and semantic mapping provided the first Narrative Gamification for Education definition, described in Chapter 3, which generated a short paper with more than 40 citations since 2019 and that has been used by other researchers as a theoretical base for many advances in gamification. Our personalization approach Gamification Journey, described in Chapter 5 also is the first to deal with students' behavioural profiles for gamification, and our ontology that arisen from this approach, described in Chapter 6 is the first to map Gamification for Education, being conceived as a model that can be expanded to many other approaches and gamification theories, facilitating the implementation of general gamification constructs for educational purposes. Finally, our Narrative Gamification Framework for Education, described in Chapter 4 provides teachers with a simple and effective way of gamifying their classes, even if they do not have access to specific technologies. Being a model focused on the gamification of the content and not only the environment, ours also differs from others because it gives step-by-step instructions on creating gameful learning content from scratch. Regarding what computational environments would better benefit from these artifacts, we believe Intelligent Tutoring Systems (ITS) and Adaptive Educational Systems are the primary targets. Amongst all of these deliverables, the framework is our most significant contribution, as it sets the groundwork for using subjective game elements in education. Figure 49 shows a summary of our contributions.

7.2 Scientific Production

Regarding the scientific production, since the end of 2017, when the author entered the Ph.D. program, until May/22, she published 24 papers, five as first author and 19 as co-authors, all of them dealing with research in gamification in education. According to Google Scholar, she has more than 350 citations. As co-author, she participated in the creation of TGEEE, the Game Element Taxonomy for Education (TODA *et al.*, 2019), working on the definitions of the Narrative and Storytelling game elements. This paper won Best Paper Award at *ICALT 2019*. Another collaboration paper that yielded second best paper award on the track on *SBIE 2020* is "For whom should we gamify? Insights on the users' intentions and context towards gamification in education" (TODA *et al.*, 2020). Her position paper "From the Lack of Engagement to Motivation: Gamification Strategies to Enhance Users Learning Experiences" (PALOMINO *et al.*, 2020), published on the *Forum on Grand Research Challenges in Games*

Figure 49 – Research Map detailing RQs, objectives, methods and final results



and Entertainment Computing in Brazil (2020-2030) is being expanded to a book chapter. Furthermore, from January/2020 to December/2021, she was registered as an International Visiting Graduate Student (IVGS) at the University of Waterloo, under the supervision of Prof. Dr. Lennart Nacke, who became her co-supervisor in this Ph.D. There, she conducted research with the HCI Games Group and have several papers in reviewing with international journals and in progress with the group. In partnership with them, she also did the card sorting experiment for assessing the validity of the Gamification Journey personalization approach.

7.3 Scientific Community Participation

The author also contributed to the academic community, acting as a reviewer for many important conferences and journals and helping to organize CHI Play 2021 conference, acting as Web Chair. Table 25 show some of these contributions.

In addition, the author acted as co-advisor in several final papers from students of the Specialization in Computing Applied to Education at USP, which gave her more teaching experience and proximity to the user profiles for her research (teachers and students).

Table 25 – Venues where the author contributed as reviewer, PC member and organization staff

Name/Abbreviation	Type	Relevance (Qualis)	Function
CHI 2022	Conference	A1	Reviewer
CHI Play 2021	Conference	A1	Web Chair
CHI Play 2020	Conference	A1	Reviewer
Transactions on Learning Technologies	Journal	A1	Reviewer
International Journal of Human - Computer Studies	Journal	A1	Reviewer
SIGCSE 2020	Conference	A1	PC Member
Congresso Brasileiro de Informática na Educação 2019	Conference	A3	PC Member
Simpósio Brasileiro de Jogos e Entretenimento Digital 2019	Conference	A4	PC Member

7.4 Limitations and Future Perspectives

During the development of this thesis, we faced many challenges, and we ourselves made our journey of learning and personal growth. Regarding the general limitations of this work, we believe that the most significant gap that, unfortunately, we were unable to address is the lack of field testing with students of three of our four artifacts. Except for the definition of narrative, which used an actual case study in the classroom, the framework, the ontology and the specific personalization approach for education could not be tested in a GES or classroom, with the most significant obstacle faced being the situation of the COVID-19 global pandemic, which permeated almost half of this Ph.D. In addition, we are aware that people are too complex for any classification or framework to be able to encompass all this complexity. This is a challenge faced by all frameworks, ontologies, and classifications. However, we chose this approach because we believe that, by working with this type of classification, we can contribute more incisively to the area of computer science, bringing subjective and complex concepts closer to machines languages and software development processes.

The author intends to continue the research, improve the framework, and focus on the areas brought by the experts' interviews, which seems to need more in-depth research: equity in education and gameful experiences.

7.5 Papers published as first author

- Palomino, P. T., Toda, A. M., Oliveira, W., Cristea, A. I., Isotani, S. (2019, July). Narrative for gamification in education: why should you care?. In 2019 IEEE 19th International Conference on Advanced Learning Technologies (ICALT) (Vol. 2161, pp. 97-99). IEEE. (Qualis A3).

- Palomino, P., Toda, A., Oliveira, W., Rodrigues, L., Cristea, A., Isotani, S. (2019, November). Exploring content game elements to support gamification design in educational systems: narrative and storytelling. In Brazilian Symposium on Computers in Education (Simpósio Brasileiro de Informática na Educação-SBIE) (Vol. 30, No. 1, p. 773). (Qualis A3).

- Palomino, P. T., Toda, A. M., Oliveira, W., Rodrigues, L., Isotani, S. (2019). Gamification Journey: A Novel approach for classifying gamer types for gamified educational systems. Simpósio Brasileiro de Jogos e Entretenimento Digital, 2019. (Qualis B1).

- Palomino, P. T., Toda, A. M., Oliveira, W., Rodrigues, L., Isotani, S. (2019). Teaching Interactive Fiction for Undergraduate Students with the Aid of Information Technologies: An Experience Report. RENOTE, 17(3), 527-536. (Qualis B1).

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7.6 Papers published as co-author

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APPENDIX

A

NARRATIVE GAMIFICATION FRAMEWORK FOR EDUCATION DOCUMENTATION

Gamification Journey

Narrative Gamification
Framework for Education

Narrative Gamification Framework for Education Documentation

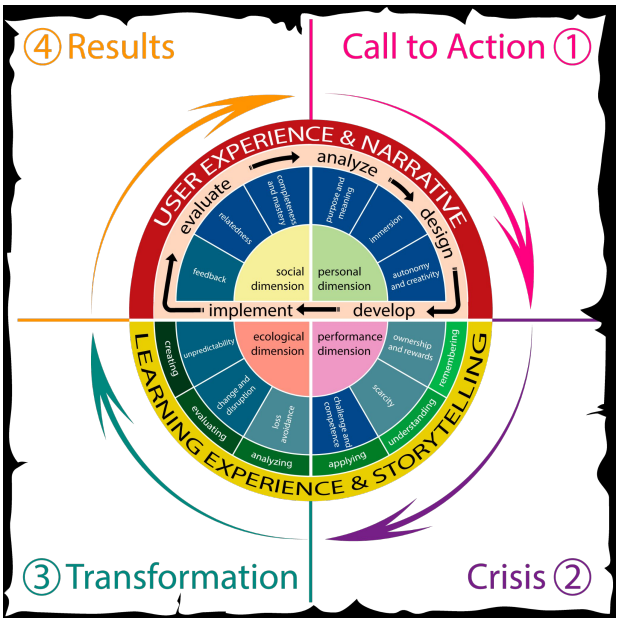
This documentation is integral part of the Ph.D. project of **Paula Toledo Palomino** in Computer Science at ICMC/USP, entitled **"Gamification of Virtual Learning Environments: A Narrative and User Experience Approach".**

Supervisor: Dr. Seiji Isotani
Co-Supervisor: Dr. Lennart Nacke

Project Overview

Description:

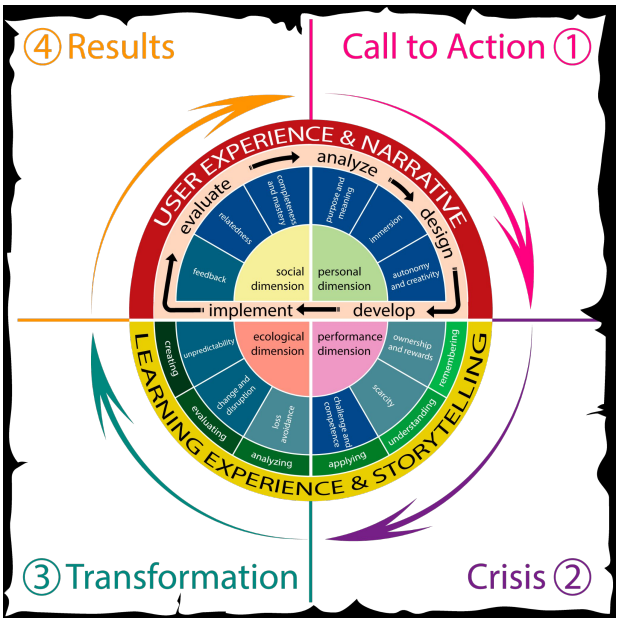
The Narrative Gamification Framework for Education **Gamification Journey** is a model created by **Paula Toledo Palomino** to help teachers gamify classes and digital learning environments, with the main objective of promoting student motivation and engagement with the learning process.



Project Overview

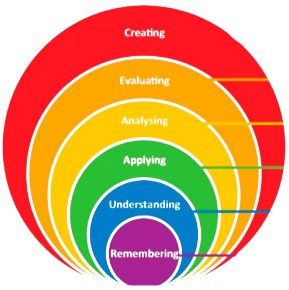
Description:

By Gamification we mean the **use of game elements and concepts outside the context of games** (1), i.e., these characteristics that constitute what a game is are mapped and these elements are isolated, so that they can be applied in systems and situations external to the games themselves, to achieve specific goals.



1 Deterding, S., Dixon, D., Khaled, R., & Nacke, L. (2011, September). From game design elements to gamefulness: defining" gamification". In Proceedings of the 15th international academic MindTrek conference: Envisioning future media environments (pp. 9-15).

Design



Conceptual Design:

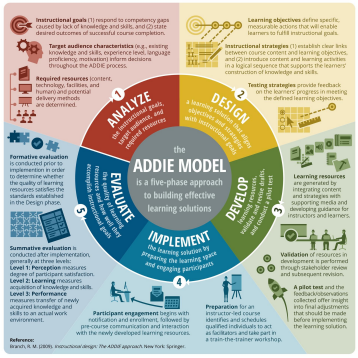
The framework was developed based on several theories in the areas of psychology, anthropology, education and HCI, being its pillars: "The Hero's Journey" (2), "Bloom's Taxonomy" (3) and "TGEEE" (4) (taxonomy of game elements for use in educational contexts).

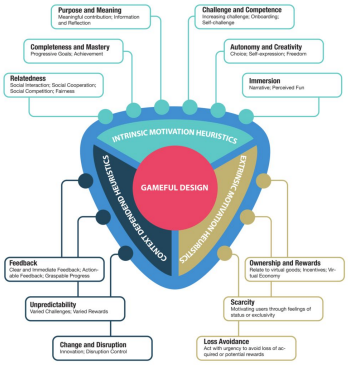
2 VOGLER, Christopher. The Writer's journey. Michael Wiese Productions Studio City, 2007.

3 ANDERSON, Lorin W. et al. A taxonomy for learning, teaching, and assessing: A revision of Bloom's taxonomy of educational objectives. Longman,, 2001.

4 Toda, A. M., Klock, A. C., Oliveira, W., Palomino, P. T., Rodrigues, L., Shi, L., ... & Cristea, A. I. (2019). Analysing gamification elements in educational environments using an existing Gamification taxonomy. Smart Learning Environments, 6(1), 1-14.

Design





Conceptual Design:

In addition, we used the heuristics for gamified designs "Gameful Design Heuristics" (5) as general principles for the design of classes and materials, and as a framework for the instructional design, we used the ADDIE model (6); although the framework also supports the use of any another thinking model and design cycle, such as Design Thinking, for example.

5 TONDELLO, Gustavo F. et al. Gameful Design Heuristics: A Gamification Inspection Tool. In: International Conference on Human-Computer Interaction. Springer, Cham, 2019. p. 224-244.

6 Morrison, Gary R. Designing Effective Instruction, 6th Edition. John Wiley & Sons, 2010.

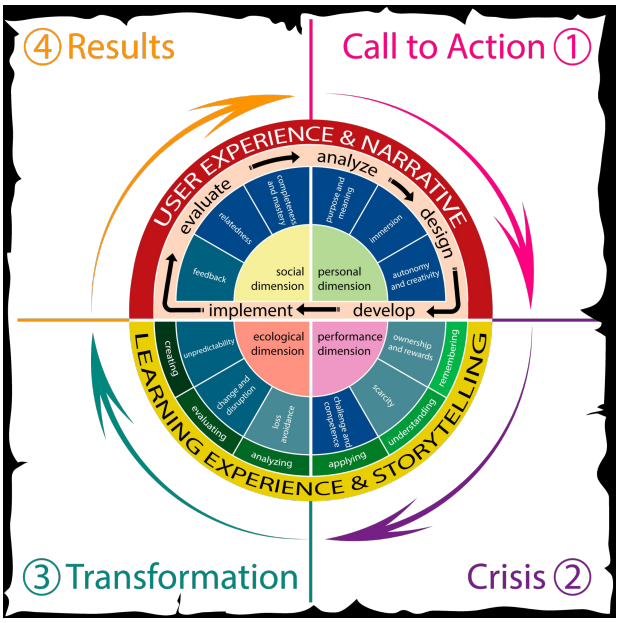
Using the Framework

- Details
- Step-by-Step

Framework Detail

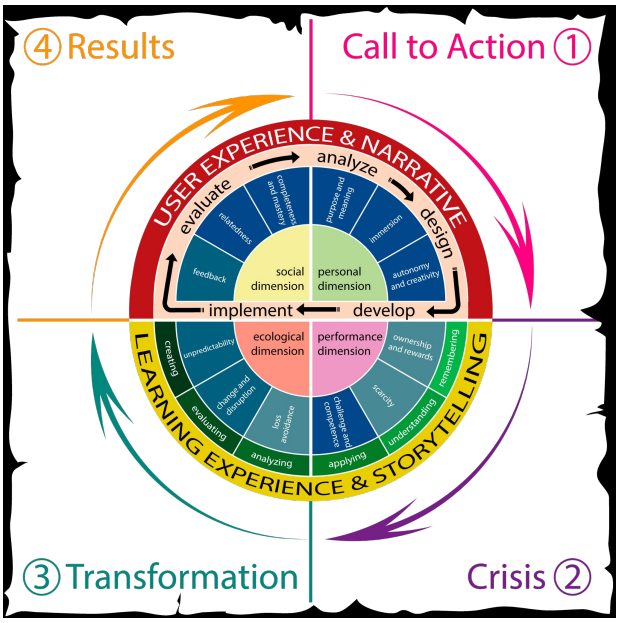
The model on the side has a double representation:

1. The student's journey in the learning process (the 4 acts and Bloom's taxonomy)
2. The guidelines that the teacher must follow to implement the strategies (heuristics, instructional design and dimensions)



Framework Detail

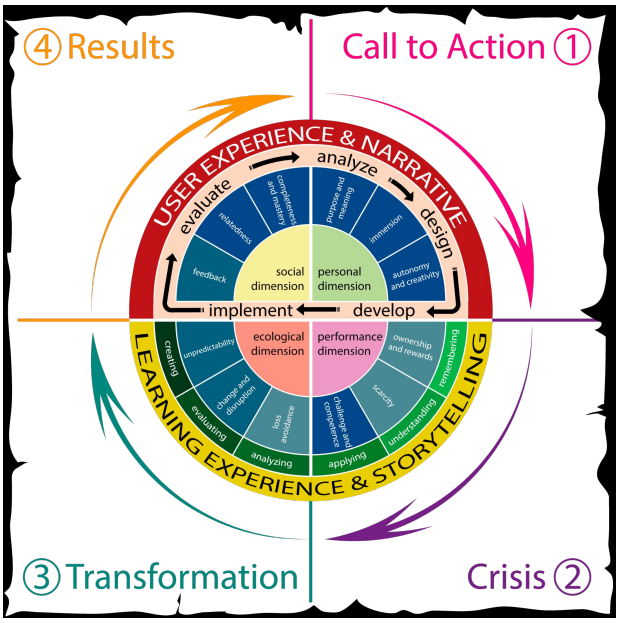
The framework works iteratively and incrementally, i.e., the educational gamification strategy can be implemented by blocks (or modules) in several different cycles, or it can be considered as a journey for an entire discipline, implementing the content progressively accordingly.



Framework Detail

The 4 Acts of the Hero's Journey:

The model describes in its macro form the Hero's Journey adapted for learning. So in the first quadrant, we have the “Call to Action”, in the second one, the "Crisis", or conflicts, in the third, the "Transformation" arc and finally, in the fourth and last one, the "Results" arc.



Framework Detail

Narrative and User Experience | Storytelling and Learning Experience

As a framework that considers the use of Narrative and Storytelling game elements a priority, both permeate the entire process and relate to the user experience (whether the student's experience with a gamified system or with the classroom itself), and the learning experience, which differs from the first in that it focus on learning itself.

Definitions

1

Narrative

It's the order of events as they happen in a game, through the user experience. This experience is influenced by the implicit choices made by the user. (4)

2

Storytelling

It is how the story (and context) of the environment is told and presented, which can be through text, voice or even sensory. (4)

3

UX

User Experience is the set of elements and factors related to the user's interaction with a product, system or service whose result generates a positive or negative perception (7).

4

LX

Learning Experience deals with methods that focus on user learning, making the student protagonist of this process.

4 Toda, A. M., Klock, A. C., Oliveira, W., Palomino, P. T., Rodrigues, L., Shi, L., ... & Cristea, A. I. (2019). Analysing gamification elements in educational environments using an existing Gamification taxonomy. Smart Learning Environments, 6(1), 1-14.
7 Norman, D. (2013). The design of everyday things: Revised and expanded edition. Basic books.

Framework Detail

Narrative & UX

The key to using Narrative and relating it to UX is to guide students so they can create their own learning experiences (as a result of their personal choices and understanding of the learning process, as well as their decisions when doing the activities), with freedom of choice but with a clear goal in mind.

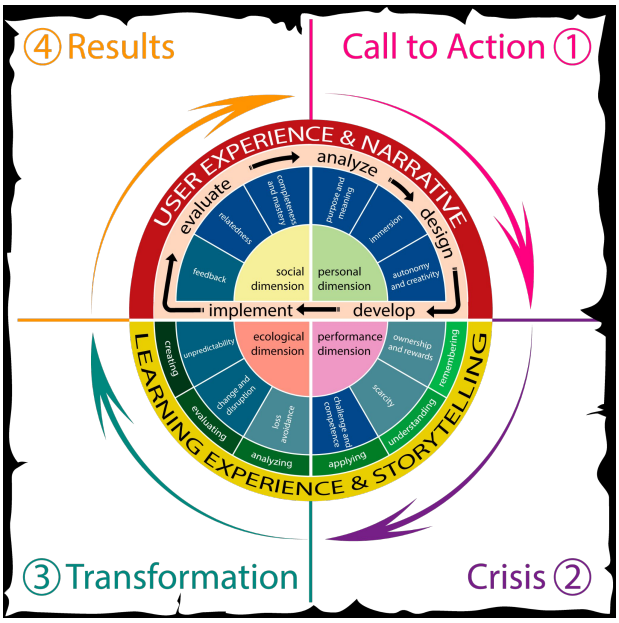
Storytelling & LX

The Storytelling game element supports the narrative approach by providing resources to guide the learning experience and strengthen the context, thus strengthening the purpose of why something should be studied.

Framework Detail

Differences between Instructional Frameworks and Bloom's Taxonomy

The framework supports the use of different frameworks for instructional design (such as ADDIE and Design Thinking) and Bloom's taxonomy, considered in some cases also as an instructional framework.



Framework Detail

Differences between Instructional Frameworks and Bloom's Taxonomy

In this case, however, what we call frameworks for instructional design (represented in the model in the upper area of the circle with ADDIE model steps: **Analyze, Design, Develop, Implement and Evaluate**) define how the **design cycle should be worked,** while Bloom's Taxonomy, represented in the model at the bottom of the circle, in gradients of green (**Remembering, Understanding, Applying, Analyzing, Evaluating and Creating**), represents the **student's learning stages during the learning journey.**

Step by Step

Act 1: Call to Action

In this first quadrant, we have the **beginning of the student's learning journey.** Either the student is being introduced to the content by the teacher in the classroom, or they are having their first interactions with the learning environment.

Step By Step

Act 1: Call to Action

From the teacher's point of view (or the system design), they should put together this introduction considering that it should have at least:

Step by Step

Purpose and Meaning

The content presented needs to be close to the student's daily life, to their 'common world'; and they need to see a significant contribution that, by studying this content, they will 'earn' something, that is, **that learning a particular subject can enrich their life experience.**

Step by Step

Immersion

The beginning of a subject or discipline must consider that you are bringing someone from an 'outside' world to a new world, and thus, **immerse the student in this new universe.** The student needs to be aware that this journey that is about to begin will be fun.

Step by Step

Autonomy and Creativity

The teacher (or the system) needs to give the student the feeling that they have the **autonomy to learn and do the tasks as they see fit,** that they can apply their creativity and **experience the journey in the best way they want to.**

Step by Step

Personal Dimension

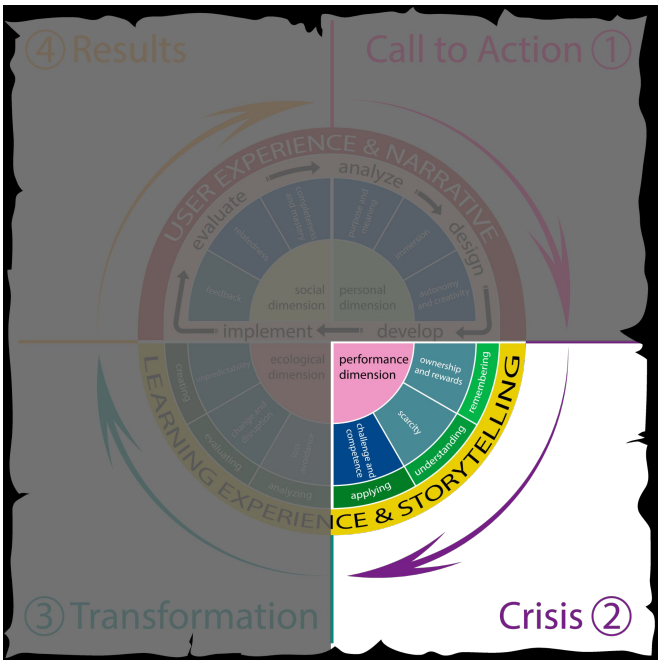
Optionally, other game elements might be used to enrich the experience. In the case of the call to action arc, the student will be more susceptible to game elements that work with their perception of things.

Additionally, the elements of the **performance dimension** can also be worked on in the background.

Step by Step

Act 2: Crisis (Conflict)

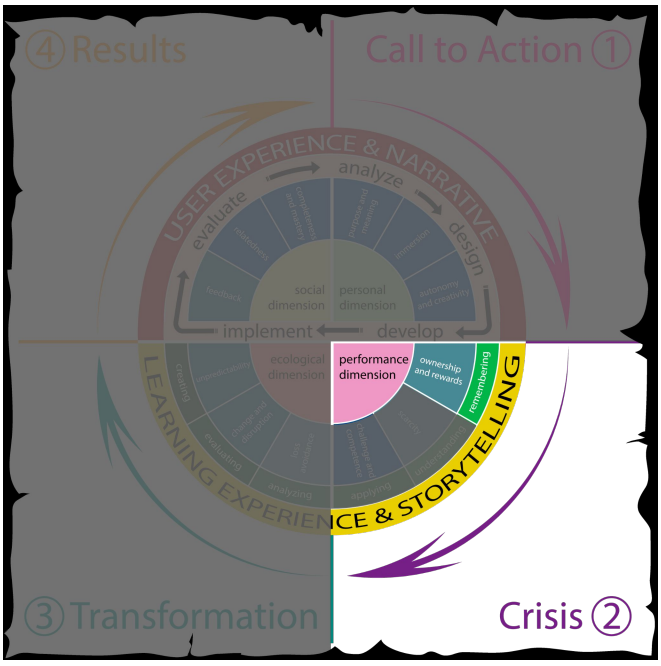
Once the student is motivated and comfortable with the beginning of the journey, it is time to start presenting the pedagogical content. The purpose of this act is to **take the student out of their 'comfort zone',** introduce them to the new and **challenge them to grow.**



Step By Step

Learning Objective: Remembering

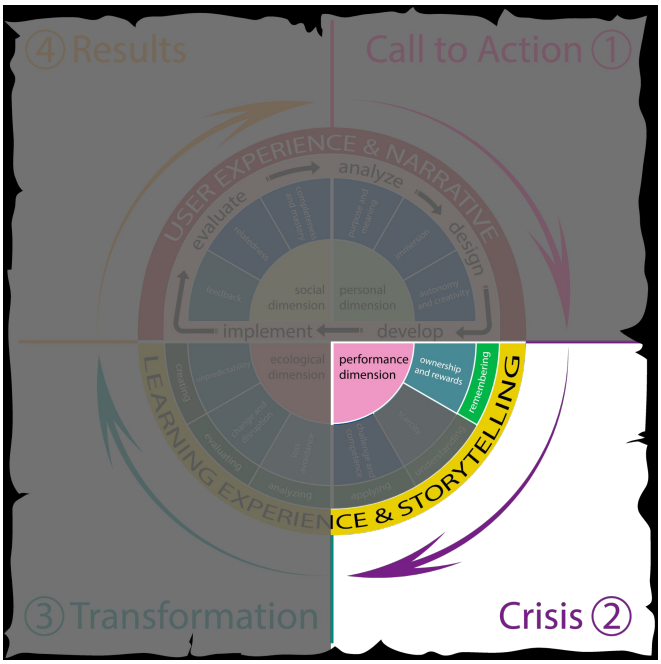
In this step, design learning activities to assess if students can **define, duplicate, list** or **memorize** the content.



Step by Step

Ownership and Rewards

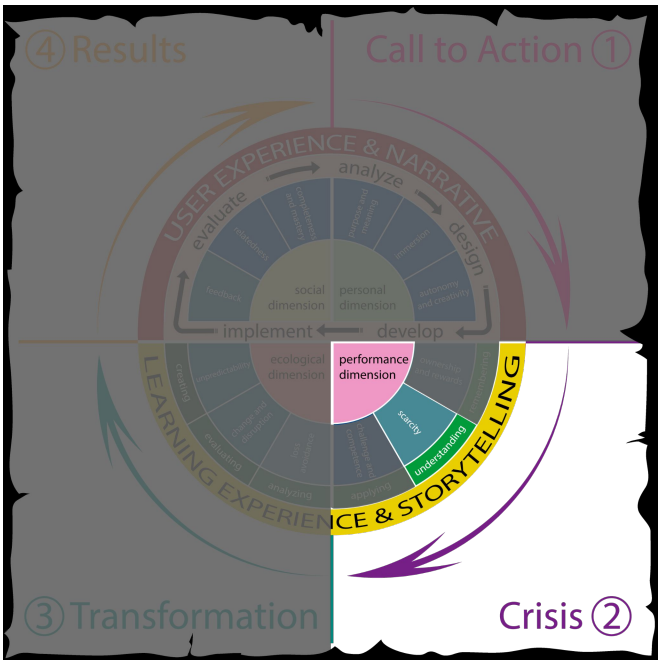
As we are introducing challenges and taking the student out of their 'comfort zone', in this step we can work on external motivational affordances, that is, whose result or value is separate from the activity itself. Here we can work with **virtual goods, incentives** or some kind of **virtual economy.**



Step by Step

Learning Objective: Understanding

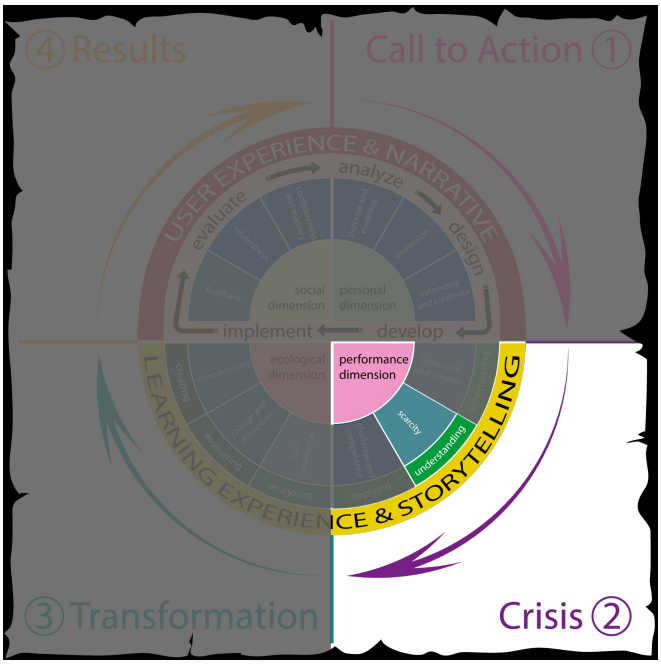
In this step, design learning activities to assess if students can **describe, discuss, explain** or **recognize** the content.



Step by Step

Scarcity

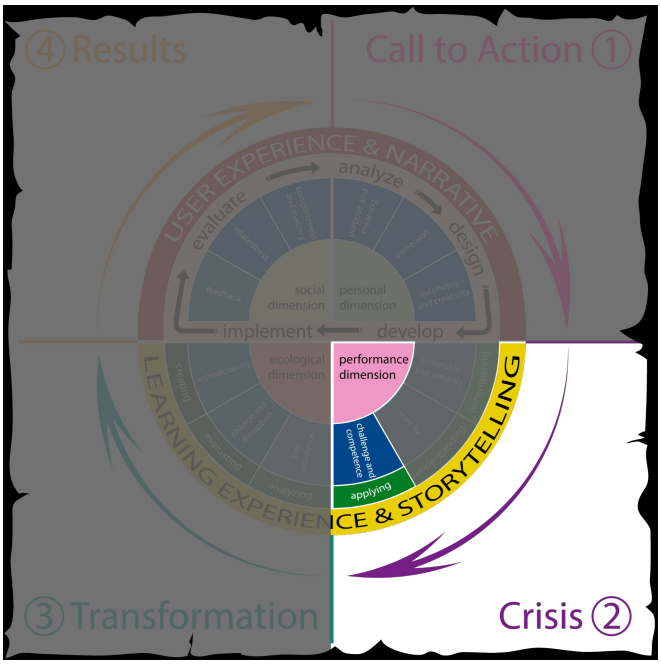
At this moment, when the student is understanding the content and not just memorizing, the teacher (or system) should work with external motivational affordances related to **exclusivity** and **status** to give the student **confidence** and **satisfaction** to continue on the journey.



Step by Step

Learning Objective: Applying

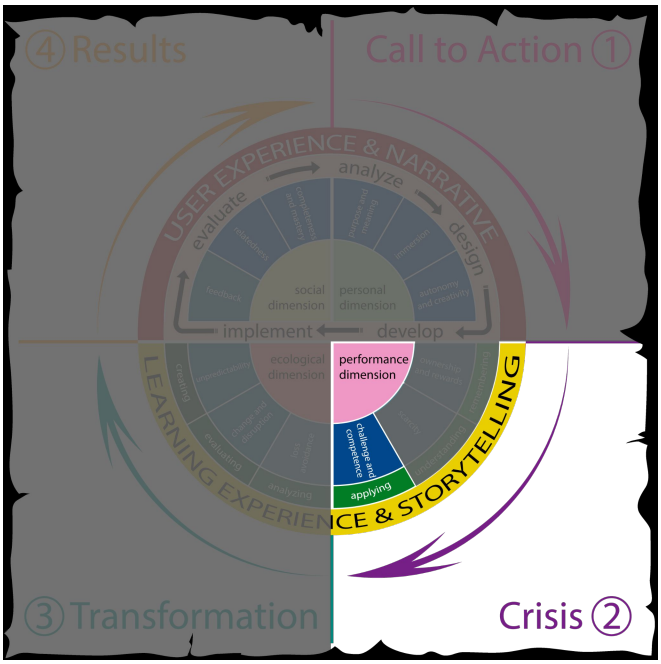
In this step, design learning activities to assess if students can **employ, sketch, solve** or **demonstrate** the content.



Step by Step

Challenge and Competence

At this stage, the student already remembers and understands the content, and prepares to apply it. Again, we shall increase the complexity of the challenges based on the fact that in the previous step they were rewarded and felt confident. At this point, the idea is to work with intrinsic motivational affordances, **integrating knowledge** and working so that the student wants to **challenge themselves to test their skills.**

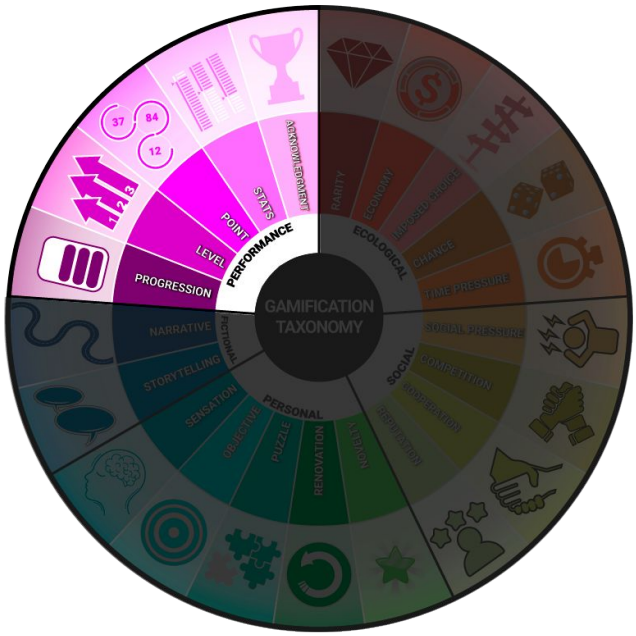


Step by Step

Performance Dimension

Optionally, other game elements might be used to enrich the experience. In the case of the crisis arc, the student will be more susceptible to game elements that work with their performance and feedback from the ambient.

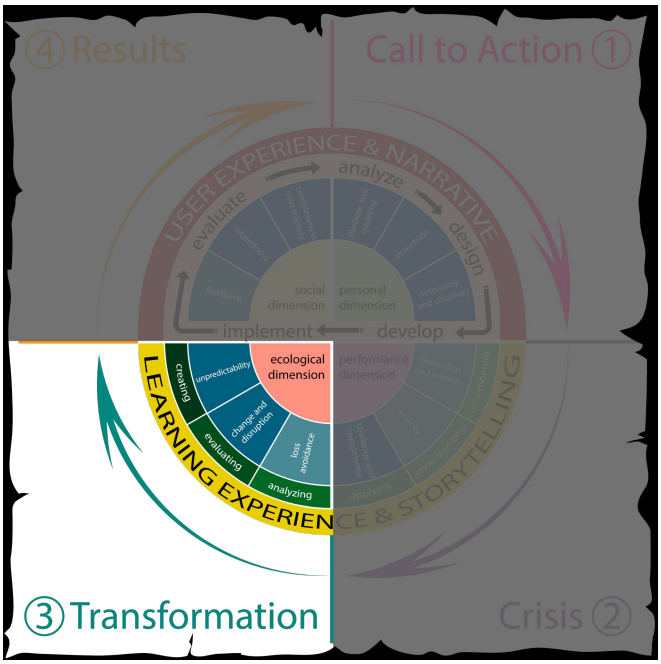
Additionally, the elements of the **ecological dimension** can also be worked on in the background.



Step by Step

Act 3: Transformation

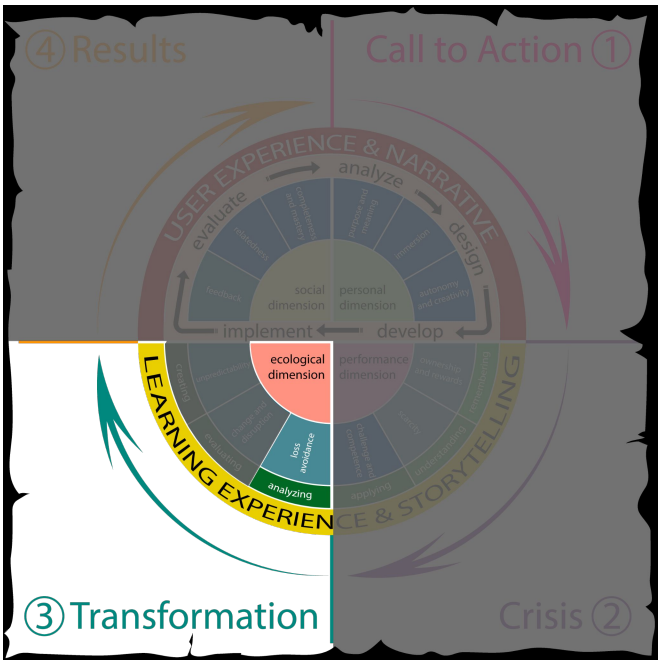
In this act, the student has already covered half the journey. They continue with their experience, but thanks to the challenges and learning from the previous act the student now is ready for their transformation, their growth. At this stage the teacher (or system) should seek to bring this transformation to light, **through challenges** and **ultimate experiences** (like the game challenge **'boss fight'**).



Step by Step

Learning Objective: Analyzing

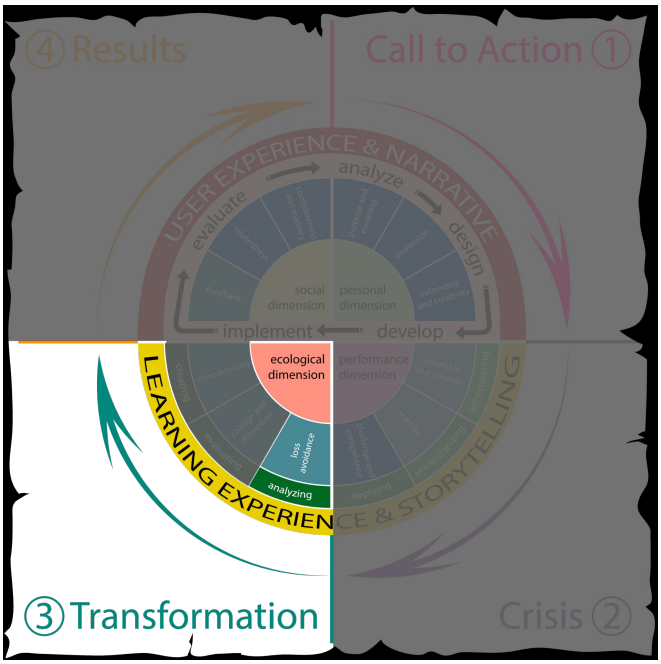
In this step, design learning activities to assess if students can **compare, criticize, examine** or **question** the content.



Step by Step

Loss Avoidance

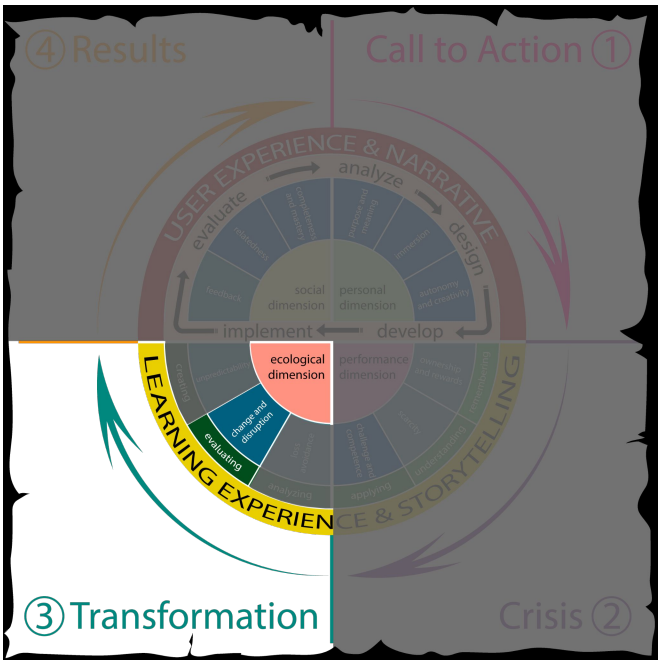
At this point, the student can apply the knowledge and now learns to analyze it to begin a learning transfer process. Here we can apply pressure by working with motivational affordances that deal with **urgency** and **loss of previously acquired rewards.**



Step by Step

Learning Objective: Evaluating

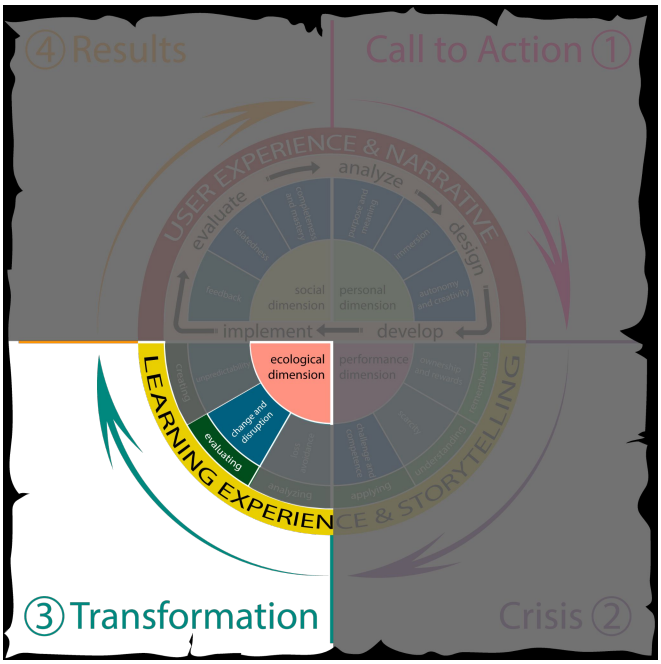
In this step, design learning activities to assess if students can **appraise, defend** or **select** the content.



Step by Step

Change and Disruption

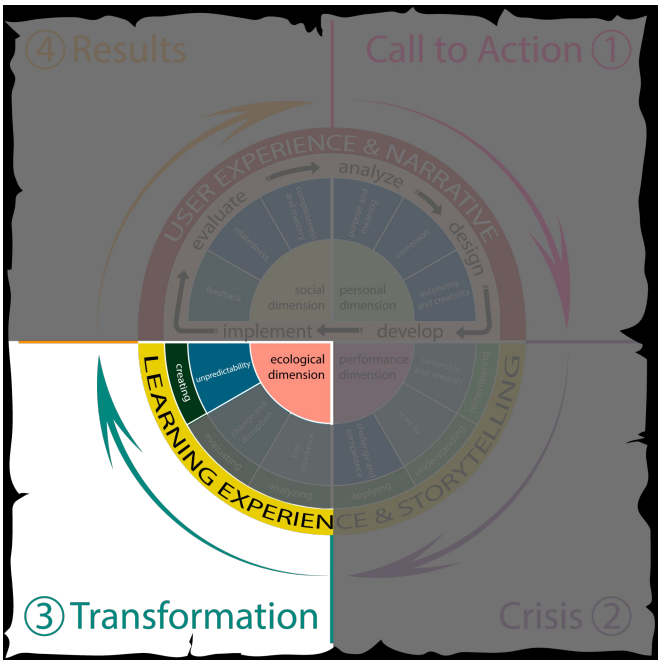
Here the student already has a basis to argue and defend their point of view, and the teacher (or system) must work so that they obtain mastery of the content taught. In this sense, proposing **innovations** and dealing with affordances that work with **disruption control**, such as debates for example, is a great start for this step of the transformative arc.



Step by Step

Learning Objective: Creating

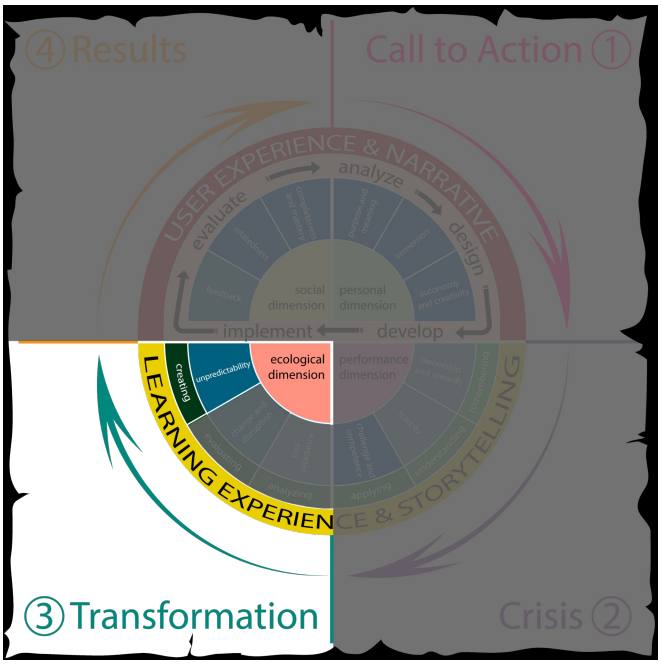
In this step, design learning activities to assess if students can **assemble, create** or **develop** new content.



Step by Step

Unpredictability

In the last stage of the transformative arc, the teacher (or the system) must introduce the student to unpredictability, with **varied challenges** and **rewards**, to stimulate their creativity and adaptive capacity. And so the student must be able to create something new on top of the acquired knowledge.



Step by Step

Ecological Dimension

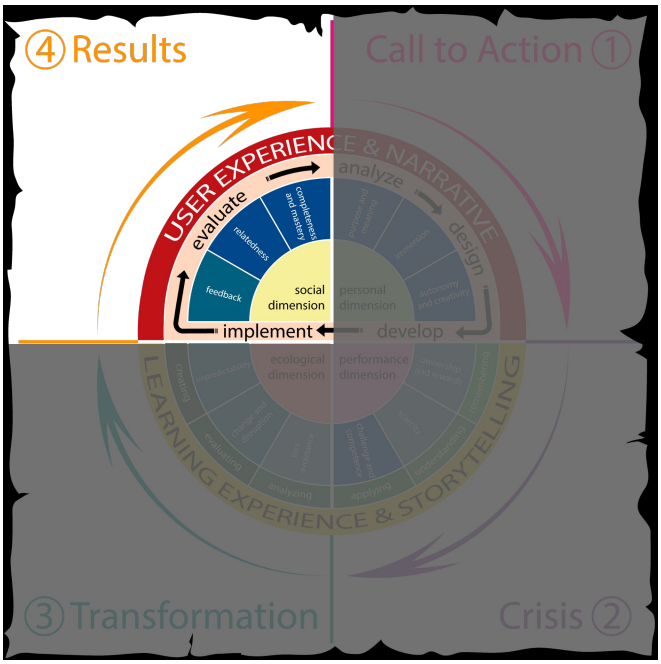
Optionally, other game elements might be used to enrich the experience. In the case of the transformation arc, the student will be more susceptible to game elements that work with the context and environment around them.

Additionally, the elements of the **social dimension** can also be worked on in the background supporting the knowledge transfer.

Step by Step

Act 4: Results

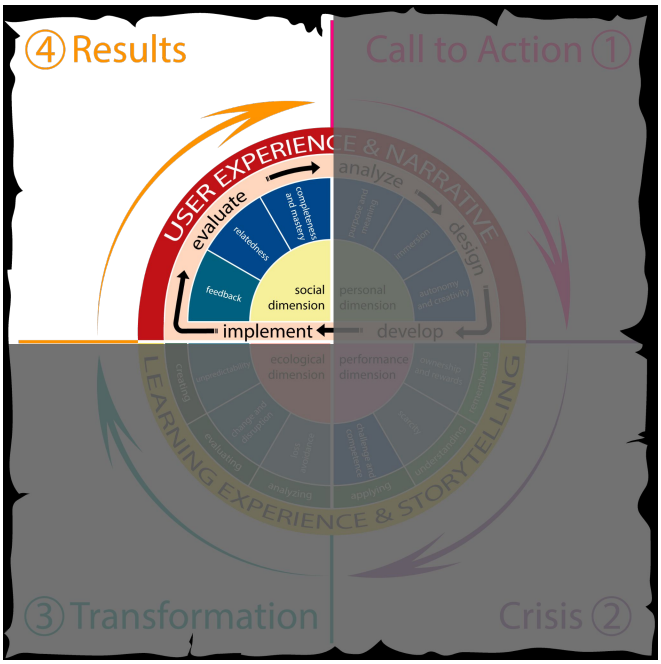
The last arc of the learning journey closes a cycle and because of this, must be seen as a moment of reflection and experiences sharing. In this arc, the teacher (or system) must provide the student with a **suitable environment so that they can express themselves** about their experience and through this expression, see the closing of the cycle with the idea that something new is about to happen (a new journey).



Step by Step

Feedback

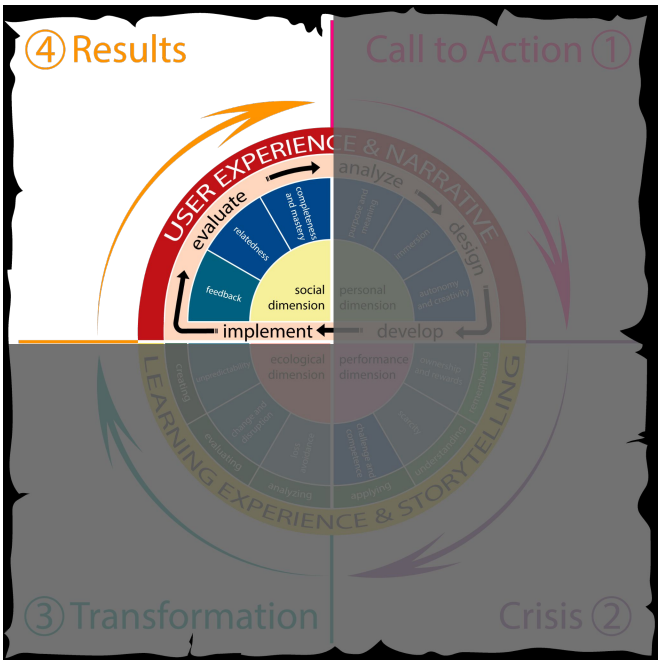
Although this heuristic must be present in the background of any system (so that the user understands what is happening), at this moment the teacher (or the system) especially needs to provide elements for the student to **understand the process they have undergone** through so far.



Step by Step

Relatedness

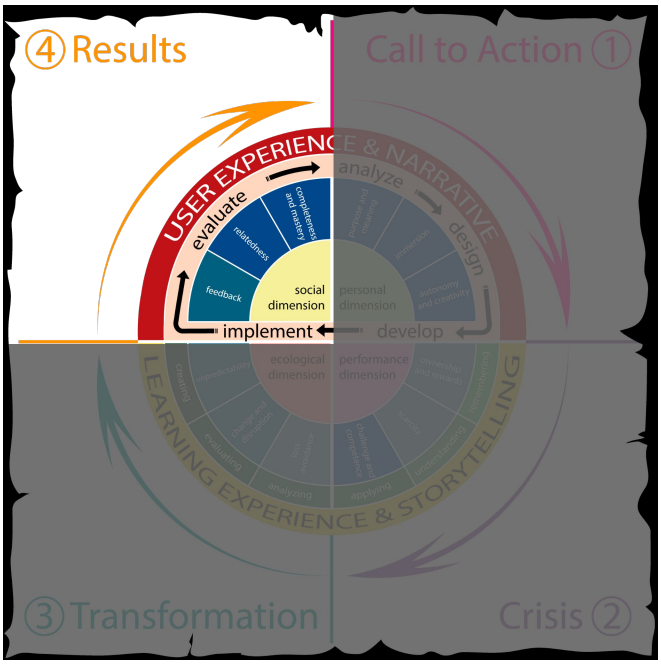
As a final result of the journey, it is important that the student feels like part of the process, as a transformative agent, the hero of their journey. And at this point, the teacher (or the system) must make sure that this feeling has been reached and consolidate it, mainly through **social ties** (collaboration, competition, etc.).



Step by Step

Completeness and Mastery

Finally, the student needs to understand where they started on this journey and where they are ending it. The motivational affordance for this can deal with progressive goals and achievement. Here the teacher (or system) must d**emonstrate the outcome of the journey.**

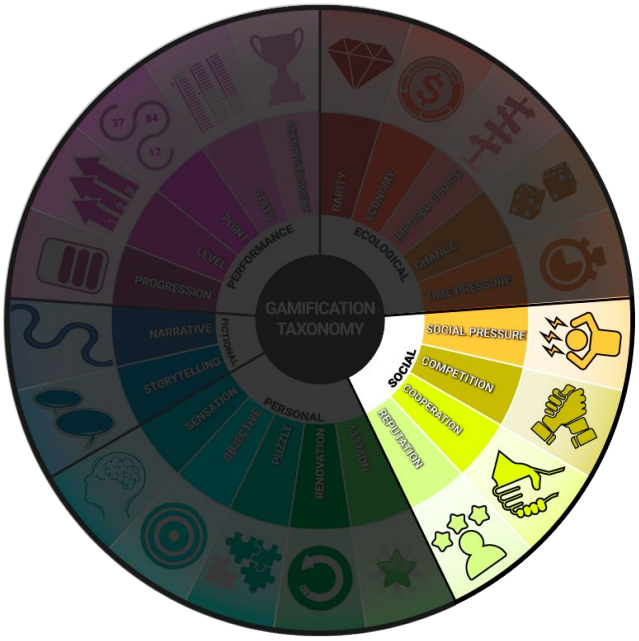


Step by Step

Social Dimension

Optionally, other game elements might be used to enrich the experience. In the case of the results arc, the student will be more susceptible to game elements that work with social ties.

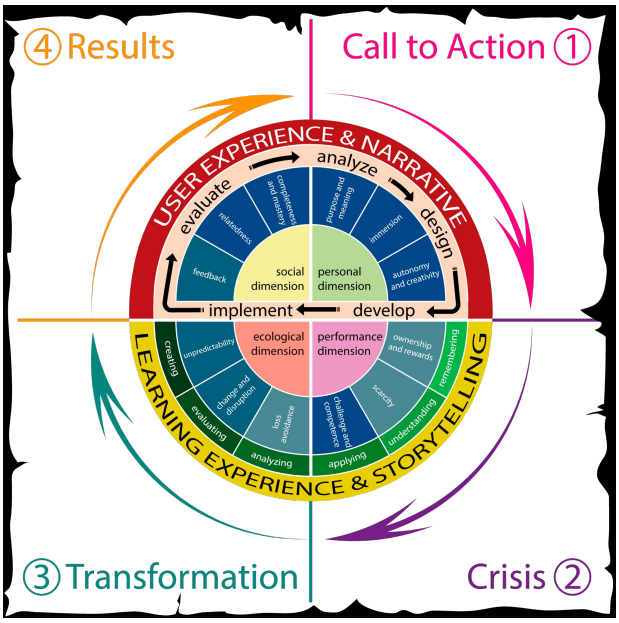
Additionally, the elements of the **personal dimension** can also be worked on in the background.



Final Considerations

Heuristics and Game Elements

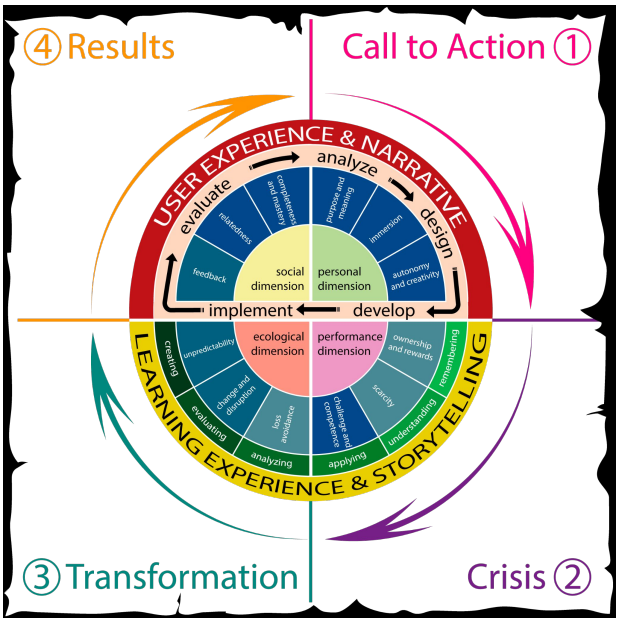
Although the framework suggests the best moments to use a heuristic or another game element, it is possible, following this model, to **prioritize a guideline, but work with others as a background.** For example, the entire journey must be immersive, but especially at the beginning of it, the student MUST be immersed in the process so that everything else goes smoothly.



Final Considerations

Heuristics and Game Elements

Some heuristics and game elements may be similar in their nomenclature, however, their goals are different. Heuristics should be seen as guidelines for the creation of pedagogical content and user experience and/or learning, while complimentary game elements (dimensions) **may or may not** be used in specific ways to **enrich the experience.**



Application Example

- Step by Step - Classroom

Application Example in a Classroom

1

We present in this section an example of a gamified strategy created following the Gamification Journey Framework, for the **unplugged environment**, in a face-to-face classroom lesson.

The content is a real introductory module on web programing, based on HTML and CSS *(frontend development)*, whose lessons were recreated according to the framework.

Introductory Module - HTML and CSS

1

Main Instructional Goal:
Explain each language and their roles in web applications

Secondary Instructional Goal:
Make the student understand the difference between languages;
Teach the basic structure of each language and how they relate to each other.

Link to the original content:
https://docs.google.com/document/d/1QrD0dG47ZemN1c4Ko-VOVDQUPJf7pC4hcTH7WvHH_j8/edit?usp=sharing (in portuguese)

Using Instructional Framework ADDIE

1

Analyze

Identify the problem and the learning requirement

(remain the same as in the traditional module)

2

Design

Define the learning objectives and the instructional strategies

(based on the framework and Bloom's Taxonomy, as detailed in the last section)

3

Development

Develop and validade the learning resources

(using the Narrative Gamification Framework, as detailed in the last section)

Using Instructional Framework ADDIE

4

Implementation

Prepare the learning environment and implement the learning solution

(choose the virtual or unplugged environment and prepare for applying the framework accordinly)

5

Evaluation

Assess the effectiveness of the course instructions

(if system-based, through learning analytics, if unplugged, through student feedback)

Call to Action

Game Elements & Heuristics	Application Example
Narrative	Start questioning if the students know how to design web applications.
Purpose and Meaning	Explain why this is important.
Immersion | Narrative	Use the analogy of housing construction and site construction and let them give examples from their lives.

Call to Action

Game Elements & Heuristics	Application Example
Autonomy and Creativity	Use their own examples to encourage them to learn.
Personal Dimension	Optionally mainly use the game elements of Sensation, Objective, Puzzles, Renovation and Novelty.
Performance Dimension	Optionally use the game elements of Progression, Level, Point, Stats and Acknowledgement secondarily.

Crisis (Conflict)

Game Elements & Heuristics	Application Example
Learning Objective: Remembering	Design learning activities to assess if students can compare, criticize, examine or question the content.
Storytelling	Explain the story of HTML and CSS, their differences and roles in web application development in a ludic way.
Ownership and Rewards	Give rewards and items according to their performance and participation.

(7) http://www.csszengarden.com/

Crisis (Conflict)

Game Elements & Heuristics	Application Example
Learning Objective: Understanding	Design learning activities to assess if students can describe, discuss, explain or recognize the content.
Storytelling	Use the site CSS ZEN GARDEN (7) to show pratical examples of how CSS and HTML can be used together.
Scarcity	Give exclusive items according to their performance and participation (like in a contest among students).

7 http://www.csszengarden.com/

Crisis (Conflict)

Game Elements & Heuristics	Application Example
Learning Objective: Applying	Design learning activities to assess if students can employ, sketch, solve or demonstrate the content.
Storytelling	Explain the basic structure of HTML and CSS using the visuals from CSS ZEN GARDEN (7).
Challenge and Competence	Based on the CSS ZEN GARDEN (7) premise, design a simpler but similar challenge.

Crisis (Conflict)

Game Elements & Heuristics	Application Example
Performance Dimension	Optionally mainly use the game elements of Progression, Level, Point, Stats and Acknowledgement.
Ecological Dimension	Optionally use the game elements of Rarity, Economy, Imposed Choice, Chance and Time Pressure secondarily.

Transformation

Game Elements & Heuristics	Application Example
Learning Objective: Analyzing	Design learning activities to assess if students can compare, criticize, examine, question the content.
Loss Avoidance	Ask the students to present their work from previous assigment and let they discuss their findings.

Transformation

Game Elements & Heuristics

Learning Objective: Evaluating

Change and Disruption

Application Example

Design learning activities to assess if students can appraise, defend or select the content.

Ask students to choose the designs that are most likely to be improved and ask them to justify the decision.

Transformation

Game Elements & Heuristics	Application Example
Learning Objective: Creating	Design learning activities to assess if students can assemble, create or develop new content.
Unpredictability	Ask the students to create a final design with all they have learned, for a site of their choice.
Storytelling	Ask the students to justify and tell the story of the final design.

Transformation

Game Elements & Heuristics	Application Example
Ecological Dimension	Optionally mainly use the game elements of Rarity, Economy, Imposed Choice, Chance and Time Pressure.
Social Dimension	Optionally use the game elements of Social Pressure, Competition, Cooperation and Reputation secondarily.

Results

Game Elements & Heuristics	Application Example
Feedback	Let students provide feedback on the related activity, become aware of progress, from the beginning of the course until now .
Relatedness	This process must be in groups, and the teacher must foster cooperation and competition among students.
Narrative	At the end of the class, check if everyone has an exact notion of their choices, decisions and achievements.

Results

Game Elements & Heuristics	Application Example
Completeness and Mastery	Encourage a final round of improvement on the site or generate a list of what could be improved in new iterations.
Feedback	Check which students had the most difficulty in which moments of the activities, and what were the individual goals of each one at the beginning of the module.
Narrative	Change the assigments, to stimulate other skills.

Results

Game Elements & Heuristics	Application Example
Social Dimension	Optionally mainly use the game elements of Social Pressure, Competition, Cooperation and Reputation.
Personal Dimension	Optionally use the game elements of Sensation, Objective, Puzzles, Renovation and Novelty secondarily.

Final Remarks

- Related Artifacts

Final Remarks

The **framework** presented can be used as a stand alone tool for **gamified educational systems** and **unplugged gamification**. However, it includes two more artifacts that complement the design of the gamification strategy.

Gamification Journey User Type (8)

This approach to personalization based on behavioral and personality user types was created using **Pierce's semiotic triad (9)** and **Jung's 12 Archetypes (10)** theories.

Through this approach, it is possible to identify a profile for the initial presentation of pedagogical content, either by an intelligent tutoring system (ITS) or by a teacher, based solely on the choice of symbolic images. Once with the initial profile, the learning journey described in this documentation is **presented adaptatively,** dinamicaly changing the content presentation and activities according to the **user type** of the student at that **particular moment.**

8 PALOMINO, P. T., Toda, A. M., Oliveira, W., Rodrigues, L., & Isotani, S. (2019). Gamification journey: A Novel approach for classifying gamer types for gamified educational systems. *Simpósio Brasileiro de Jogos e Entretenimento Digital*, *2019*.
9 PEIRCE, C. S., Peirce on signs: Writings on semiotic. UNC Press Books,1991
10 JUNG, C. G.,The archetypes and the collective unconscious. Routledge,2014

Gamification Journey Ontology (11)

To assist in building **intelligent semantic systems** that support the use of this **framework automatically,** a computational ontology was developed to categorize, connect and define the various concepts and terms used in the process as a whole, from user types and their relationships to game elements, to the different learning objectives and their respective activities, with resources on how to build pedagogical content. This ontology c**an be further extended** to any gamification taxonomy and usery type/gamer types approaches.

11 PALOMINO et. al. (in development).

Let's Talk

If you have any questions, please contact me via email paulatpalomino@usp.br or Whatsapp +55 16 98829.9169

Thank you!

Glossary

- Theories
- Game Elements

Theories

Bloom's Taxonomy

It is a framework that **classifies the process of thinking and learning,** and organizes in a hierarchical way learning objectives and learning activities, relating them to two cognitive dimensions: Cognitive Process (divided into the stages of Remembering, Understanding, Applying, Analyzing, Evaluating, and Creating) and Knowledge (divided into Factual, Conceptual, Procedural, and Meta-Cognitive knowledge).

3 ANDERSON, Lorin W. et al. A taxonomy for learning, teaching, and assessing: A revision of Bloom's taxonomy of educational objectives. Longman,, 2001.

Theories

Hero's Journey

Also called **monomyth**, it is one of the most commonly used storytelling structures in myths, legends, novels, and narrative works in general, presenting a cyclical form of storytelling, in which the protagonist overcomes various challenges to become a hero.

2 CAMPBELL, Joseph. The hero with a thousand faces. New World Library, 2008.

Theories

TGEEE

It is a taxonomy of game elements developed using data-mining resources, validated by experts. It has the **specific purpose of categorizing and defining the existing game elements with a focus on their use in education,** consisting of five dimensions (Fictional, Personal, Performance, Ecological and Social) and 21 game elements.

4 Toda, A. M., Klock, A. C., Oliveira, W., Palomino, P. T., Rodrigues, L., Shi, L., ... & Cristea, A. I. (2019). Analysing gamification elements in educational environments using an existing Gamification taxonomy. Smart Learning Environments, 6(1), 1-14.

Theories

Gameful Design Heuristics

The Gameful Design Heuristics is a **set of guidelines for heuristic evaluation of game design in interactive systems.** It is the first tool of its kind focused specifically on evaluating game design through the lens of intrinsic and extrinsic motivational resources.

5 TONDELLO, Gustavo F. et al. Gameful Design Heuristics: A Gamification Inspection Tool. In: International Conference on Human-Computer Interaction. Springer, Cham, 2019. p. 224-244.

Theories

ADDIE Instructional Design Framework

ADDIE is a **framework for instructional systems design (ISD)** that many instructional designers and training developers use to develop their courses. It is considered one of the most famous pedagogical models of nowdays and there are many other frameworks derived from it, because it presents a simple and complete process for creating educational content.

6 Morrison, Gary R. Designing Effective Instruction, 6th Edition. John Wiley & Sons, 2010.

TGEEE - Dimensions

Performance Dimension

These are elements related to the environment response, which can be used to provide feedback to the learner.

Ecological Dimension

This context is related to the environment that the gamification is being implemented.These elements can be represented as properties.

4 Toda, A. M., Klock, A. C., Oliveira, W., Palomino, P. T., Rodrigues, L., Shi, L., ... & Cristea, A. I. (2019). Analysing gamification elements in educational environments using an existing Gamification taxonomy. Smart Learning Environments, 6(1), 1-14.

TGEEE - Dimensions

Social Dimension

This dimension is related to the interactions between the learners presented in the environment.

Personal Dimension

This dimension is related to the learner that is using the environment.

4 Toda, A. M., Klock, A. C., Oliveira, W., Palomino, P. T., Rodrigues, L., Shi, L., ... & Cristea, A. I. (2019). Analysing gamification elements in educational environments using an existing Gamification taxonomy. Smart Learning Environments, 6(1), 1-14.

TGEEE - Dimensions

Fictional Dimension

It is the mixed dimension that is related to the user (through Narrative) and the environment (through Storytelling), tying their experience with the context.

4 Toda, A. M., Klock, A. C., Oliveira, W., Palomino, P. T., Rodrigues, L., Shi, L., ... & Cristea, A. I. (2019). Analysing gamification elements in educational environments using an existing Gamification taxonomy. Smart Learning Environments, 6(1), 1-14.

TGEEE - Performance Dimension

Acknowledgement

Also known as **badges, medals, trophies and achievements**.It is a kind of extrinsic feedback that praises the players'specific set of actions, e.g. completing a certain number of problems may lead them to earn a 'Solver' badge; finishing a task in a predefined time limit may earn them a 'Flash' trophy and so on.

4 Toda, A. M., Klock, A. C., Oliveira, W., Palomino, P. T., Rodrigues, L., Shi, L., ... & Cristea, A. I. (2019). Analysing gamification elements in educational environments using an existing Gamification taxonomy. Smart Learning Environments, 6(1), 1-14.

TGEEE - Performance Dimension

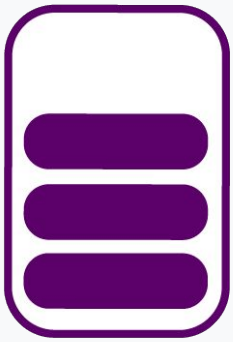
Level

Also known as **skill level, character level** etc. This is related to an extrinsic hierarchical layer that provides the user new advantages as they advance in the environment, e.g. the students gain a level every time they complete a certain number of tasks, when they advance their level, they have access to more challenging tasks.

4 Toda, A. M., Klock, A. C., Oliveira, W., Palomino, P. T., Rodrigues, L., Shi, L., ... & Cristea, A. I. (2019). Analysing gamification elements in educational environments using an existing Gamification taxonomy. Smart Learning Environments, 6(1), 1-14.

TGEEE - Performance Dimension

Progression

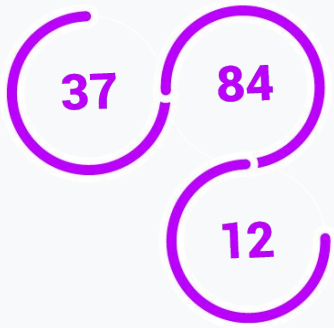


Also known as p**rogress bars, steps, maps.** Provides an extrinsic guidance to the users of their advance in the environment, allowing these users to locate themselves.

4 Toda, A. M., Klock, A. C., Oliveira, W., Palomino, P. T., Rodrigues, L., Shi, L., ... & Cristea, A. I. (2019). Analysing gamification elements in educational environments using an existing Gamification taxonomy. Smart Learning Environments, 6(1), 1-14.

TGEEE - Performance Dimension

Point



Also known as **scores, experience points, skill points**, etc. It is a simple way to provide extrinsic feedback to the users' actions. Point is the most basic concept found in almost all gamified applications.

4 Toda, A. M., Klock, A. C., Oliveira, W., Palomino, P. T., Rodrigues, L., Shi, L., ... & Cristea, A. I. (2019). Analysing gamification elements in educational environments using an existing Gamification taxonomy. Smart Learning Environments, 6(1), 1-14.

TGEEE - Dimensão de Performance

Stats

Also known as **information, Head Up Display (HUD) and data.** It is related to the visual information provided by the environment to the learner (extrinsic), e.g. how many tasks they completed or overall stats on the environment. In virtual environments this can also be dashboards.

4 Toda, A. M., Klock, A. C., Oliveira, W., Palomino, P. T., Rodrigues, L., Shi, L., ... & Cristea, A. I. (2019). Analysing gamification elements in educational environments using an existing Gamification taxonomy. Smart Learning Environments, 6(1), 1-14.

TGEEE - Ecological Dimension

Chance

Also known as **randomness, luck, fortune or probability.** This intrinsic concept is related to the random property of a certain event or outcome, e.g. the student may get a random number of points after completing a task; spinning a roulette that may give the user a bonus; user has a probability of getting a special item based on its luck.

TGEEE - Ecological Dimension

Imposed Choice

Also known as **choice, judgment, and paths.** This extrinsic concept occurs when the player faces an explicit decision that they must make to advance in the environment. An example of this concept is to present the user two different contents and make them choose one or another, blocking their advance if a choice is not to pick.

4 Toda, A. M., Klock, A. C., Oliveira, W., Palomino, P. T., Rodrigues, L., Shi, L., ... & Cristea, A. I. (2019). Analysing gamification elements in educational environments using an existing Gamification taxonomy. Smart Learning Environments, 6(1), 1-14.

TGEEE - Ecological Dimension

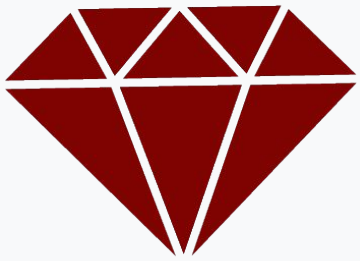
Economy

Also known as **transactions, market, exchange.** This concept is extrinsically related to any transaction that may occur in the environment. Examples are trading points for advantages within the environment and related to the content.

4 Toda, A. M., Klock, A. C., Oliveira, W., Palomino, P. T., Rodrigues, L., Shi, L., ... & Cristea, A. I. (2019). Analysing gamification elements in educational environments using an existing Gamification taxonomy. Smart Learning Environments, 6(1), 1-14.

TGEEE - Ecological Dimension

Rarity



Also known as **limited items, collection, exclusivity.** It is related to extrinsically limited resources within the environment which can stimulate the learners through a specific goal.

4 Toda, A. M., Klock, A. C., Oliveira, W., Palomino, P. T., Rodrigues, L., Shi, L., ... & Cristea, A. I. (2019). Analysing gamification elements in educational environments using an existing Gamification taxonomy. Smart Learning Environments, 6(1), 1-14.

TGEEE - Ecological Dimension

Time Pressure

Also represented as **countdown timers or clocks.** It is related to time itself used to pressure the learners' actions (extrinsic). In learning environments, this can also be represented as deadlines.

4 Toda, A. M., Klock, A. C., Oliveira, W., Palomino, P. T., Rodrigues, L., Shi, L., ... & Cristea, A. I. (2019). Analysing gamification elements in educational environments using an existing Gamification taxonomy. Smart Learning Environments, 6(1), 1-14.

TGEEE - Social Dimension

Competition

Also known as **conflict, leader boards, scoreboards, player vs player**, etc. It's an intrinsic concept, tied to a challenge where the user faces another user to achieve a common goal, e.g. using scoreboards based on the number of points, badges, levels, etc.

4 Toda, A. M., Klock, A. C., Oliveira, W., Palomino, P. T., Rodrigues, L., Shi, L., ... & Cristea, A. I. (2019). Analysing gamification elements in educational environments using an existing Gamification taxonomy. Smart Learning Environments, 6(1), 1-14.

TGEEE - Social Dimension

Cooperation

Also known as **teamwork, co-op, groups,** etc. It is also an intrinsic concept (related to a task) where the users must collaborate to achieve a common goal, can be considered the opposite of competition (however, both concepts can be used together).

4 Toda, A. M., Klock, A. C., Oliveira, W., Palomino, P. T., Rodrigues, L., Shi, L., ... & Cristea, A. I. (2019). Analysing gamification elements in educational environments using an existing Gamification taxonomy. Smart Learning Environments, 6(1), 1-14.

TGEEE - Social Dimension

Reputation

Also known as **classification, status**. It is related to titles that the learner may gain and accumulate within the environment (intrinsic). Differing from levels, titles represent more of a social status which does not necessarily reflect on the learners'skills.

TGEEE - Social Dimension

Social Pressure

Also known as **peer pressure or guild missions.** This intrinsic concept is related to social interactions that exert pressure on the learner.

4 Toda, A. M., Klock, A. C., Oliveira, W., Palomino, P. T., Rodrigues, L., Shi, L., ... & Cristea, A. I. (2019). Analysing gamification elements in educational environments using an existing Gamification taxonomy. Smart Learning Environments, 6(1), 1-14.

TGEEE - Personal Dimension

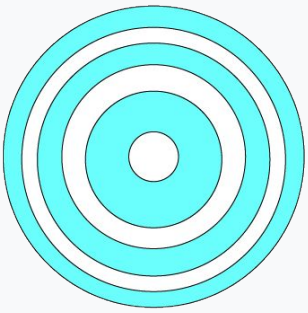
Novelty

Also known as an **update, surprise, changes,** etc. It is intrinsically related to the updates that occur within the environment, by adding new information, content or even new game elements.

4 Toda, A. M., Klock, A. C., Oliveira, W., Palomino, P. T., Rodrigues, L., Shi, L., ... & Cristea, A. I. (2019). Analysing gamification elements in educational environments using an existing Gamification taxonomy. Smart Learning Environments, 6(1), 1-14.

TGEEE - Personal Dimension

Objective



Also known as **missions, side-quests, milestones**, etc. This intrinsic concept is related to goals, it provides the player an end, or a purpose to perform the required tasks. Examples on the use of Objective can be broadened (as getting approved in the course) or more specific (as obtaining a certain score in a task).

4 Toda, A. M., Klock, A. C., Oliveira, W., Palomino, P. T., Rodrigues, L., Shi, L., ... & Cristea, A. I. (2019). Analysing gamification elements in educational environments using an existing Gamification taxonomy. Smart Learning Environments, 6(1), 1-14.

TGEEE - Personal Dimension

Puzzles

Also known as **challenges, cognitive tasks, actual puzzles**, etc. This intrinsic concept is related to the activities that are implemented within the environment, they can be tied or considered as the learning activities since the focus is to provide a cognitive challenge to the learner.

4 Toda, A. M., Klock, A. C., Oliveira, W., Palomino, P. T., Rodrigues, L., Shi, L., ... & Cristea, A. I. (2019). Analysing gamification elements in educational environments using an existing Gamification taxonomy. Smart Learning Environments, 6(1), 1-14.

TGEEE - Personal Dimension

Renovation

Also known as **boosts, extra life, renewal**, etc. This concept is intrinsically related to the property of re-doing a task, event or any of the sorts. It allows the learner a second chance after they fail a task.

4 Toda, A. M., Klock, A. C., Oliveira, W., Palomino, P. T., Rodrigues, L., Shi, L., ... & Cristea, A. I. (2019). Analysing gamification elements in educational environments using an existing Gamification taxonomy. Smart Learning Environments, 6(1), 1-14.

TGEEE - Personal Dimension

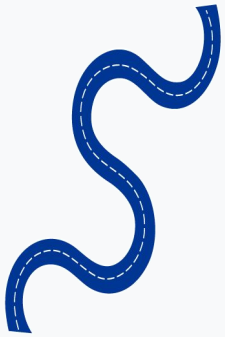
Sensation

This is either v**isual or sound stimulation,** etc. It is related to the use of learners' senses to improve the experience (intrinsic). This can be done through dynamic and gameful interfaces, Virtual Reality (VR) and/or Augmented Reality (AR).

4 Toda, A. M., Klock, A. C., Oliveira, W., Palomino, P. T., Rodrigues, L., Shi, L., ... & Cristea, A. I. (2019). Analysing gamification elements in educational environments using an existing Gamification taxonomy. Smart Learning Environments, 6(1), 1-14.

TGEEE - Fictional Dimension

Narrative



Also known as **karma system, implicit decisions,** etc. This intrinsic concept is the order of events as they happen in the game, through the user experience. This experience is influenced by implicit choices made by the user. Examples of this are providing the content in different ways for the learner to choose by themselves, creating a branch and consequently a different user experience.

4 Toda, A. M., Klock, A. C., Oliveira, W., Palomino, P. T., Rodrigues, L., Shi, L., ... & Cristea, A. I. (2019). Analysing gamification elements in educational environments using an existing Gamification taxonomy. Smart Learning Environments, 6(1), 1-14.

TGEEE - Fictional Dimension

Storytelling

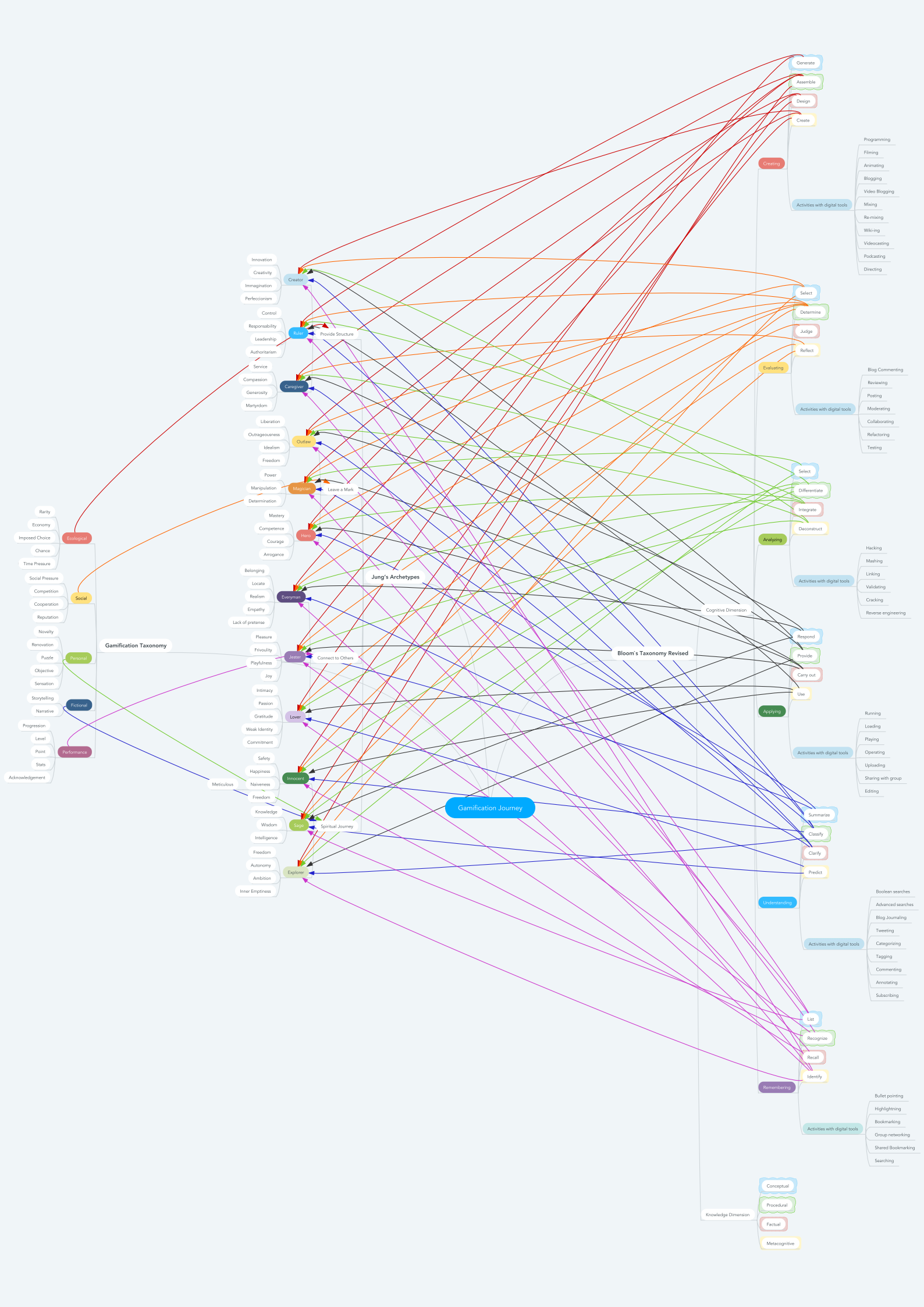
Can be seen as a**udio queues, text stories,** etc. It is the way the story of the environment is told (as a script). It is told through text, voice, or other sensorial resources. It is highly used as a tool to support the narrative within an environment.

4 Toda, A. M., Klock, A. C., Oliveira, W., Palomino, P. T., Rodrigues, L., Shi, L., ... & Cristea, A. I. (2019). Analysing gamification elements in educational environments using an existing Gamification taxonomy. Smart Learning Environments, 6(1), 1-14.

APPENDIX

B

LIGHTWEIGHT GAMIFICATION ONTOLOGY CONCEPT MAP


Gamification Journey
Gamification Taxonomy
Ecological
Rarity
Economy
Imposed Choice
Chance
Time Pressure
Social
Social Pressure
Competition
Cooperation
Reputation
Personal
Novelty
Renovation
Puzzle
Objective
Sensation
Fictional
Storytelling
Narrative
Performance
Progression
Level
Point
Stats
Acknowledgement
Jung's Archetypes
Creator
Innovation
Creativity
Immagination
Perfeccionism
Ruler
Control
Responsability
Leadership
Authoritarism
Provide Structure
Caregiver
Service
Compassion
Generosity
Martyrdom
Outlaw
Liberation
Outrageousness
Idealism
Freedom
Magician
Power
Manipulation
Determination
Leave a Mark
Hero
Mastery
Competence
Courage
Arrogance
Everyman
Belonging
Locate
Realism
Empathy
Lack of pretense
Jester
Pleasure
Frivolity
Playfulness
Joy
Connect to Others
Lover
Intimacy
Passion
Gratitude
Weak Identity
Commitment
Innocent
Safety
Happiness
Naiveness
Freedom
Meticulous
Sage
Knowledge
Wisdom
Intelligence
Spiritual Journey
Explorer
Freedom
Autonomy
Ambition
Inner Emptiness
Bloom's Taxonomy Revised
Cognitive Dimension
Creating
Generate
Assemble
Design
Create
Activities with digital tools
Programming
Filming
Animating
Blogging
Video Blogging
Mixing
Re-mixing
Wiki-ing
Videocasting
Podcasting
Directing
Evaluating
Select
Determine
Judge
Reflect
Activities with digital tools
Blog Commenting
Reviewing
Posting
Moderating
Collaborating
Refactoring
Testing
Analyzing
Select
Differentiate
Integrate
Deconstruct
Activities with digital tools
Hacking
Mashing
Linking
Validating
Cracking
Reverse engineering
Applying
Respond
Provide
Carry out
Use
Activities with digital tools
Running
Loading
Playing
Operating
Uploading
Sharing with group
Editing
Understanding
Summarize
Classify
Clarify
Predict
Activities with digital tools
Boolean searches
Advanced searches
Blog Journaling
Tweeting
Categorizing
Tagging
Commenting
Annotating
Subscribing
Remembering
List
Recognize
Recall
Identify
Activities with digital tools
Bullet pointing
Highlightning
Bookmarking
Group networking
Shared Bookmarking
Searching
Knowledge Dimension
Conceptual
Procedural
Factual
Metacognitive

Gamification Journey

1. Bloom`s Taxonomy Revised

1.1. Cognitive Dimension

1.1.1. Creating

1.1.1.1. Generate

1.1.1.2. Assemble

1.1.1.3. Design

1.1.1.4. Create

1.1.1.5. Activities with digital tools

1.1.1.5.1. Programming

1.1.1.5.2. Filming

1.1.1.5.3. Animating

1.1.1.5.4. Blogging

1.1.1.5.5. Video Blogging

1.1.1.5.6. Mixing

1.1.1.5.7. Re-mixing

1.1.1.5.8. Wiki-ing

1.1.1.5.9. Videocasting

1.1.1.5.10. Podcasting

1.1.1.5.11. Directing

1.1.2. Evaluating

1.1.2.1. Select

1.1.2.2. Determine

1.1.2.3. Judge

1.1.2.4. Reflect

1.1.2.5. Activities with digital tools

1.1.2.5.1. Blog Commenting

1.1.2.5.2. Reviewing

1.1.2.5.3. Posting

1.1.2.5.4. Moderating

1.1.2.5.5. Collaborating

1.1.2.5.6. Refactoring

1.1.2.5.7. Testing

1.1.3. Analyzing

1.1.3.1. Select

1.1.3.2. Differentiate

1.1.3.3. Integrate

1.1.3.4. Deconstruct

1.1.3.5. Activities with digital tools

1.1.3.5.1. Hacking

1.1.3.5.2. Mashing

1.1.3.5.3. Linking

1.1.3.5.4. Validating

1.1.3.5.5. Cracking

1.1.3.5.6. Reverse engineering

1.1.4. Applying

1.1.4.1. Respond

1.1.4.2. Provide

1.1.4.3. Carry out

1.1.4.4. Use

1.1.4.5. Activities with digital tools

1.1.4.5.1. Running

1.1.4.5.2. Loading

1.1.4.5.3. Playing

1.1.4.5.4. Operating

1.1.4.5.5. Uploading

1.1.4.5.6. Sharing with group

1.1.4.5.7. Editing

1.1.5. Understanding

1.1.5.1. Summarize

1.1.5.2. Classify

1.1.5.3. Clarify

1.1.5.4. Predict

1.1.5.5. Activities with digital tools

1.1.5.5.1. Boolean searches

1.1.5.5.2. Advanced searches

1.1.5.5.3. Blog Journaling

1.1.5.5.4. Tweeting

1.1.5.5.5. Categorizing

1.1.5.5.6. Tagging

1.1.5.5.7. Commenting

1.1.5.5.8. Annotating

1.1.5.5.9. Subscribing

1.1.6. Remembering

1.1.6.1. List

1.1.6.2. Recognize

1.1.6.3. Recall

1.1.6.4. Identify

1.1.6.5. Activities with digital tools

1.1.6.5.1. Bullet pointing

1.1.6.5.2. Highlightning

1.1.6.5.3. Bookmarking

1.1.6.5.4. Group networking

1.1.6.5.5. Shared Bookmarking

1.1.6.5.6. Searching

1.2. Knowledge Dimension

1.2.1. Conceptual

1.2.2. Procedural

1.2.3. Factual

1.2.4. Metacognitive

2. Gamification Taxonomy

2.1. Ecological

2.1.1. Rarity

- 2.1.2. Economy
- 2.1.3. Imposed Choice
- 2.1.4. Chance
- 2.1.5. Time Pressure
- 2.2. Social
  - 2.2.1. Social Pressure
  - 2.2.2. Competition
  - 2.2.3. Cooperation
  - 2.2.4. Reputation
- 2.3. Personal
  - 2.3.1. Novelty
  - 2.3.2. Renovation
  - 2.3.3. Puzzle
  - 2.3.4. Objective
  - 2.3.5. Sensation
- 2.4. Fictional
  - 2.4.1. Storytelling
  - 2.4.2. Narrative
- 2.5. Performance
  - 2.5.1. Progression
  - 2.5.2. Level
  - 2.5.3. Point
  - 2.5.4. Stats
  - 2.5.5. Acknowledgement

3. Jung's Archetypes

- 3.1. Provide Structure
  - 3.1.1. Creator
    - 3.1.1.1. Innovation
    - 3.1.1.2. Creativity
    - 3.1.1.3. Immagination
    - 3.1.1.4. Perfeccionism
  - 3.1.2. Ruler
    - 3.1.2.1. Control
    - 3.1.2.2. Responsability
    - 3.1.2.3. Leadership
    - 3.1.2.4. Authoritarism
  - 3.1.3. Caregiver
    - 3.1.3.1. Service
    - 3.1.3.2. Compassion
    - 3.1.3.3. Generosity
    - 3.1.3.4. Martyrdom
- 3.2. Leave a Mark
  - 3.2.1. Outlaw
    - 3.2.1.1. Liberation
    - 3.2.1.2. Outrageousness
    - 3.2.1.3. Idealism
    - 3.2.1.4. Freedom
  - 3.2.2. Magician
    - 3.2.2.1. Power
    - 3.2.2.2. Manipulation
    - 3.2.2.3. Determination
  - 3.2.3. Hero
    - 3.2.3.1. Mastery
    - 3.2.3.2. Competence
    - 3.2.3.3. Courage
    - 3.2.3.4. Arrogance
- 3.3. Connect to Others
  - 3.3.1. Everyman
    - 3.3.1.1. Belonging
    - 3.3.1.2. Locate
    - 3.3.1.3. Realism
    - 3.3.1.4. Empathy
    - 3.3.1.5. Lack of pretense
  - 3.3.2. Jester
    - 3.3.2.1. Pleasure
    - 3.3.2.2. Frivoulity
    - 3.3.2.3. Playfulness
    - 3.3.2.4. Joy
  - 3.3.3. Lover
    - 3.3.3.1. Intimacy
    - 3.3.3.2. Passion
    - 3.3.3.3. Gratitude
    - 3.3.3.4. Weak Identity
    - 3.3.3.5. Commitment
- 3.4. Spiritual Journey
  - 3.4.1. Innocent
    - 3.4.1.1. Safety
    - 3.4.1.2. Happiness
    - 3.4.1.3. Naiveness
      - 3.4.1.3.1. Meticulous
    - 3.4.1.4. Freedom
  - 3.4.2. Sage
    - 3.4.2.1. Knowledge
    - 3.4.2.2. Wisdom
    - 3.4.2.3. Intelligence
  - 3.4.3. Explorer
    - 3.4.3.1. Freedom
    - 3.4.3.2. Autonomy
    - 3.4.3.3. Ambition
    - 3.4.3.4. Inner Emptiness

APPENDIX

C

NARRATIVE FOR GAMIFICATION IN EDUCATION: WHY SHOULD YOU CARE?

2019 IEEE 19th International Conference on Advanced Learning Technologies (ICALT)

Narrative for gamification in education: why should you care?

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***Abstract*—Gamification applied to education studies are focusing to encourage students to perform specific tasks, however many of these studies are still inconclusive about how much gamification can influence engagement. Also, the frameworks used to apply gamification in those systems are mainly structural (e.g. scoring and ranking systems) rather than content frameworks (where the game elements are applied to the content). Therefore, this paper aims at creating a narrative definition exclusively for gamification purposes. First, we developed an empirical research starting with a literature review of the narrative concept in other medias, such as games. Then, we mapped these definitions into features and crossed the similarities and differences across them, to find a common ground that could be applied in gamification contexts. Our results show that the narrative element definition to use in gamification contexts best drifts from the games ones, however its definition is unique to the point it could be isolated and used in future frameworks. We also found that the characteristics of this concept resembles some of User Experience.**

***Index Terms*—gamification, narrative, games, framework, education**

I. Introduction

One of the main purposes of gamification (defined as the use of game elements outside its main context) is to engage and motivate, to perfect or to create a desired behavior in training and teaching processes and to improve the user experience [1], [2]. Concerning the gamification educational potential, the process has been achieving positive results [1], [3], [4], when used concomitantly with traditional methodologies or as a complement to virtual applications.

Still, several authors disagree on the classification and definition of these terms, and few use a formal definition for use in gamification processes [5]. As an example, we can cite the framework developed by Dignan [6], where the author classified 19 concepts found in games, in contrast to the study by Aparicio *et al*. [5], where these concepts can be classified according to the motivational pillars of Pink [7] and Marczewski´s [8] Gamification Hexad Scale for User Types, a more recent model where they present six types of users described at a basic level. The model then mapped and validated these user types preferences based on the 52 game elements and mechanics classified in Marczewski´s Gamification Elements Periodic Table [8].

One of these underused elements is the narrative. Described as the 10th element of Marczewski's Periodic Table of Gamification Elements [8], narrative is described only as the element that should deal with stories and plot lines. Other works does similar descriptions, which contributes to the element being misunderstood and consequently underutilized.

Based on this premise, this study aim at answering the following questions: *i) what is the narrative in gamification contexts? ii) what are its specific features* and above all, *iii) how it can be applied in practice*, in the education domain? This information will be used, amongst other things, to develop a framework focused on well-thought narratives that can be used in education domain, aimed at improving students' engagement and motivation, as well as their learning rate.

II. Conceptualization and Existing Works

As one of the first theoretician to research narrative, Ricoeur [9] wrote his considerations regarding the reason human being narrates and tells stories, as well as the stages (or *mimeses*) through which these representations take shape. According to Ricoeur, one of the explanations to why human beings need to tell stories, is connected to the relationship between time and narration.

In this sense, the narrative becomes a way of assuring humans against their anguish and pain in the face of the passage of time. Life can take unexpected turns, but the story, created by humans, will always follow its designs and a programmed logic [10]. Thus, narrative is a sequence of events transmitted by an individual. This sequence may undergo modifications and be modified in quantitative or qualitative terms through the way, *i.e*. how it is told, aka storytelling. Narrative also fulfills a calming function and, in this sense, it's crucial to understand their role as a gamification element related to motivation and purpose. The act of narrating stories comes together with a purpose of meaning, and constant transformation - by establishing a dialogue with your receptor.

To discuss narrative in games, it is important to observe the role of the narrative as it is lived through the game. In this sense, the narrative begins to unfold from the moment the player starts the game, the visual representation of the game and its interaction mechanics. Everything is an element that contribute directly, and in a unique way, to this narrative experience in games [10]. Bellow we present three base narrative definitions in digital media, and especially in games. Manovich [11] discusses what the new media would be, and how this new language or digital code affects the narrative. For the researcher, the changes in the media have triggered

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transformations in the cultural body, promoting new communication, language, behavioral, and representative strategies. The narrative, in turn, is established as a modality within a broader aspect, which is the way the human being experiences its existence and how he chooses to represent it in the digital age. Manovich [11] verifies its basic elements can be found in the fundamentals of programming.

As for Salen and Zimmerman [12] narrative is defined as a composition of rules that are experienced through play, so the player interacts in the space of possible actions within a game, allowing them to explore and interact with the game's universe. They further stress that it is important not to rely only on comparison with narrative in other medias to not be distracted from essential elements such as rules, objectives, the player's participation and the impact of their actions in the game universe. This can occur in two distinct ways. The first one is called of embedded narrative [12], and is defined as a pre-generated content that exists prior to the interaction of the player. This kind of narrative is designed to provide motivation for playing the game, the games' story for example, because it gives a sense of purpose to actions. The embedded narrative aims to give a significant stake to the player through the plot, as a premise to story, characters and sequence of events, which give a dramatic unity to the player's interactions and journey.

The second narrative possibility is called emergent, configuring itself in the story that is created from the interactive experience of the player. Its base is also planned by the game designer, but its unfolding is often not. This is due to the events created as an organic consequence of the player's autonomy in the face of the game mechanics and their meaning experience as a user [10], [12], [13]. By this logic, the emergent narrative is only possible because it is directly connected to the chain of mechanisms that make up the game system and meaningful participation of the player who is able to interfere. Thus, a change in the system, from the actions of the player, can result in another modification of the narrative patterns of the game and affect the experience as as a whole. The emergent narrative depends not only on the player's action, but also of what is happening in the system at that very moment. Thus, it is possible that the same actions result in different outcomes, since the changes occurred in the systems are not necessarily the same. The emphasis of narrative is how the player interacts with the game system and creates their own, and unique, sequence of facts [10], [13]. In addition, the two narrative types should balance each other when well worked. This balance allows the creation of unique narrative experiences, only possible in games [12].

As we can see from these two main definitions, narrative in a digital media is intrinsically connected to the system from which it derives. In this aspect we found important to consider the Human-Computer Interaction (HCI) concepts such as user experience [14]. From this point in the work what can be stated is that narrative (be it embedded or emergent) in interactive digital systems depends heavily on the user experience.

III. Methods

To be able to use these elements, such as narrative, with the same understanding and breadth as we have covered the structural elements of game mechanics in the development of future frameworks and / or gamified solutions, it is believed to be of utmost importance the correct understanding of the characteristics or features that carry such a definition, both in its literary origins and consequent unfolding in films and in the digital games themselves, as well as in the specific context of gamification. Thus the present work was carried out through an empirical research based on a literature revision of the definitions and concepts presented by the most traditional authors in the areas of literature and narratology, communication and digital games, culminating in the most recent studies on the subject. The four definitions resulting from this analysis were then compared on the concepts similarities among each other in order to identify elements in common and discordant. These elements were then classified as their relevance and possible use in the construction of gamification projects.

Finally, we elaborated a definition of narrative for use in gamification, so that the element is better understood and consequently more used in future projects, researches and development of frameworks and / or approaches focused on content.

IV. Results and Discussion

TABLE I
Breakdown of the narrative definitions common features

Features	Ricoeur	Manovich	Salen and Zimmerman	Marczewski
Actor		X	X	
Choice or Possibility		X	X	
Interactivity		X	X	
Narrator		X	X	
Plot			X	X
Sequence of events	X	X	X	
Space	X		X	
Story/Data	X	X	X	X
Time	X		X	
User Experience		X	X	

The analysis of the basic definitions of the term, as well as its most recent and technological derivations allowed us to map and catalog features in common, as presented in Table I.Based on these concepts, we can assume that: (1) The term narrative and story blend together and are often confused. We believe that this is one of the reasons why it is still rare to work with narrative as an approach / framework in gamification (and its application in education). If the spatial problem of the element is not well delimited, its practical use becomes too complex. Structural elements, more easily defined and delimited, become more viable alternatives for use in the instructional design of gamification projects; (2) existing frameworks of gamification see the narrative as the same as story or storytelling, and not as the events that are developed through users' interactions, aka as part of the user experience; (3) the definition of narrative for digital games by Salen and Zimmerman [12] is the most complete in terms of the concepts they are built on, having as a differential the classification of

the two types of narrative (embedded and emergent), which in principle would solve the confusion regarding the terms narrative and story. However, by working with other intrinsic elements of digital games, it is not possible to simply use it for gamification; and (4), on the mapped features, only one is unique to all definitions applied to digital games: user experience. This is supported by the fact that in the academic context, especially in computing, the use of gamification is a mean for conditioning behaviors in the user [15] which intersects with the design view of HCI software.

To measure the quality of a particular software, including digital games, HCI has some criteria such as Usability and User Experience, Accessibility and Communicability. Based on the recent studies by Hodent [16], it can be said that the part of UX that is most relevant to a user's willingness to use a system and to continue using it.

We concluded that to be able to use narrative as an element for the design of gamified projects, especially for education, the term narrative should cover at least the following features: The existence of the actor (as the user / student), the element of choice (while options available for content progression), interactivity (the system must respond to user actions), sequence of events (there must be a logical chain of these actions so that progress makes sense to the user) , space (as the virtual space), date (as the information presented), time of interaction and mainly, so that it is constituted in an element capable of motivating the student, the feature of the user experience. As such we could say that:

"*The Gamification narrative element can be understood as the process in which the user builds his own experience through a given content, exercising their freedom of choice in a given space and period of time, bounded by the system's logic.*"

We believe the path to using narrative as a content element for gamification frameworks and/or approaches is the ability to map and control the user experience in a way to guide the student through the content. In order to do that we should delve into HCI user experience concepts and cross them with digital games interaction. As stated before, the engaging ability is, amongst other things, directly connected to the experience and satisfaction resulting of the interaction process [16].

V. Final remarks

In this work, we presented a concept of Narrative that can be used in gamification applications, based on existing literature. As for the limitations of this research, we opted to work only with grounded theories about narrative. We are aware that recent communication studies are delving into the crossmedia and transmedia [17]) viewings of narrative.As we believed the very base definition of narrative in gamification did not matched the concepts from game studies literature, we choose to develop a solid definition that could be understood and used with different areas aiming to build and/or relate with content gamification frameworks.

As a way to validate the concept, we are currently working on creating a taxonomy of elements based on gamification experts' opinions.

As future works we intend to propose the development of a narrative-based content-oriented gamification framework for educational purposes, that will be experienced by the student as they advance in their studies. We work with the hypothesis that a narrative can be embedded in a subtly way into the learning environment. In this sense, it is of utmost importance a more in-depth study of the user experience field, seeking to bring the multidisciplinary knowledge of the HCI area to the Gamification context. In specifically addressing Gamification of Educational Systems, this is believed to be a valid path for future works.

Acknowledgment

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APPENDIX

D

EXPLORING CONTENT GAME ELEMENTS TO SUPPORT GAMIFICATION DESIGN IN EDUCATIONAL SYSTEMS: NARRATIVE AND STORYTELLING.

Exploring Content Game Elements to Support Gamification Design in Educational Systems: Narrative and Storytelling

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Abstract. *Several studies on gamification applied to educational systems aim at encouraging students to do certain tasks and improving their learning. According to the literature, most gamification frameworks are structural (e.g. scoring systems, ranking, etc.), with few content-related frameworks. To the best of our knowledge, there is no narrative framework available. Therefore this paper analyses data obtained from a survey about the students' preferred game elements in an educational context, with focus on Association Rules found concerning Narrative and Storytelling elements. We show that Narrative and Storytelling are tightly related and provide insights of their use in groups with other game elements, enabling the creation of gamified strategies based on these aspects.*

1. Introduction

From their inception to the current day, implementation and use of information technologies (ITs) have undergone substantial changes in the way in which they are represented in a great variety of areas, including learning [Preece et al. 2015, Jenkins 2006]. Specifically in the latter learning context, one of these changes refers to the increasing use of gamification (defined as the use of game elements outside of a game). Concretely, gamification is mostly used to engage and motivate students in the learning process, as well as improving their experience [Deterding et al. 2011a, Seaborn and Fels 2014, Hamari et al. 2014].

Gamified education has already achieved positive results [Borges et al. 2014, Deterding et al. 2011b], when used concomitantly with traditional methodologies, or as a complement to virtual applications. According to [Smith-Robbins 2011], one can observe some of these elements already present in the traditional methodology. Traditional teaching can be compared to the process of gamification, through a parallel between concepts found in the traditional model, such as grades, groups, and degrees, and game elements such as points, levels, and achievements.

Nevertheless, in spite of its advantages, gamification interventions might still sometimes fail to improve students' motivation [Toda et al. 2018]. Thus, we have researched ways to improve the current gamification landscape. One way to provide better gamification recommendations, explored in this paper, is to rely on elements different

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from the traditional PBL approaches (Point-Badge-Leaderboard) [Bogost 2014]. The reason is that these elements are more related to structural gamification and are not concerned with the content of applications [Kapp 2012]. According to [Palomino et al. 2019], *Narrative* and *Storytelling* are elements that are concerned with both the content and immersive experiences in gamified systems, but have nevertheless been neglected/forgotten by a majority of studies in the field. To address this gap, we aim at answering the following research question *"How can we use Storytelling and Narrative alongside other gamification elements to improve students engagement?"*. To answer this question, we propose a data-driven study based on a previous work developed by [Toda et al. 2019b], where they explored the acceptance of gamified strategies. Our main contribution is a new set of recommendations based on the group of preferred game elements that can be used alongside Narrative and Storytelling elements, by teachers and instructors.

2. Background and Related Work

2.1. On the Concepts of Narrative, Story and Storytelling

Here we consider the concepts of the game elements *Narrative* and *Storytelling*, relating both of them with the concept of "story", from the perspective of gamification design, and specifically, gamification design of educational systems. The act of telling stories is as old as humanity itself. According to [Ricoeur 2010], one of the explanations of why human beings need to tell stories is connected to the relationship between time and narration [Augustine 1876]. A narrative is a sequence of events transmitted by an individual. This sequence may undergo modifications of quantitative or qualitative nature, changing, *e.g.* the way it is told, *i.e.* the storytelling. A narrative can also fulfill a calming function and, in this sense, it is crucial in its role as a game element related to motivation and purpose [Palomino et al. 2019].

According to [Salen et al. 2004], there are two types of narrative that are concerned with player experience: embedded and emergent. The former is the story inserted in the game system, which confers meaning and context to the rules. Without it, actions simply inherent in the interaction mechanics could be abstract and devoid of purpose. In this way, the embedded narrative aims to give a significant stake to the player through its plot, as a premise to story, characters and sequence of events, which render a dramatic unity to the player's interactions and journey. As for the latter, it is the story that is created from the interactive experience of the player. Its base is also planned by the game designer, but its unfolding is often not. This occurs due to the events created that are a natural consequence of the player's freedom of choice in the face of the game mechanics and their experience as a user [Salen et al. 2004].

As for gamification studies, [Palomino et al. 2019] defines narrative as the sequence of events that guides the users towards a defined goal, which can be supported by storytelling. The act of narrating stories comes together with a purpose of meaning, and constant transformation, by establishing a dialogue with the receptor. By understanding the act of teaching, amongst other things as an act of communication from the teacher to the student, we can see why the elements Narrative and Storytelling are specifically important to the education domain.

2.2. Related Works

As we can observe from the background, Narrative and Storytelling have been explored by humanity for a long time, and their importance understood. Nevertheless, few works focused on exploring the concept of Narrative or Storytelling in games applied to education. One example is [Champagnat et al. 2010], who dealt directly with the storytelling concept applied to learning. The authors presented a variation of Campbell's Hero Journey [Campbell 2008] exclusively for interactive storytelling and show how this model can be used in an educational context using serious games.

Following, [Adams et al. 2012] stated that the narrative hypothesis deals with how a story or narrative element can impact on learning outcomes, suggesting that when considering learning from texts, if the information is in a narrative genre style, it is better learned and retained than the information from an expository or descriptive text [Landers et al. 2017]. Although this narrative view is restricted to text literature, it provides insights into how the narrative element can be applied to improve the learning.

Next, the theory of gamified learning [Landers 2014] presented a model in which game elements could be used in isolation or in limited combination, to gamify the instructional process aiming to improve learning. Each game element should be linked to specific behavioral, motivational or attitudinal outcomes that connect with learning outcomes, in order to make gamification in education effective [Landers et al. 2017].

[Chauvin et al. 2015] presented a study directed to supporting player-triggered narrative processes in game emergent narratives, working with methods such as procedural content generation [Togelius et al. 2011, Hendrikx et al. 2013] to increase the number of possible situations the player encounters. Although it is focused towards games that are not educational and do not deal with gamification, the aspects covered by the study (*i.e.,* support the generation of emergent narrative using "Interpretation Engines" and Procedural Content Generation techniques) can point to a practical way to use narratives for gamification in educational environments.

Finally, [Toda et al. 2019b] designed an approach to identify gamification patterns using Association Rule Mining (ARM), by applying surveys of people who play games and analysing their preferences. Although showing interesting initial results, the authors do not specifically explore in-depth the concepts of Narrative or Storytelling, and instead look into the genders' influence over general gamification patterns.

Concluding, there are no studies, to the best of our knowledge, which focus on designing and applying the concepts of Narrative and Storytelling to gamified systems through a data-driven approach. This gap shows that it is important to conduct deeper studies and analyses into this area, especially since it can potentially contribute to increase the student motivation in the learning process.

3. Methods and Tools

To conduct our study, we replicated the methods used in [Toda et al. 2019b], which consisted of three phases: Data collection, Analysis and Summary.The first phase consists in applying a survey designed in [Toda et al. 2019a] asking which are the game ele-

ments (N = 21 game elements) most preferred by students[1]. To recruit users, we used social networks. In total, we obtained 430 answers. To verify the reliability of the questionnaire, we applied Cronbach's alpha and obtained $\alpha = 0.81$ (high reliability) [Tavakol and Dennick 2011].

This population is composed of Brazillian individuals, where 347 consider themselves as males, 80 females, 1 agender, 1 non-binary and 1 transgender. The average age is 26.9 years (SD = 8.2), with most individuals between 15 - 34 years (82.6%). This population has an experience in playing games of approximately 17.9 years (with relatively high variance, SD = 7) and play an average of 16.6 hours per week (with very high variance, SD = 17.2). This population also prefer RPG genre (43.3%) and single player games (68.4%).

Secondly, we analysed the data through Association Rule Mining (ARM) [Manimaran and Velmurugan 2015a], which is a method to discover patterns within data based on the frequency of the items. ARM uses the support (frequency) of an item in the dataset, and creates rules based on logical sentences (*e.g.*, $A \rightarrow B$) [Agrawal et al. 1993]. These rules are measured through their *confidence* and *lift* [Manimaran and Velmurugan 2015b]. To conduct the analyses and report we analyse rules focused on Narrative and Storytelling with high confidence (> 0.8) and lift (1.5). These analyses were made in R version 3.4.3 with packages *arules* and *arulesviz*. After extracting the rules, we evaluated and analysed them with specialists in the field of gamification and aimed at creating the recommendations in a way that could be understood by teachers and instructors.

4. Results and Discussion

This section introduces and interprets the results. First, when we analysed the element of Narrative, we found a total of 43 rules (Table 1) [2] that met the predefined conditions, as can be seen in Figure 1. As per Table 1, we identified the following: *i)* users who consider the elements of Cooperation, Objectives and Storytelling as totally important will prefer the element of Narrative with the same intensity. This suggests that, in an educational context, the gamified content should be presented with clear objectives and description (as in Storytelling) and their tasks should be able to be carried out cooperatively. As a result of this instructional design, the students would also look for their liberty of choice, constructing their own way (as in Narrative); *ii)* other association rule grouped Puzzles, Stats and Storytelling with the same importance as Narrative (=5). This suggests that students who favour Narrative associated with Storytelling also expect mental challenges (Puzzles) and real time inputs (Stats). In instructional design terms, this means that the content should be presented in a challenging way, with a subjective purpose (such as via a story), with clear information about the steps and a logical myriad of options and paths the student could choose to finish the task; *iii)* the group composed by Puzzle, Sensation and Storytelling indicates that the students could benefit from instructional design based on a story that should be told in a certain way to evoke sensations and experiences, while maintaining the challenge and logical order of events coming from the students' choices;

[1]The survey uses a Likert scale [Tavakol and Dennick 2011] from 1 (where they do not think the game element is important to them) to 5 (where they think the element is really important to them). More details can be seen in [Toda et al. 2019a].

[2]The Consequent Rules - right-hand-side (RHS) - are, in all cases, Narrative=5.

iv) the group formed by Progression, Puzzles and Storytelling is similar to the previous one, but these students favour their sense of advancing in detriment of their subjective sensations; and *v)* the group composed by Objectives, Puzzles, Sensation and Storytelling expands the previous analysis and provides us with a possible cause for the uncertain improvement we gain with the use of exclusively structural elements in gamified educational systems. By bringing together the elements of Objectives and Puzzles (structure) with Sensation and Storytelling (content), associated with Narrative, we can infer that students, while wishing to have mental challenges and clear goals to follow, want to feel themselves sensorially and mentally immersed in the task; *vi)* the group composed by Progression, Objectives, Puzzles and Storytelling show us that even in the case in which the students' preference lays with structural game elements (Progression, Objectives and Puzzles), the addition of Storytelling associated with Narrative is equally important in the tailoring of the activity, for a better result.

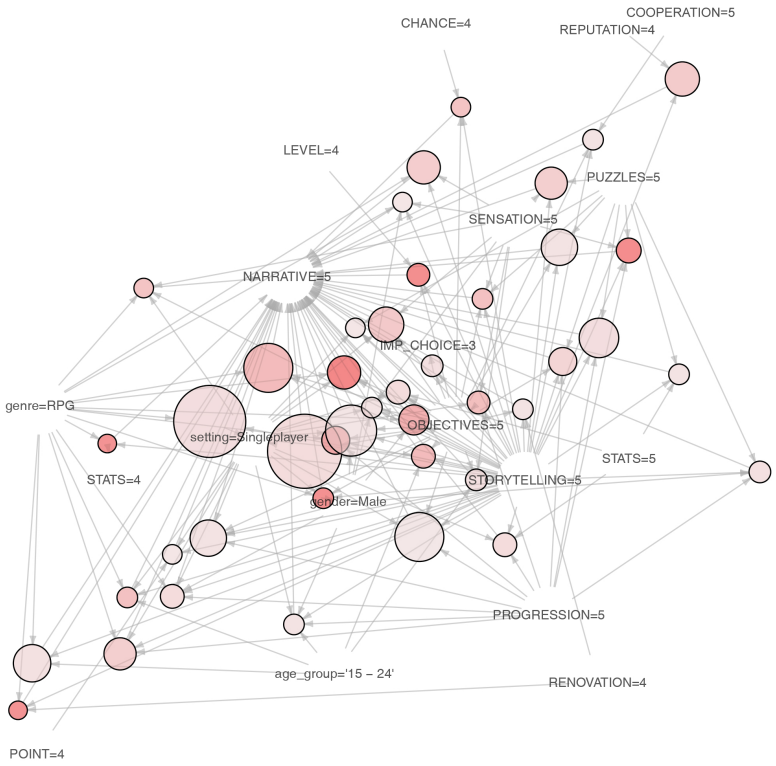

Figure 1. Graph for 43 Narrative Rules

The same process was done with the Storytelling element, where we found 66 rules (Table 2)[3], using the same predefined conditions, as can be seen in Figure 2. From this, we can infer that: *i)* The elements of Rarity and Narrative are tied with Storytelling, suggesting that in educational contexts, the tasks should have some kind of collectible reward related to how the students solve the task and the story/content to be learned; *ii)* another group composed by Progression, Rarity and Narrative, associated with Storytelling, suggests an instructional design based on the previous analysis, but with the addition of the Progression element (*e.g.*, letting the students know where they are in the content; how much they progressed on the task at hand; and how much they still have

[3]The Consequent Rules - right-hand-side (RHS) - are, in all cases, Storytelling=5.

Table 1. RHS Narrative Rules

Antecedent Rules - left-hand-side (LHS)	Sup.	Conf.	Lift
{REPUTATION=4,STORYTELLING=5}	0.13	0.95	1.52
{COOPERATION=5,OBJECTIVES=5,STORYTELLING=5}	0.10	0.93	1.50
{OBJECTIVES=5,CHANCE=4,STORYTELLING=5}	0.10	0.95	1.53
{setting=Singleplayer,POINT=4,STORYTELLING=5}	0.10	0.93	1.50
{PUZZLES=5,STATS=5,STORYTELLING=5}	0.10	0.93	1.50
{OBJECTIVES=5,PUZZLES=5,STORYTELLING=5}	0.13	0.93	1.50
{PUZZLES=5,sensation=5,STORYTELLING=5}	0.13	0.94	1.52
{PROGRESSION=5,PUZZLES=5,STORYTELLING=5}	0.14	0.94	1.50
{genre=RPG,STATS=4,STORYTELLING=5}	0.10	0.97	1.56
{LEVEL=4,OBJECTIVES=5,STORYTELLING=5}	0.10	0.97	1.57
{genre=RPG,RENOVATION=4,STORYTELLING=5}	0.10	0.97	1.56
{RENOVATION=4,OBJECTIVES=5,STORYTELLING=5}	0.10	0.93	1.50
{OBJECTIVES=5,IMP_CHOICE=3,STORYTELLING=5}	0.10	0.93	1.50
{age_group='15 - 24',genre=RPG,STORYTELLING=5}	0.14	0.93	1.50
{genre=RPG,OBJECTIVES=5,STORYTELLING=5}	0.16	0.96	1.54
{genre=RPG,sensation=5,STORYTELLING=5}	0.13	0.95	1.52
{genre=RPG,setting=Singleplayer,STORYTELLING=5}	0.21	0.94	1.50
{setting=Singleplayer,OBJECTIVES=5,STORYTELLING=5}	0.22	0.94	1.51
{OBJECTIVES=5,PUZZLES=5,sensation=5,STORYTELLING=5}	0.10	0.95	1.53
{PROGRESSION=5,OBJECTIVES=5,PUZZLES=5,STORYTELLING=5}	0.12	0.94	1.51
{setting=Singleplayer,OBJECTIVES=5,PUZZLES=5,STORYTELLING=5}	0.10	0.93	1.50
{PROGRESSION=5,PUZZLES=5,sensation=5,STORYTELLING=5}	0.11	0.98	1.57
{gender=Male,PROGRESSION=5,PUZZLES=5,STORYTELLING=5}	0.10	0.93	1.50
{setting=Singleplayer,OBJECTIVES=5,STATS=5,STORYTELLING=5}	0.11	0.94	1.51
{setting=Singleplayer,PROGRESSION=5,STATS=5,STORYTELLING=5}	0.11	0.94	1.51
{age_group='15 - 24',genre=RPG,setting=Singleplayer,STORYTELLING=5}	0.10	0.95	1.53
{genre=RPG,PROGRESSION=5,OBJECTIVES=5,STORYTELLING=5}	0.12	0.96	1.54
{genre=RPG,setting=Singleplayer,OBJECTIVES=5,STORYTELLING=5}	0.13	0.98	1.57
{gender=Male,genre=RPG,OBJECTIVES=5,STORYTELLING=5}	0.12	0.96	1.54
{genre=RPG,setting=Singleplayer,sensation=5,STORYTELLING=5}	0.10	0.95	1.53
{gender=Male,genre=RPG,sensation=5,STORYTELLING=5}	0.10	0.93	1.50
{genre=RPG,setting=Singleplayer,PROGRESSION=5,STORYTELLING=5}	0.13	0.94	1.52
{age_group='15 - 24',OBJECTIVES=5,sensation=5,STORYTELLING=5}	0.10	0.93	1.50
{age_group='15 - 24',setting=Singleplayer,OBJECTIVES=5,STORYTELLING=5}	0.11	0.96	1.54
{setting=Singleplayer,OBJECTIVES=5,sensation=5,STORYTELLING=5}	0.13	0.95	1.52
{setting=Singleplayer,PROGRESSION=5,OBJECTIVES=5,STORYTELLING=5}	0.16	0.93	1.50
{gender=Male,setting=Singleplayer,OBJECTIVES=5,STORYTELLING=5}	0.17	0.93	1.50
{gender=Male,genre=RPG,setting=Singleplayer,OBJECTIVES=5,STORYTELLING=5}	0.10	0.97	1.56
{gender=Male,genre=RPG,setting=Singleplayer,PROGRESSION=5,STORYTELLING=5}	0.11	0.94	1.51
{gender=Male,age_group='15 - 24',setting=Singleplayer,PROGRESSION=5,STORYTELLING=5}	0.10	0.93	1.50
{setting=Singleplayer,PROGRESSION=5,OBJECTIVES=5,sensation=5,STORYTELLING=5}	0.10	0.95	1.53
{gender=Male,setting=Singleplayer,OBJECTIVES=5,sensation=5,STORYTELLING=5}	0.10	0.93	1.50
{gender=Male,setting=Singleplayer,PROGRESSION=5,OBJECTIVES=5,STORYTELLING=5}	0.13	0.93	1.50

to do to finish it); *iii)* the group formed by Cooperation, Objectives and Narrative, associated with Storytelling, can be analysed in the same way as the first analysis on the Table 1's information; moreover, its existence shows that the relation between Narrative and Storytelling is bi-directional (*e.g.*, people who like Narrative also like Storytelling and vice-versa); *iv)* the group composed of Progression, Objectives, Novelty and Narrative adds a new element as a preference, suggesting that users would like the content to be updated and fresh, in order to hold their interest; and *v)* the group formed by Level, Objectives, Sensation and Narrative adds for the first time the Level element, meaning that content and structural elements can co-exist in harmony in gamified educational systems. People from these group favours clear goals and a measure of hierarchical layers present in the environment, as well as the content to be presented inside a context, arising sensations and, consequently, meaning.

Other more general insights include the fact that Time Pressure is not considered important by these users, that they favours the RPG game genre and that most of them are males and between 15-24 years old. These are demographic information relevant to plan future instructional designs. In short, whilst different people have different preferences,

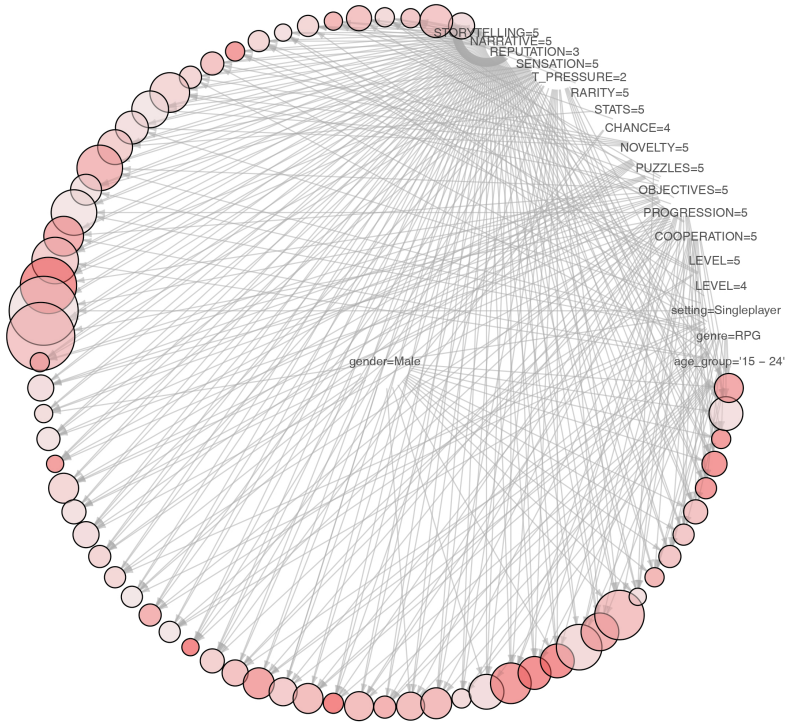

Figure 2. Graph for the 66 Storytelling Rules

it possible to identify and cluster these groups to ultimately tailor an educational system to suit these varied tastes. This is one of the reasons why it is necessary to deepen the studies in the recent field of data-driven education, as through this approach it is possible to reach a higher level of specificity and depth regarding these personal preferences of each student.

As far as the technical limitations of this study are concerned, only rules based on two elements and with high limits were considered (since this is a limitation of the ARM algorithm itself). Our sample of students also belongs only to Brazil, and these results have not yet been validated empirically.

5. Conclusions

The purpose of this paper was to analyse the importance of the game elements Narrative and Storytelling for students (represented by the user sample that answered the survey that aimed to collect their game element preferences in educational contexts), as well as the relationships between those elements (as antecedent and consequent) and other game elements, categorised by the taxonomy proposed by [Toda et al. 2019a]. For that, ARM techniques were used, which, within the data-driven approach applied to educational contexts, are quite recent and still need more studies. Our main contribution was to provide insights and strategies to support the design of gamified content educational environments and/or frameworks, based mainly on the strong connection we found between Narrative and Storytelling elements.

For future works we intend to use these strategies to design a narrative gamification framework, focused on the education domain. We intend to test and validate their use in an empirical experiment, in order to provide solid guidelines that could be used in the

Table 2. RHS Storytelling Rules

Antecedent Rules - left-hand-side (LHS)	Sup.	Conf.	Lift
{RARITY=5,NARRATIVE=5}	0.12	0.89	1.52
{T_PRESSURE=2,NARRATIVE=5}	0.13	0.92	1.56
{PROGRESSION=5,RARITY=5,NARRATIVE=5}	0.10	0.91	1.56
{COOPERATION=5,OBJECTIVES=5,NARRATIVE=5}	0.10	0.9	1.52
{COOPERATION=5,sensation=5,NARRATIVE=5}	0.11	0.92	1.57
{OBJECTIVES=5,CHANCE=4,NARRATIVE=5}	0.10	0.93	1.59
{setting=Singleplayer,REPUTATION=3,NARRATIVE=5}	0.10	0.90	1.53
{genre=RPG,LEVEL=4,NARRATIVE=5}	0.1	0.89	1.52
{LEVEL=4,OBJECTIVES=5,NARRATIVE=5}	0.10	0.90	1.53
{LEVEL=4,PROGRESSION=5,NARRATIVE=5}	0.10	0.95	1.62
{genre=RPG,NOVELTY=5,NARRATIVE=5}	0.11	0.92	1.57
{age_group='15 - 24',NOVELTY=5,NARRATIVE=5}	0.11	0.90	1.53
{OBJECTIVES=5,NOVELTY=5,NARRATIVE=5}	0.15	0.90	1.53
{NOVELTY=5,sensation=5,NARRATIVE=5}	0.14	0.88	1.50
{setting=Singleplayer,NOVELTY=5,NARRATIVE=5}	0.13	0.89	1.51
{STATS=5,sensation=5,NARRATIVE=5}	0.14	0.91	1.54
{genre=RPG,OBJECTIVES=5,NARRATIVE=5}	0.16	0.93	1.58
{genre=RPG,sensation=5,NARRATIVE=5}	0.13	0.89	1.51
{genre=RPG,PROGRESSION=5,NARRATIVE=5}	0.167	0.88	1.51
{age_group='15 - 24',OBJECTIVES=5,NARRATIVE=5}	0.15	0.94	1.60
{age_group='15 - 24',sensation=5,NARRATIVE=5}	0.16	0.91	1.55
{OBJECTIVES=5,sensation=5,NARRATIVE=5}	0.19	0.96	1.64
{setting=Singleplayer,OBJECTIVES=5,NARRATIVE=5}	0.22	0.88	1.51
{PROGRESSION=5,sensation=5,NARRATIVE=5}	0.22	0.92	1.56
{OBJECTIVES=5,PUZZLES=5,sensation=5,NARRATIVE=5}	0.10	0.93	1.59
{PROGRESSION=5,OBJECTIVES=5,PUZZLES=5,NARRATIVE=5}	0.12	0.89	1.52
{setting=Singleplayer,OBJECTIVES=5,PUZZLES=5,NARRATIVE=5}	0.10	0.89	1.52
{PROGRESSION=5,PUZZLES=5,sensation=5,NARRATIVE=5}	0.11	0.89	1.51
{OBJECTIVES=5,NOVELTY=5,sensation=5,NARRATIVE=5}	0.1	0.95	1.62
{PROGRESSION=5,OBJECTIVES=5,NOVELTY=5,NARRATIVE=5}	0.13	0.90	1.53
{gender=Male,OBJECTIVES=5,NOVELTY=5,NARRATIVE=5}	0.11	0.89	1.51
{PROGRESSION=5,NOVELTY=5,sensation=5,NARRATIVE=5}	0.12	0.89	1.52
{gender=Male,NOVELTY=5,sensation=5,NARRATIVE=5}	0.11	0.90	1.53
{setting=Singleplayer,PROGRESSION=5,NOVELTY=5,NARRATIVE=5}	0.10	0.90	1.53
{gender=Male,setting=Singleplayer,NOVELTY=5,NARRATIVE=5}	0.10	0.88	1.50
{LEVEL=5,OBJECTIVES=5,sensation=5,NARRATIVE=5}	0.11	0.94	1.59
{setting=Singleplayer,LEVEL=5,OBJECTIVES=5,NARRATIVE=5}	0.10	0.88	1.50
{OBJECTIVES=5,STATS=5,sensation=5,NARRATIVE=5}	0.1	0.97	1.66
{PROGRESSION=5,STATS=5,sensation=5,NARRATIVE=5}	0.11	0.90	1.54
{genre=RPG,PROGRESSION=5,OBJECTIVES=5,NARRATIVE=5}	0.12	0.92	1.57
{genre=RPG,setting=Singleplayer,OBJECTIVES=5,NARRATIVE=5}	0.13	0.95	1.61
{gender=Male,genre=RPG,OBJECTIVES=5,NARRATIVE=5}	0.12	0.91	1.55
{genre=RPG,setting=Singleplayer,PROGRESSION=5,NARRATIVE=5}	0.13	0.93	1.58
{age_group='15 - 24',OBJECTIVES=5,sensation=5,NARRATIVE=5}	0.10	0.97	1.66
{age_group='15 - 24',PROGRESSION=5,OBJECTIVES=5,NARRATIVE=5}	0.12	0.93	1.58
{age_group='15 - 24',setting=Singleplayer,OBJECTIVES=5,NARRATIVE=5}	0.11	0.94	1.59
{gender=Male,age_group='15 - 24',OBJECTIVES=5,NARRATIVE=5}	0.12	0.93	1.58
{age_group='15 - 24',PROGRESSION=5,sensation=5,NARRATIVE=5}	0.13	0.93	1.58
{age_group='15 - 24',setting=Singleplayer,sensation=5,NARRATIVE=5}	0.10	0.9	1.52
{gender=Male,age_group='15 - 24',sensation=5,NARRATIVE=5}	0.14	0.89	1.52
{PROGRESSION=5,OBJECTIVES=5,sensation=5,NARRATIVE=5}	0.15	0.95	1.62
{setting=Singleplayer,OBJECTIVES=5,sensation=5,NARRATIVE=5}	0.13	0.96	1.64
{gender=Male,OBJECTIVES=5,sensation=5,NARRATIVE=5}	0.13	0.96	1.64
{setting=Singleplayer,PROGRESSION=5,OBJECTIVES=5,NARRATIVE=5}	0.16	0.9	1.52
{setting=Singleplayer,PROGRESSION=5,sensation=5,NARRATIVE=5}	0.14	0.94	1.59
{gender=Male,PROGRESSION=5,sensation=5,NARRATIVE=5}	0.17	0.92	1.57
{gender=Male,PROGRESSION=5,OBJECTIVES=5,NOVELTY=5,NARRATIVE=5}	0.1	0.89	1.52
{gender=Male,genre=RPG,setting=Singleplayer,OBJECTIVES=5,NARRATIVE=5}	0.10	0.93	1.59
{gender=Male,genre=RPG,setting=Singleplayer,PROGRESSION=5,NARRATIVE=5}	0.11	0.92	1.56
{gender=Male,age_group='15 - 24',PROGRESSION=5,OBJECTIVES=5,NARRATIVE=5}	0.10	0.92	1.56
{gender=Male,age_group='15 - 24',PROGRESSION=5,sensation=5,NARRATIVE=5}	0.11	0.92	1.57
{setting=Singleplayer,PROGRESSION=5,OBJECTIVES=5,sensation=5,NARRATIVE=5}	0.10	0.95	1.63
{gender=Male,PROGRESSION=5,OBJECTIVES=5,sensation=5,NARRATIVE=5}	0.11	0.96	1.63
{gender=Male,setting=Singleplayer,OBJECTIVES=5,sensation=5,NARRATIVE=5}	0.10	0.95	1.62
{gender=Male,setting=Singleplayer,PROGRESSION=5,OBJECTIVES=5,NARRATIVE=5}	0.13	0.89	1.52
{gender=Male,setting=Singleplayer,PROGRESSION=5,sensation=5,NARRATIVE=5}	0.12	0.94	1.61

instructional design of content-focused gamified educational systems.

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APPENDIX

E

GAMIFICATION JOURNEY: A NOVEL APPROACH FOR CLASSIFYING GAMER TYPES FOR GAMIFIED EDUCATIONAL SYSTEMS.

Gamification Journey: A Novel Approach for Classifying Gamer Types for Gamified Educational Systems

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***Abstract*—Gamification applied to education studies are often related to the student's motivation and performance in specific tasks. However, what stimulates one student does not always have the same result with another one. Thus, some methods were developed to group and identify gamification users preferences, called "gamer types". By identifying the "gamer type" of a user, it is possible to tailor a gamified educational system (GES) to achieve better results. This approach, however, has some limitations, such as the fact that these classifications are based on the behavioral profiles of gamers and that, in order to identify the profile, the process is relatively complex and time-consuming. This paper proposes a new approach in the identification of student' profiles for use in a GES, using Jung's 12 universal archetypes, concepts of the Peirce's Triadic Semiosis, and the Campbell's Hero's Journey. We address these concepts and how it was related in the design process of avatar creation interfaces for a GES focused on the game elements of narrative and storytelling.**

***Keywords*-gamification, archetypes, semiotic, monomyth, educational design**

I. Introduction

Games became part of our routine, evolving fast since its emergence and being found in many areas (including education) with different purposes, deviating from being just simple entertainment systems [1]. In education domains, games have been widely used as a way to engage students and improve the learning process through serious games [2].

The studies on this field brought the emergence of gamification as the process of using game elements outside their main context, aiming at engaging and motivating students in the learning process, as well as improving their experience [3]–[5]. Gamification in education has been widely explored since its emergence, culminating in the development of frameworks to support its planning and deployment [6], [7]. While these frameworks are important to provide guidelines and steps to support the gamification design, the lack of frameworks focused on how to design and apply gamification for education is problematic for this domain. Furthermore, most of these frameworks focus at providing a *one-fits-all* gamification approach containing specific game elements in very different contexts [7]–[9].

Recent research has shown that using gamification may increase the student's motivation, but it can also decrease their motivation, if the student is not interested in the elements being used, or if the gamification design was not well planned [9], [10]. There are studies affirming that people are motivated or demotivated by different game elements according to their "gamer type" [11]–[14]. This need for personalisation comes from human diversity, which makes each person have different tastes, coming from cultural aspects, demographic characteristics, psychological and behavioral characteristics [15]. However the process of identifying the correct "gamer type" is not intuitive and can be intrusive and time-consuming. This may hinder the student's initial motivation to even begin a task.

To address this gap, this paper aims to answer the following research question: **"How can we identify a student's user preference in an educational gamified system in a subtle and fast way?"**. For that we propose an original approach for identifying a gamified educational system (GES) user's preference in a broader and intuitive way. We did not work with the gamer type approach, instead we worked with the 12 Jungian archetypes [16] in order to create an avatar for the student, who would be their representation in an educational system. The student should choose from a series of pictures related to emotional states and personal preferences, and according to their choices the system would present a given avatar based on one of the 12 Jungian archetypes. From this point on, the GES would present the educational content tailored to that initial preference, using the game elements of narrative and storytelling to guide the student in a 'journey for knowledge', based on Campbell's Hero Journey [17].

Jung's archetypes are universal and are used in psychology [16], marketing [18], education [19], design [20], anthropology [17] and social sciences [21]. Their classification is extensive and complex, but by using Peirce's Triadic Semiosis theory and based on Santaella's adaptation of it in Matrices of Language and Thought [22], we broke each archetype in keywords and abstract concepts related to the Firstness and Secondness perceptions. These concepts were used to collect and categorise pictures that should evoke these characteristics. Our tests have demonstrated that this approach is coherent and robust and can be easily replicated in other contexts.

The next section provides the base concepts and the following discusses related works. Then we present the development process of the approach, followed by the dis-

cussion, and the final remarks, with the possible threads and limitations, as well as the conclusion and future works.

II. Background

This section details the three main concepts used on this study: The 12 Jungian's Archetypes, The Hero's Journey and Peirce's Triadic Semiosis.

According to researches [23] based on Jung's original studies [16], there are 12 primary archetypes that represent the range of basic human motivations, and each person tends to have one main archetype that dominates their personality. This is part of Jung's classic psychology theory of the human psyche and postulates that these 12 universal and mythic characters archetypes reside within the collective unconscious [16]. These archetypes are briefly summarised as follows:

1) **The Innocent:** characterized by people with positive outlook and happy personalities, who often try to see the good in the world and looks for the silver lining in every situation. Their goal can be summarized as being happy, and they usually fear being punished for doing something wrong. They are too trusting of others, but are people of faith and open-mindedness.
2) **The Sage:** values ideas above all else. They use wisdom and intelligence in order to understand the world and teach others. They fear being ignorant and can take too much time to come to a decision if they think they do not have enough information. People of The Sage are intelligent, curious and carries great wisdom.
3) **The Explorer:** seek to experience as much of life as possible, fearing getting trapped or being forced to a daily boring routine. They often have a hard time to compromise, but are true to themselves.
4) **The Outlaw:** people who want to overturn what they think is not working. They often fear being powerless and can become obsessed with their own ideals, but they have great ideas and are good inspiring people to join in their tasks.
5) **The Magician:** seek to understand the fundamental meaning of the universe, having a true belief in their ideas. They usually see things in a completely different way to other archetypes and use these perceptions to bring transformative ideas and philosophies to the world. However they can become manipulative or egoistical, and they fear unwanted negative consequences for their actions.
6) **The Hero:** They often believe they have a destiny or a mission they must accomplish. Their main objective is to help others and protect the weak, but they fear being perceived as frightened. They can be arrogant, but also competent and courageous.
7) **The Lover:** seek harmony in life, aiming to be in a relationship with people, work or environment they love. They fear being unwanted or unloved, and they desire to please others can risk them losing their own identity. But they are social people, passionate and diplomatic.
8) **The Jester:** seek to lighten up the world and make others have fun. They fear being perceived as boring by others, and are often frivolous, wasting time and hiding emotions beneath a humorous disguise. But they can see the funny side of everything and are masters of using humor for positive changes.
9) **The Everyman:** dependable and realists, and search for belonging in the world, usually joining many groups and communities in order to find a place they can fit in. Their main goal is to belong (in a broader sense), and they can fear being left out. They are often cynical but also honest and open, pragmatic and realistic.
10) **The Caregiver:** emphatic and compassionate. They fear being considered selfish and seek to help others most of their time. Because of that, they can be exploited by others because of their compassion and generosity.
11) **The Ruler:** seek to create a prosperous community, fearing the chaos and being undermined. They can be authoritarian but also great leaders, bearing a fair share of responsibilities for the others.
12) **The Creator:** create things of enduring value. They fear failing to create something that lasts and are perfectionist people, which often leads them to creative blocks caused by their fear of not being exceptional. Their greatest strength is their creativity and imagination.

These archetypes are also guided by four cardinal orientations, with each group containing three types [16]. These orientations help in understanding one's personality through the lens of the 12 main archetypes, serving as a broader grouping. Each orientation has three archetypes within its group, where the middle archetype has the strongest orientation and the archetypes to its left and right are inside that group but a little more distant from the full orientation. As an example: The Outlaw archetype values much more freedom than the archetypes of the Jester (who is inside the Freedom orientation, but hangs over to the Social orientation) and the Explorer (who is also inside the Freedom orientation, but prizes for the Ego orientation), and so on, as demonstrated by the cardinal wheel on Figure 1.

Jung's studies were used in many areas, one of them being Marketing (as Brand Archetypes) [18], [23], [24]. This area's researches postulate that there is something about the brands people can connect with, having an affinity with them, many times in an unconscious level. In order to help the brands to understand the collective mind of their audience in creating enduring connections, Mark and Pearson [23]

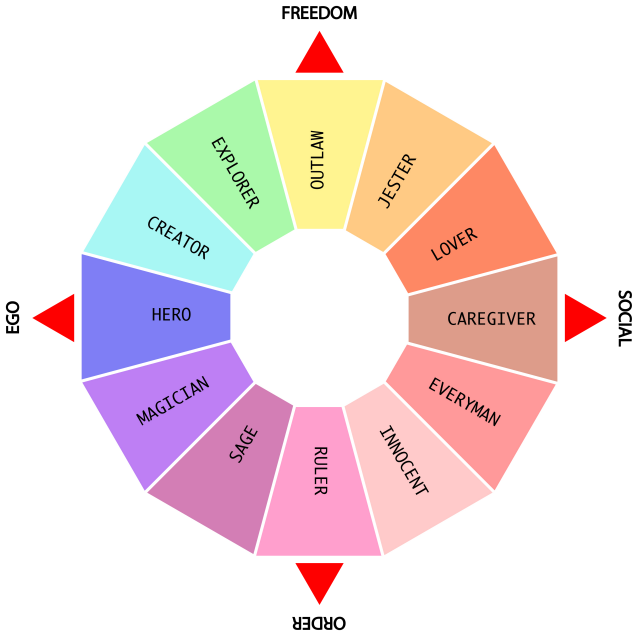

Figure 1. 12 Jung's personalities archetypes diagram [23]

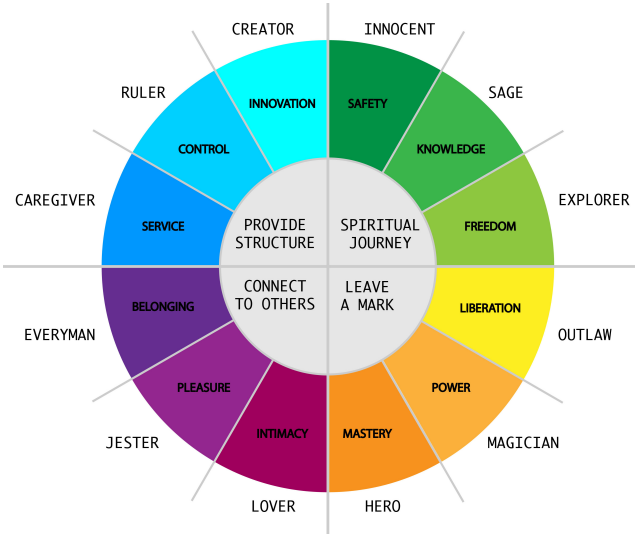

Figure 2. 12 Jung's personalities archetypes human [23]

created a framework. In their model, the 12 archetypes are classified according to four human main drivers: *i)* provide structure, *ii)* spiritual journey, *iii)* leave a mark and *iv)* connect to others, as seen in Figure 2. In their model every person has basic human desires that are instinctive and primitive. Each of his 12 archetypes are then connected to one of these main desires: *i)* The Outlaw wants liberation; *ii)* the Magician seeks power; *iii)* The Hero desires mastery; *iv)* the Lover, intimacy; *v)* the Jester, enjoyment; *vi)* the Everyman wants to belong; *vii)* the Caregiver desires to be of service; *viii)* the Ruler wants to control; *ix)* the Creator seeks innovation; while *x)* the Innocent seeks safety; *xi)* the Sage, understanding and finally *xii)* the Explorer seeks freedom. The archetypes are then divided into broader groups related to the focus of each of these desires. So, people from the archetypes of the Innocent, Sage and Explorer seek an spiritual journey (with different focus); The people from Outlaw, Magician and Hero seek to leave a mark in the world (each with their own way of doing that); people from the Lover, Jester and Everyman wants to connect to others (again, with different reasons and/or focus); and finally, people from the Caregiver, Ruler and Creator (or Artist) seek to provide structure to the world.

In the education domain, Jung's studies were also used since 1978's Mezirow's transformative learning theory, that postulates that the process of perspective transformation has three dimensions *i)* psychological, as in changes in understanding of the self; *ii)* convictional, as in a revision of belief systems and *iii)* behavioral, as in changes in the lifestyle [19], [25]–[27].

> "Transformative learning is the expansion of consciousness through the transformation of basic worldview and specific capacities of the self; transformative learning is facilitated through consciously directed processes such as appreciatively accessing and receiving the symbolic contents of the unconscious and critically analyzing underlying premises [28]".

Based on these archetypes, the monomyth, or the "Hero's Journey", is a template derived from various categories of tales and lore that involves a hero who goes on an adventure, and after dealing with a decisive crisis wins a victory, returning home changed or transformed [17]. Since then, other authors continued studying this universal epic journey, connecting it to a person's daily life struggles, simplifying and signifying Campbell's original 17 steps [21], [29], [30]. Vogler's 12 Steps were developed based on Campbell's study as a script to creating stories (*e.g.* movies, games, comics, books) and is widely used in occidental cinema [21]. For this research, we chose to work with Vogler's 12 steps as it is actually one of the most used and accepted templates in stories creation [31], [32]. Although it is not directly related to the stage of the work described in this paper (*i.e.* the avatars creation based on Jung's archetypes), it is important to establish this relationship at this time, as the fact that our decision to use the Hero's Journey in the presentation of the learning content in the future stages of the work is directly related to the choice of the archetypes at this moment. Because it was based, among other things, on Jung's archetypes, the Hero's Journey becomes a very relevant storytelling template to work with the chosen avatars.

Finally, to support our proposal of letting the users choose their avatar based on their subconscious personality

archetypes, we worked with Peirce's Triadic Semiosis [33]. To the author, sign is something that has a significance, something that is attributed value, meaning the understanding of something, formed through a physical stimulus that generates understanding, happening only through the relationship built between the "I" and the "other/something". Whenever there is attribution of meaning, there is the formation of a sign. Every sign consists of two faces: the sensorial aspect, called *significant* and the understandable aspect, called *meaning*. The harmony between perception and understanding, significant and meaning, results in *significance* [34]. The author classifies the signs in three types: *i)* The icons, that are signs that bear a relation of similarity to what they represent; *ii)* The symbols, that have no relation of similarity or contiguity with the represented thing, being the relation purely conventional. To understand a symbol, it is needed to learn what it means; and *iii)* The indices, that establish an association of one thing or another with an acquired experience.

The triadic theory is related to the way people perceives and interacts with the world, assigning meaning to their perceptions and personal experiences, in a process Peirce called "semiosis", as seen in Figure 3. The Object is the concrete or mental object, while the Representamen constitutes of the signification, the way of representation. Finally the Interpretant is the signified, the meaning a person does of all of it. These three edges defines what is a sign. When the Object and the Representamen are related via similarity we have an icon. When this relationship is by convention, we have a symbol and when it is by factual relation, we have an index. The appearance of a sign is therefore started by the Representamen, which is the trigger for a mental image formed by the Interpretant of the Object, which then becomes the referent of the Representamen sign. However, none of the possible bilateral relations between these elements can produce this specific triadic perspective. For Peirce, a sign can not be decomposed into something more primitive and still retain its meaning [34].

Peirce relates the Firstness to the iconic aspect, the first impression, this being the quality of immediate consciousness as an invisible impression (quality of feeling), un-analysable and fragile. Everything that is immediately present to one's consciousness is all that is in their mind at the present moment. Secondness is related to the indicial aspect, from the point of view of the object, constituting itself in the whole of everyday existence, where it continually comes up against facts considered "external", dealing with obstacles, real and feasible things [33].

According to Santaella, to exist is to be in a relationship, to take a place in the infinite myriad determinations of the universe, to resist and react, to occupy a particular time and space. Wherever there is a phenomenon, there is a quality, that is, its Firstness. But quality is only part of the phenomenon, since in order to exist, quality must be incarnated in matter. The fact of existing (Secondness) lies in this material embodiment. Thus, Secondness is when the subject reads with comprehension and depth of its content [35].

Thirdness is the last concept from the triad and is related to the argumentative or symbolic aspect, that is, the interpretation of the world by a person, corresponding to the layer of "intelligibility," or thought in signs, through which the world is represented and interpreted. [33].

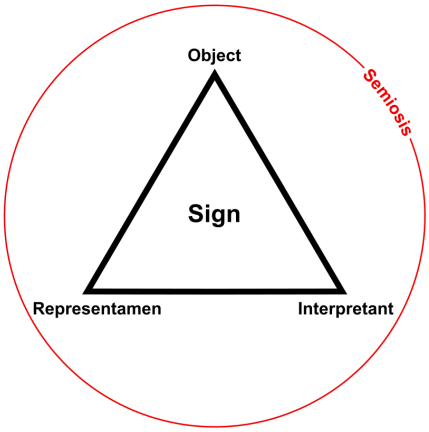

Figure 3. Peirce's Sign Triad [33]

Based on these concepts and definitions we were able to choose images (as signs) that could better represent Jung's 12 universal archetypes in a unconscious way, helping the users to choose their avatars in an intuitive, not intrusive and fast way, as it is described in details in the next section.

III. Related Works

Yee's work identified the correlation between personality traits and the motivations of playing [15], and other researches from the area of personalisation and the "gamer type" approach did the same in different ways [36], such as Bartle's model, which is based on observations of the behavioral characteristics of Multi-User Dungeon (RPG) players [37]; Hexad, a model proposed for use specifically in gamification and that relates the concepts of the Bartle's model with theories of human needs and the experience game design of the author [38]; BrainHex, whose model is based on neurobiological findings that relates players' behavioral characteristics to elements of the nervous system [39] and finally, Yee's own Model, that is based on the motivations of MMORPG (Massive Multiplayer Online Roleplaying Games) players, and also employs concepts from the Bartle model [40].

However, the related work on which this process was inspired was in the interpretation of Peirce's signs by Santaella. Her work assumes that language is formed and processed according to a sign system that resembles the

human way of life. In this way, the language is also subjected to mutations and evolution. To understand how signs are formed and language and meaning combined and mixed, this study establishes three matrices of language and thought: the verbal, which has the property of discourse; the visual; and the sonorous. Each of these matrices have elements categorised in the aspects of Peirce's Firstness, Secondness and Thirdness, in a very similar way to what was done in this work. Every Secondness presupposes a Firstness and every Thirdness the two preceding categories, be they the matrices themselves or their subdivisions. The more we tend to the universe of the Firstness, the more evocative power, because there is less conventionality. The more we move into Thirdness, on the other hand, the less the interpretive possibilities, because there is a code that must be understood in order to determine the object to which the sign refers [22]. This is a purely theoretical research. However we found in it the bases from which categorise the images using the visual matrix and relate them to the user's perceptions, culminating in the avatar's creation.

IV. Development

The purpose of this research was to develop a new approach to the identification of students profiles for use in a GES, relating Jung's 12 universal archetypes, concepts of the Peirce's Triadic Semiosis regarding human perception, and the Campbell's Hero's Journey in the content presentation. The study was designed and executed in five steps following the design thinking methodology as seen in Figure 4 [41]. Next, we describe and introduce how we implemented each step of this methodology:

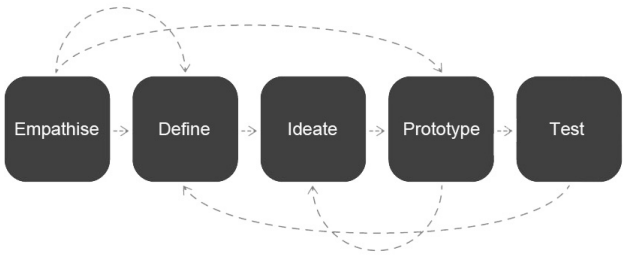

Figure 4. Design Thinking Steps [41]

1) Empathize: The main objective of this step was to understand the problem being worked on, identifying the needs of the target users and the issues surrounding the problem. Our gap was the fact that the existent approaches (such as the "gamer type" ones) for tailoring GES can be intrusive and/or time-consuming (working with materials such as long surveys, for example) and can not address subtle details from a human psyche, being based mostly on studies focusing on gamer's behaviours in certain types of digital games (such as MMO in BrainHex) [39]. As such, we wanted a subtle and bread approach to identify the users preferences in a GES for the creation of their avatars, and our main objective was to devise an intuitive and fast solution that could be as subtle and broad as possible.
2) Define: In this step we defined a set of pillars we would work with: *i)* Jung's 12 universal archetypes [16] would be our avatars, as they represent and categorise in a detailed way the universal human psyche, intrinsic motivations and view of the external world ; *ii)* Peirce's Triadic Theory [33] for choosing the sequence of images that should be chosen in order to generate the avatar of one of Jung's Archetypes; and *iii)* The Hero's Journey [21] for presenting the educational content to the student.
3) Ideate: The main objective of this step was to propose alternative interfaces to explain and illustrate the potential design space. For that we worked with sketches and wireframes to explore and refine our idea. These concepts were based on Buxton's [42] sketches and prototype differences table, as it can be seen on Table I. We created a couple of sketches (Figure 5 and Figure 6) and wireframes[1] (Figure 7 and Figure 8) looking for these alternatives and decided to prototype the following process: The user would be presented with four initial images, each representing in an abstract way (using the concept of Peirce's Firstness) one of the four human main drivers: provide structure, spiritual journey, leave a mark and connect to others. When this first step is concluded, the interfaces closed the other three images and opens up to 3 new images, directly connected to the previously chosen one. Each of these images represents one of the 12 archetypes, in a subtle way. It is expected that the person chooses these images looking only for what pleases them the most. With the avatar chosen, the user is ready for the next step, the materialization of their sensations (or the Secondness). From now on, during their journey through the content, the user is creating his Thirdness view of the world and the educational content.

Table I
Sketches from Prototypes According to Intent [42]

Sketch	Prototype
Invite	Attend
Suggest	Describe
Explore	Refine
Question	Answer
Propose	Test
Provoke	Resolve
Tentative, non committal	Specific Depiction

[1]The process of wireframing is a way to design interfaces at the structural level and is commonly used to sort content and functionality, taking into account the users perspective. They are used to define the basic structure before visual design and content is finally added [43].

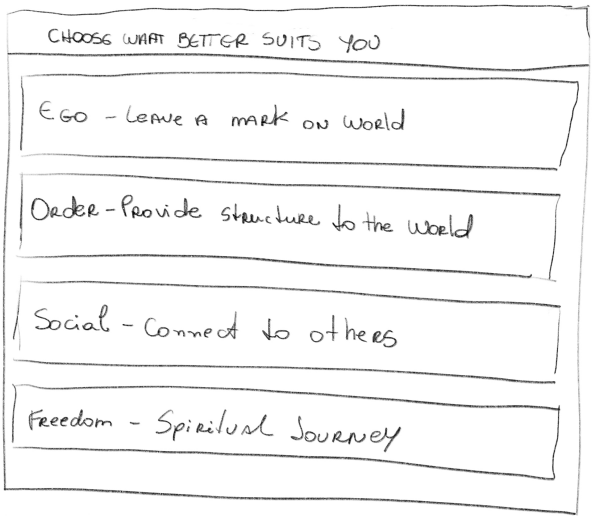

Figure 5. First Interface Sketch

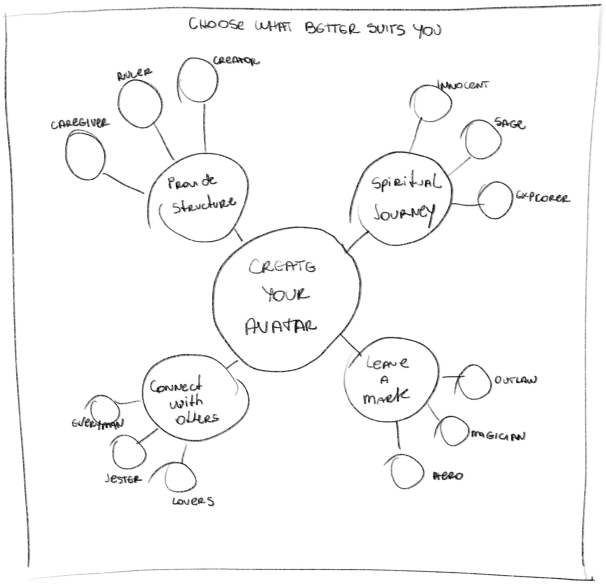

Figure 6. Final Interface Sketch

4) Prototype and evaluation plans: In this step we created a series of mock-ups for the avatar creation screens, as showed on Figure 9 and Figure 10. After that we carried out the implementation of a horizontal high-fidelity prototype [2] of the idea designed in the previous phases. Our evaluation plan was designed with the use of personas [3] as it can be seen on Table II and Table III.

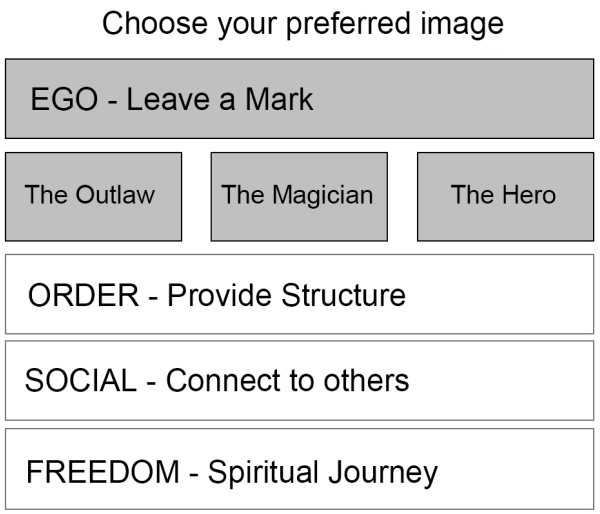

Figure 7. First Interface Wireframe

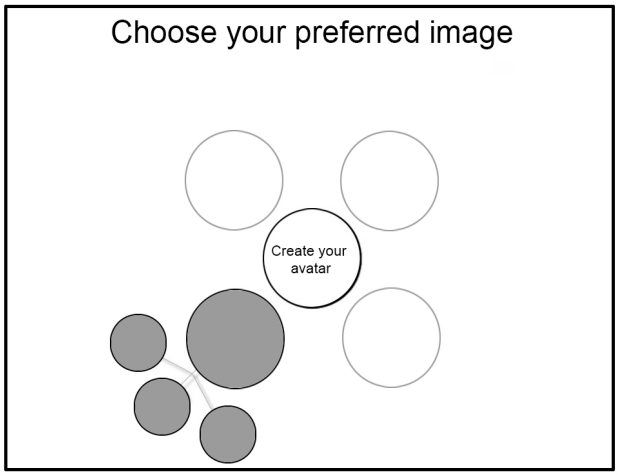

Figure 8. Final Interface Wireframe Choice

5) Test: In this part of the study we executed the evaluation of the horizontal high-fidelity prototype [46] implemented, according to the evaluation plan presented in the previous part, using the persona's technique [43]. Four specialists embodied the role of each of the two personas and sought to interact with the images, making sense of them and interacting

[2]According to Nielsen [44], there are two dimensions of prototypes, the horizontal one that provides a broad view of the entire system or subsystem, focusing on user interaction and low-level system functionality and the horizontal prototype, that is a complete elaboration of a single function or subsystem, being useful to obtain detailed requirements. These dimensions can be of low-fidelity such as wireframes of high-fidelity such as mock-ups.

[3]Personas are fictional characters templates, created based on target users to represent the different user types that might use a service, product, software or brand. Their objective is to help the designers understand the user's experiences, needs, behaviours and goals. According to Nielsen [45], they need to be goal-directed, role-based, engaging and fictional.

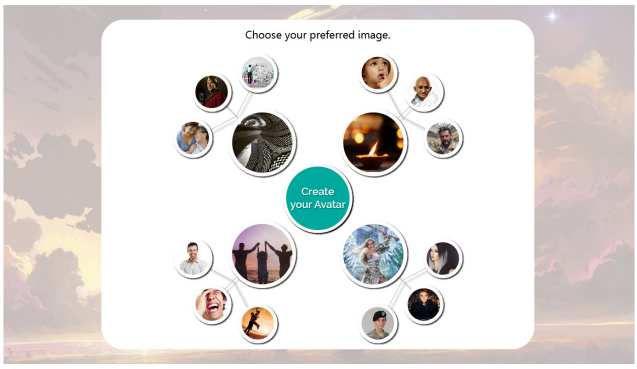

Figure 9. Avatar creation screen mock up

Figure 10. Avatar creation result example mock up

Table II
USER PERSONA - HIGHER EDUCATION STUDENT (NON-GAMER)

SOFIA	
Background	- Sophomore at University - Works part-time in a drugstore - Plays in one university sports team
Demographics	- 20 years old - Female - Makes <$800 a month - Lives in the college city in a kitnet - She is the oldest of three children
Identifiers:	- Unruffled demeanor - Charismatic - Always using her phone in Whatsapp - Very busy, have few time for her hobbies

with the prototype. The reports showed that the gamer user persona found the process much easier then the non-gamer persona. However both persona types understood the tasks and did the process easily and quickly, being satisfied at the end, when the avatar was presented.

V. DISCUSSION

From the notion that the significance derived from the Firstness is abstract, internal and primal, and the Secondness is to materialize the Firstness significance through a real action, we sought to map the concepts related to each of

Table III
USER PERSONA - HIGHER EDUCATION STUDENT (GAMER)

CARLOS	
Background	- first year at University - works as a laboratory assistant and receives a funding - plays League of Legends and other online games
Demographics	- 18 years old - Male - Makes <$500 a month - Lives in the university students dormitory - He is an only child
Identifiers:	- Introvert demeanor - Intelligent and is a good student - Always using his phone to play mobile games - Can separate time to study and to his hobbies very well

Jung's archetypes to these two edges of Peirce's triad. At the moment, we did not work with Thirdness because, being a significance that comes from the personal experience of each one, it would be impracticable to represent it through images (Thirdness enters this process through the final significance that the students themselves make of the set of their choices of images, and is subjective to it).

With these concepts mapped, as shown in Table IV, we sought to gather images related to these moments (from free image banks), working with the Firstness in the first choice (of the four basic intrinsic motivations of the archetypes), and the Secondness in the choice of the own archetype. The idea is that the user could choose in a subjective but effective way, what would be the best approach to study from there. However, one of the limitations of it lies in the fact that because one chooses the images simply for the sake of taste and at that moment, it is possible that the chosen avatar is suitable for that very moment, but in another day it does not make as much sense anymore. This is a serious gap that needs to be better worked on in the future. One of the possible solutions for this lies in the use of adaptive systems, for example.

VI. FINAL REMARKS

The present paper described the process to design a tailored GES avatar creation interface. This is part of a larger project where we developed the prototype of the users first contact with a platform like this and then used Human-Computer Interaction evaluation techniques [43], [47], [48] to validate its proof-of-concept. Our results showed that this approach is feasible and can be implemented in GES. However, due to the limitations already mentioned, this system would need to be adaptative in some way for the experience to be maintained with the same success rating.

As future works we intend to map how the educational content should be presented to the student based on their chosen avatar. In order to do that we are going to work

Table IV
THE 12 ARCHETYPES AND THEIR RELATIONS TO THE SIGN TRIAD (FIRSTNESS AND SECONDNESS)

Archetype	Firstness	Secondness
The Innocent	freedom, happiness and naiveness	aim to do things right and fear doing things wrong
The Sage	wisdom, intelligence and meticulous	aim to find the truth and fear being misled
The Explorer	autonomy, ambition and inner emptiness	aim to experience a fulfilling life and fears conformity
The Outlaw	outrageousness, idealism, radical freedom	aim to overturn what isn't working and fears being powerless
The Magician	make things happen, manipulation, determination	aim to understand the laws of universe and fear negative consequences
The Hero	competence, courage and arrogance	aim to expert mastery in a way that improves the world and fear weakness
The Lover	passion, gratitude, commitment and weak identity	aim to be in a good relationship and fear being alone or unwanted
The Jester	joy, frivolity, playfulness	aim to have a great time and fear being bored
The Everyman	realism, empathy and lack of pretense	aim to belong and fear to be left out
The Caregiver	compassion, generosity and martyrdom	aim to help others and fear ingratitude and selfishness
The Ruler	responsibility, leadership and authoritarism	aim to create a prosperous community and fear chaos
The Creator	creativity, imagination and perfectionism	aim to realise a vision and fear mediocre execution

with the game elements of narrative (*i.e.* "the process in which the user builds his own experience through a given content, exercising their freedom of choice in a given space and period of time, bounded by the system's logic" [49]) and storytelling (*i.e.* the way the story is told, using multimedia resources such as audio, images and texts [49]), based on the Hero's Journey twelve steps [21].

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APPENDIX

F

TEACHING INTERACTIVE FICTION FOR UNDERGRADUATE STUDENTS WITH THE AID OF INFORMATION TECHNOLOGIES: AN EXPERIENCE REPORT.

Teaching Interactive Fiction for Undergraduate Students with the Aid of Information Technologies: An Experience Report

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Abstract. *This paper presents an experience report concerning the use of a platform called "Storium" in the subject of "Interactive Fiction" for undergraduate students, from a Digital Design Course. The objective was to use the learning theories of constructivism and multimedia learning to create an instructional plan devised to teach the students how to create complex interactive narratives and stories from a practical perspective. During the course, the students learned the subject's theoretical concepts and applied them directly, creating their own interactive fiction. The results from this research proposes a new approach, using digital tools whose resources provides an environment for the creation of interactive narratives. These narratives can be used to aid future designs of instructional plans for complex writing concepts.*

1. Introduction

The way stories are told has greatly changed in recent decades, with the advent of the digital environment and the media convergence that followed [Jenkins 2006]. Stories, previously told primarily by voice, writing or drawings, can now be told using a variety of audiovisual resources at the same time, thus making the narrative construction much more complex [Salen et al. 2004]. Since "Interactive Fiction" greatly relies on the narrative element, it is important to describe what the main concepts this practice focused on teaching the students were. The first one is the embedded narrative which is the inserted story in the digital medium (*e.g.,* games and series), that provides meaning and context to the environment [Palomino 2015]. This narrative tends to resemble the typical elements of narrative experiences that traditional media, such as books and movies, often offer [Salen et al. 2004]. The second concept is the emergent narrative configuring itself in the story that is created from the interactive experience of an user with the digital medium (*e.g.* websites, games and interactive stories) [Palomino et al. 2019b].

Audiovisual and interactive narrative are used in movies, series, digital games, websites and apps [Murray 2017]. Traditionally this content is taught through multimedia learning methods [Mayer 2005]. However, given the specificities of the various types of narrative, such as digital and interactive narratives (embedded and emergent; linear and non-linear) [Manovich et al. 2001], [Salen et al. 2004], [Bissell 2011], [Palomino et al. 2019b] it was found that this method alone was not enough for students to internalize knowledge and to apply it in a practical way (e.g., in the creation of such narratives and stories in games) [Rau et al. 2009], [Policarpo and Santaella 2018]. Given

this context, there is a concern on how to prepare students to write for the digital media [Lewis 2007]. This teaching practice experience was inspired by the following question: **"How can we add a level of complexity to writing lessons and still engage students?"**

In this sense, this research proposes a new approach, using digital tools whose resources provided an environment for the real construction of an interactive narrative. Furthermore, we choose the "Interactive Fiction" subject from a Digital Games undergraduate course. Formerly, this subject was taught using multimedia learning resources. Although the students succeeded in the evaluations and theoretical tests (*i.e.* they could define each concepts in words), it was noticed that in the practical tasks, these definitions had not been assimilated correctly. Thus, students were able to repeat the concepts without really understanding and internalizing, being unable to retain that knowledge or even to apply it in practice. Then, we taught the same subject using multimedia learning resources [Mayer 2005] plus direct practical application with the support of Information Technologies (ITs), the platform *Storium*[1]. Storium is a platform that support writing stories through game-like elements and experience [Protagonist Labs]. From novice to professional levels, the platform is a good way to apply the concepts of the subject taught.

The challenge was: how to make students learn and internalize concepts so intrinsic and complex to be viewed separately? **How to train someone to plan an embedded narrative and an emergent narrative in interactive stories?** In addition, this paper exposes the experience gained in this class from the perspective of the lecturer and the participating students. Thus this paper contributes with materials to support courses and lectures that are interested in working in this way.

2. Methods and Materials

This experiment was based on the constructionist learning method, which understands that learning takes place between lecturer and student together, that is, the lecturer is a mediator of the knowledge that the students already have in search of new knowledge, creating conditions for the student to experience situations and interactive activities, in which they will create their new knowledge [Ertmer and Newby 1993].

The research method used was the "action research", which can be understood as a strategy for conducting qualitative and applied scientific research, of a participatory approach, which includes the objective of seeking a collective solution for a specific situation. Action research proposes that the researcher take a collaborative and iterative approach, aiming, together with the participants, to transform their practices and the understanding of life and work situations [Hammond and Wellington 2012].

For a research to be characterized as an action research, there must be an intervention process that is an integral and central part of the research itself, through joint action with the other individuals involved. This method has two objectives: through the research, it promotes the expansion of scientific knowledge; through action, an improvement is promoted for a real problem existing within the environment where this research is carried out [Filippo and Pedrosa 2019].

In the educational area, action research contributes mainly to the improvement of the teaching process by lecturers, based on their research, reflecting on the students'

[1] http://www.storium.com

learning process. Although this method is most commonly used by a group of lecturers, instructors and other members of an educational institution [Filippo and Pedrosa 2019]. For this experiment, guided by the concepts of constructivism, we sought to assign students, in addition to the role of learners, the role of researchers whose construction of knowledge would occur in an iterative and incremental way. Therefore, we aimed to not only teach the students how to plan an embedded narrative and an emergent narrative in interactive stories, but to also create these stories in a collaborative way.

2.1. Participants Profile

In total 27 students were enrolled in the "Interactive Fiction" lecture, 25 male and 2 female, age group of 18 - 28 years, all of the students were in the third semester in the Digital Games undergraduate course at University of Araraquara (UNIARA). These students had experience with storytelling because of the previous lectures of "Script and Storyboard I and II", focusing on Digital Games. The progression of these two disciplines was "Interactive Fiction", whose objective, according to its instructional plan is to enable the student to reflect on the artistic and technical genres (traditional and interactive), debating the nuances of the technological and literary universe. At the end of the lecture, they should be able to elaborate narratives focused on the development of digital games.

2.2. Instructional Plan

This section describes the instructional plan of the subject, the standardized structure for each class (Figure 1) and the lesson plan used (Table 1), with classes being weekly and having 100 minutes each, during a whole semester. The lesson begins with a **theoretical explanation**, followed by a **task** to demonstrate the concept explained in real situations. This task can link the concept to the activities of the IT platform and the examples of students' daily life in an interactive way, leading them to seek their own examples. Then, the second half of the lesson deals with the **discussion of practical activities**, with students' follow-up, discussion of strategies, *etc.*, always connecting with the main topic of the lesson, presented in the theoretical explanation. Finally, it ends with a brief **review and questioning time**, reminding the activities that need to be delivered next week.

Figure 1. Standard structure created for all classes

2.3. The Storium Platform

Storium is a web-based collaborative game. It allows the player to choose from a library of imaginary worlds to play in, or build their own. They can create their story's characters and decide what happens to them [Protagonist Labs]. Storium uses game design elements that are favourable in educational environments, such as avatars, narrative, storytelling, challenges and rewards, etc. [Toda et al. 2019a]. In each Storium game, one player is the narrator, and everyone else takes on the role of a character in the story. The narrator

Table 1. Interactive Fiction Lesson Plan

Lesson	Topic
01	Subject Presentation
02	Brief history: from the literary universe to the technological one
03	Traditional Fiction x Interactive Fiction
04	Narrative x Storytelling (What is the difference?)
05	Narrative in Digital Media - Websites
06	Narrative in Digital Media - Series
07	Narrative in Digital Media - Games
08	First Bimester Test
09	Delivering of results and Test discussion
10	Using flowchart to aid in the narrative construction
11	Character Creation for Interactive Narratives
12	Embedded Narrative - Linear Progression
13	Embedded Narrative - Non Linear Progression
14	Emergent Narrative - The Power of Choice
15	Second Bimester Test
16	Delivering of results and Test discussion

creates dramatic challenges for the other players to overcome. In doing so, they move the story forward in a new direction. Everyone gets their turn at telling the story.

The platform uses the same basic concepts as RPGs (Role-playing Games), where a storyteller tells a story and players interact with scenes and NPCs (non-player characters) to build a shared narrative [Gygax and Arneson 1974]. However, if we analyze it as a platform for creating collaborative stories (*i.e.*, into the very experiment this paper describes), we stop seeing the platform as a game by itself to visualize it as a gamified environment (where game design elements are used in contexts external to it [Kapp 2012]).

2.4. Practical Tasks

The learning theory behind this instructional plan was the constructivism paradigm, which postulates that we learn to do something in doing it - actively building our knowledge, and the environment can act as a facilitator (or an obstacle) [Piaget 1964]. The emphasis on this theory is in the learning process itself, which directly relates to the way in which our memory works: the deeper the information processing, better the retention of knowledge [Craik and Lockhart 1972]. The student is encouraged to explore, discover and experience as long as there is a feedback on their successes and failures. This approach emphasizes the importance of purposeful learning (as opposed to learning forced) or meaning.

The lecturer first designed the world for the interactive fiction to be created, based on one of the imaginary worlds from the platform's own library, and called it "Monster Academy". Then, the students were directed to create their characters inside this world, their own avatars with whom they would create their narratives and collaborative story. The story was organized into three acts and seven scenes, being each scene related to 1-2 of the traditional classes detailed on Table 1.

The scenes were triggered by the lecturer, who described some sort of situation that was happening in the imaginary world. This situation was related to a challenge that the characters needed to overcome. The students then needed to interact with that situation, describing their characters actions, trying to solve the challenge in the most efficient way. The lecturer would intervene wherever needed to guide the scene, but most of the time, the students were free to construct their whole scene. This could end in one of three ways: strong ending, weak ending, and neutral ending. This would be the metric from which the lecturer would then construct the next scene, continuing with the story progression, and so on. As the story narrator, the lecturer thought about the scenes in a way to link the situation to the theoretical concepts they were working on the face-to-face classes.

In this task the students would face the embedded narrative (*i.e.*, the lecturer's scene triggers) and the construction of the emergent narrative (*i.e.* their choices as characters and their strategies). In parallel with the interactive story's construction, the lecturer conducted other practical activities such as the characters origin's story in a solo adventure format [Harrigan and Wardrip-Fruin 2010]. As for the theoretical content, the instructional plan was created using multimedia learning concepts (*i.e.*, learning from words and pictures), assuming that the students should first select the information, then organize and finally integrate it [Mayer 2005]. In order to do that the content was presented as pictures (via slides) and words (via lecturer's presentation).

The students were warned that their grades would be given for their participation in the face-to-face classes and execution of tasks (regardless of performing them in the Storium platform or the other complementary works). The First and Second Bimesters Tests were the surveys to gather the students feedback and evaluate their knowledge assimilation and was not considered for the grade composition. The First Test collected feedback about the Storium tasks so that the lecturer could calibrate the next activities. The Second one was focused on getting the students final feedback of the whole experience.

3. Experience Report

In this section we present the experience reports of the lecturer who led the "Interactive Fiction" class, the report of the participating students and an analysis of the results of the practical tasks performed by them.

3.1. Lecturer's Report

At the end of the course, a face-to-face interview was conducted with the lecturer, to understand how the experience was and analyze the different stages of the instructional plan from the perspective of teaching.

The lecturer reported that it was an excellent experience in which it was possible to share the knowledge between them and the students in an organic and playful way. According to them, the experience was something fun and did not seem like a traditional subject itself. The students seemed engaged in building the story and most of the class actively participated until the end of the activities. Only three students did not get involved and did not meet the deadlines, thus failing in the subject. One student had trouble in writing with his classmates, requiring close supervision of the lecturer to complete

the assignments. In general, the lecturer considers that the classes had a high level of acceptance on the student's side, favoring the understanding of the concepts of embedded narrative and emergent narrative [Salen et al. 2004], through the construction of their own interactive story. Regarding the instructional plan, the lecturer considers that the integration of face-to-face classes focusing on multimedia learning [Mayer 2005], adding to the practical activities carried out at home through the digital platform, was enough to pass theoretical concepts and immediately test and validate the students with the aid of Storium.

One of the greatest challenges encountered by the lecturer was precisely to focus on the didactic aspect of the classes. Since it was widely accepted, and for many students these activities became something they looked forward to as entertainment rather than an educational task, the lecturer had to mediate some of these interactions to maintain the cohesion of the teaching/learning process. According to the lecturer, some students even lost interest in other subjects taught by the same lecturer, for the sake of only learning and talking about this discipline.

When asked about "what topic did the students have the most difficulty in? And Why?" the lecturer replied that it was the understanding of the breadth of students own options on the platform to build their stories and how far they could influence the stories of their peers (*i.e.*, emergent collaborative narrative). And when questioned "Which subject was best understood by students and why?", the lecturer replied that it was the concept of embedded narrative, collaborative writing and character building.

The lecturer also noted that most of the students who didn't like and/or had difficulties with this approach also didn't like and/or understand the core subject. This can be demonstrated by these same students poor performance on the previous related subjects of "Script and Storyboard I and II". Students that had difficulties with the base subjects form their first year on the course continued showing the same problem in the next subject. From this insight, we can infer that this approach was useful to deepen the learning process of those who were already understanding the basic concepts, but was not effective to motivate those who already had difficulties and get them to learn from scratch something they had not understood before.

3.2. Student's report and evaluation

In order to obtain an account of the experience of the students who participated in the "Interactive Fiction" subject, a survey that included the level of satisfaction, learning and difficulty was applied, as well as a group interview. Of the 27 students who were present on the first day, 23 fully succeeded the course, with 4 students doing recovery final exams where only 1 student failed as seen on Figure 2a. Of the total number of students, 78% said they liked it or liked to have participated, while 22% reported feeling lost and because they did not like writing, they did not feel motivated to write so much and preferred fully theoretical classes as seen on Figure 2b.

The students also reported having identified themselves with the created universe and having fun creating the characters and role-playing them to describe their actions. Also concerning the experience, some students complained there were colleagues who, according to them "did not write together and did not worry about all the details of the scene, wearing it down". This vision and behavior generated some misunderstandings

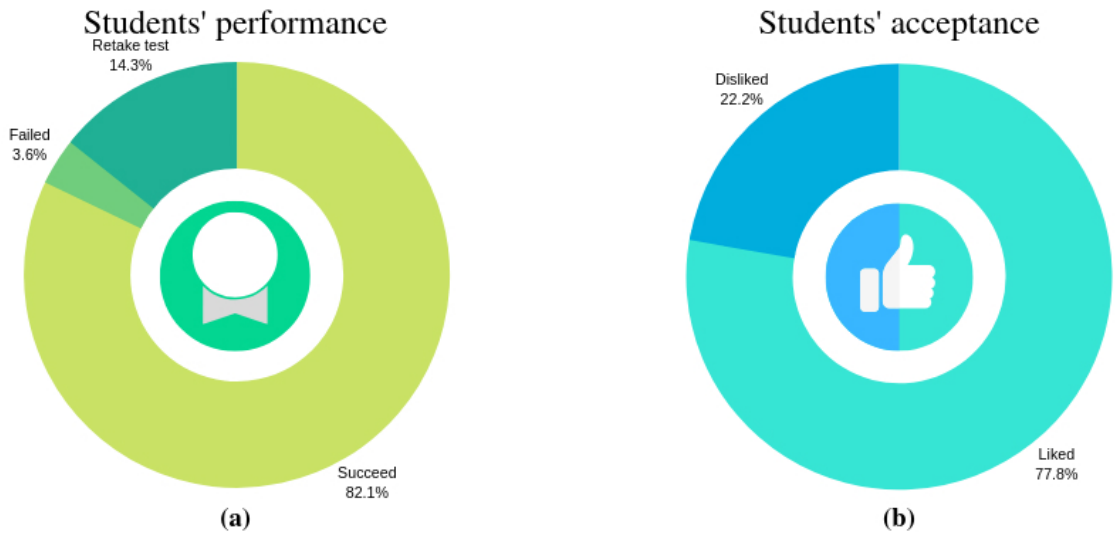

Figure 2. Students success rate on the subject

among the students, and thus needed the lecturer intervention.

In general, the students realized that in order to create a strong narrative, they could use strategy with their colleagues and align their movements on the platform, so that the writing of one would directly support the writing of the next one. Through this behavior the students reported that they were more successful in making their choices and how they would unfold.

Regarding the level of difficulty, 45% of the students reported that the platform could be more intuitive, because they had some difficulty in understanding the mechanics of challenges and cards that the platform offers as support for the construction of the story while 23% of the students reported having had no difficulty with the platform and 10% reported that by the end they had not understood the platform's supporting mechanics. Yet even without their use, they had been able to understand the concepts and build their stories.Besides that 22% of the students reported that they did not like or did not understand the tasks and therefore abandoned the subject, preferring to face a final test before ultimate failing the subject as seen on Figure 3.

4. Conclusion

This paper presented an experience report of an experiment in teaching the "Interactive Fiction" subject for undergraduate students in Digital Games using Storium. In total, 27 students participated in classes for 4 months in the period of one semester.

As a result of this experience, the new class, using the playful and interactive environment, finished the discipline both knowing how to define the concepts (*i.e.*the 'research' part of the action research method used) and knowing how to apply them in practice (*i.e.* the action part of the action research method). Also, the same definitions were deeper than the previous class, attesting that the students were able to internalize the knowledge successfully. However, some problems arisen in the course of the experiment. A few students were completely demotivated, others engaged excessively to the point where they did not want to deal with the other course subjects, and there were some

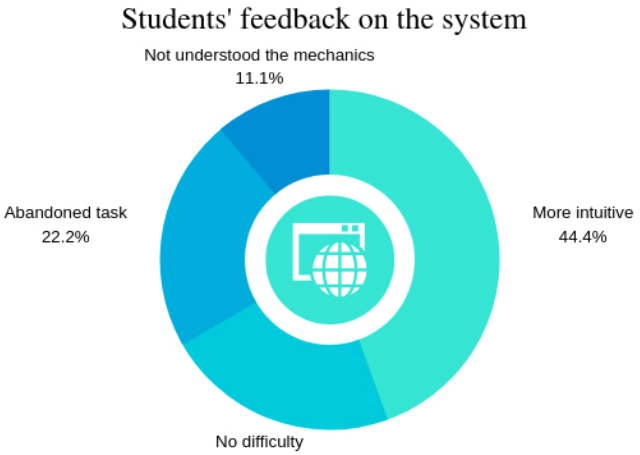

Figure 3. Students feedback regarding the IT use

conflicts between colleagues because of the high level of involvement with the characters and the story (which some authors call gaming the system [Pedro and Isotani 2016]). Because of this, although they were working around problems, the overload on the lecturer became greater than in a traditional classroom. Also, this kind of approach will not work on larger classes, because the content the lecturer needs to read, create, moderate and mediate would be too large.

As future works, we intend to use this experience to create an experiment to validate an instance of a narrative framework of gamification (*i.e.* use of game elements in contexts external to them [Kapp 2012]) applied to educational environments [Palomino et al. 2019a, Toda et al. 2019b], as an aid in the teaching of subjects related to Computer Science undergraduate courses.

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APPENDIX

G

FROM THE LACK OF ENGAGEMENT TO MOTIVATION: GAMIFICATION STRATEGIES TO ENHANCE USERS LEARNING EXPERIENCES.

From the Lack of Engagement to Motivation: Gamification Strategies to Enhance Users Learning Experiences

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***Abstract*—One of the main challenges we face in the educational domain nowadays is the lack of student engagement in traditional teaching methods. One way to address this challenge is through the use of gamification strategies, especially in educational systems. In this paper we address some difficulties and possible solutions to this challenge, discussing high-impact national studies in the area which obtained international recognition, whose strategies together comprise frameworks and guidelines that assist in the development, implementation and evaluation of gamified strategies both from the point of view of the developers, the teachers and the students themselves.**

***Index Terms*—gamification, gamified educational systems, computers and education, students' experience**

I. Introduction

Gamification, defined as "the use of game elements in non-game contexts" [1], is an approach being widely used to engage and motivate users, to perfect or to create a desired behaviour in the learning process, and to improve users' experience in digital systems [2]. In the educational domain, one of the biggest problems educators face nowadays is the students' lack of engagement [3]. This occurs due to the rapid advances in Information Technologies (IT) services that are not assembled or tied to the traditional teaching approaches [4]. Consequently, traditional models are not effective enough to maintain the interest and attention of these students [5]. This situation became even more prominent since the beginning of the COVID-19 pandemic in early 2020, where the traditional educational system had to be quickly migrated to the remote system, bringing a series of new challenges for both teachers, students, and school administrations [6]. In the specific case of Brazil, the problems were emphasized due to the pandemic, since part of the population lack access to internet or technological resources and the teachers also have no training in the use of digital technologies.

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Gamification is an approach used mainly through digital environments, however, it is also possible to apply it in non-technological environments, through the use of unplugged strategies [7]. The application of gamification in education have overall positive results [8], [9]; however some studies show uncertain and negative findings (*e.g.*, demotivation and disengagement) [10], with gamification designs often blamed for these undesired outcomes [11], [12]. Henceforth, the main challenge we pose in this paper is how to increase students' engagement in the learning process through the use of cutting-edge research on gamification design.

Based on recent reviews in the field of gamification in education [13], [14], we summarized some topics that must be addressed in order to implement the best gamified strategies to enhance students' motivation and engagement:

(i) Provide tools to support teachers to design and implement gamification properly (within virtual or unplugged environments);
(ii) Identify and measure the motivation in real time (*i.e.* through the identification of flow states [15], without intrusive methods (*e.g.*, as surveys which can affect the students' experience);
(iii) Understand, design and implement ways to keep the student immerse within the content with the help of the game elements, where their user experience is of utmost importance.

To address these challenges, we propose a connection of multiple research directions that scholars have been exploring recently, which we summarize as follows:

i) Automatically identifying psychological states related to engagement in real time, as well as features that lead to those [16]; with that, *ii)* create personalized contents, through automatic generation, that drive learners towards motivation and engagement [17], [18]; with the goal of *iii)* delivering a clear and effective framework that can be used by any educator, even by those without knowledge in gamification, to create instructional designs [19]; *iv)* featuring gamified contents to be experienced in a subtle way, guiding the students to an enhanced learning process by means of immersive experiences [20].

II. Research Challenges and Direction

There are numerous frameworks and guidelines for gamification design strategies [13]. Some of them, derived directly from the gaming domain, such as the Bartle model, which was created upon observations of behaviour characteristics of Multi-User Dungeon (RPG) players [21]; the MDA framework, which was created in games studies and have not been empirically tested or validated to gamification purposes [22]; the Hexad, which was specifically proposed for use in gamification research and which relates the concepts of Bartle's model with Self-Determination Theory (SDT) [23] and game experience design [24], [25]; and BrainHex, that was based on neurobiological discoveries that relate the behavioural characteristics of players to elements of the nervous system [26] and was recently superseded by the five player traits model [27] after re-analysis of the original data. However, none of these generic approaches encompass educational properties. In this sense, the field of education encompass the concepts of teaching and learning, both adopting different perspectives that involves different characteristics from educators and students. This alone makes gamifying education a challenge, since there are many variables that need to be considered that might affect the students' learning and educators' teaching practices. Recent research in the field of gamified education have presented mixed results on its application [28], [29], which motivated us even more to pursue the best gamified learning experience for students and the best practices to implement it by teachers and educators.

Based on this perspective, the study by Toda *et al.* [30], using data mining techniques, designed a taxonomy of game elements for specific use in gamified educational environments.The differential of this taxonomy lies in the fact that its development was made based on two layers of evidence: *(i)* by the validation of domain experts, considering both aspects of engagement and motivation, as well as learning; and *(ii)* by confirming the importance of these elements, from students perspective, in the design of gamified classroom strategies. Since then, this taxonomy has been used successfully in the development of some Gamified Educational Systems (GES) [31], and is being used in the construction of a framework whose objective is to allow educators, even without specific knowledge in gamification, to create gamified strategies in a simple and practical way for their classes. In this sense, this framework seeks to bring the design of gamified strategies to be more accessible.

Another research pillar is based on the fact that the learning process is fluid and depends on the performance and particularities of each student [32]. Recent systematic reviews show that the gamification design must be adaptable [14], [33] and based on evidence [34]. Gamification works with the concepts of gamer types, where it is possible to personalize the gamified experience by identifying behavioural profiles (usually obtained through surveys). There are currently several classifications, from the previous mentioned Bartle Model [21], to the most recent Hexad [24], [25] and the five Player Traits models [27].

However, most tailoring approaches work with these models as absolute profiles (*i.e.*, if a person is identified with a greater score in the Socializer user type in the Hexad model, they will be presented to a personalized system based on this profile, throughout the whole gamified experience). Human nature, however, is fickle, and when it comes to learning processes, at a given moment a student may be more likely to compete and at another time to collaborate with their colleagues. To address this gap, Palomino *et. al.* [35] developed a new approach called Gamification Journey (GJ), specifically for educational contexts, based on Jung's 12 Archetypes, which is an approach used both in psychology and in several other areas, such as marketing and communication, being the basis for the creation of characters and stories for games, and thus being intrinsically linked to game design, providing several resources for use in gamified strategies.

In the GJ approach, the students begin their learning journey classified into one of these archetypes, that are defined based on an immersive experience at the first login into the gamified system. Through the users' experience on the system, the GES can identify the change in their behaviour and consequently into their initial archetypes, presenting the content in different ways as to adapt to the students pacing and preferences at that moment.

This approach takes into account the use of unconventional game elements, such as Narrative and Storytelling, seeking greater immersion within the learning context [31]. These elements, according to Palomino *et al.* [20] are concerned with both the content and immersive experiences in gamified systems and are defined as the sequence of events that guides the users towards a defined goal, which can be supported by storytelling. These come together with a purpose of meaning, and constant transformation, by establishing a dialogue with the user. In this sense, it is necessary to consider the user experience (UX)[1] and how it can influence the system's tailoring. Through the association of Jung's approach to classifying user types with UX concepts, it is possible to think of interactive systems that suit these desires and perceptions, working with the hedonic qualities of usability (novelty, stimulation, and attractiveness) [37].

[1]That is, the study of practical, experiential, affective, meaningful and valuable aspects of Human-Computer Interaction (HCI) [36].

To seek evidence on the importance of these elements for the learning process, data mining techniques were used, which returned several association rules of great importance between the elements Narrative and Storytelling, and the other elements present in Toda's taxonomy [30]. Considering teaching as an act of communication from the teacher to the student [38], we can conclude why these two specific elements are so important to the education domain.

Still in this research area, it is noted a great focus on the user and little to the learning content [34]. To tackle this gap, Rodrigues *et al.* [18] proposed the personalization of GES based on learning activities types, suggesting specific game elements for each type of learning activities to improve the system's impact on users and, by considering activities' context, contributing to their learning process. The proposal's key point is that almost all personalization approaches demonstrate how to tailor gamified interventions to user characteristics. That is, they provide guidance on which game elements are more suitable for users with characteristics X or Y (e.g., Socializer from Hexad). However, the user is not the only factor impacting gamification's success; the context also does and demands more research [10]. Accordingly, Rodrigues *et al.* [18] expanded the literature with a proposal that, rather than only focusing on users, tailoring gamification to learning activities should be performed with the goal of bringing the context into the personalization process. Hence, complementing user-based approaches and addressing gaps in personalized gamification literature [34].

Finally, another challenge considering all the previous research mentioned, is on the evaluation field (*e.g.*, dealing with the detection of student's level of engagement), so that all tailoring can occur in the best way. Flow is considered to be a state of deep engagement that is closely related to the learning process [15]. However, one of the biggest challenges in this field is the automatic detection of this state, since currently, to identify a person's flow state, it is necessary to answer a survey. The implicit detection of this state can improve not only in the student's immersive experience, but also in the instructional design of educational systems. The research by Oliveira *et al.* [39] proposes a conceptual model that associates student interactions, detected through data logs in educational environments with each flow experience dimensions. Through this model, it is possible to progress towards automatic flow detection in the future.

All of the research presented to tackle the challenges mentioned on this paper can be summarized dealing with the following aspects of gamification applied to education *(i)* Design; *(ii)* Tailoring and *(iii)* Evaluation, and they are intrinsically related to the effectiveness of good gamification strategies to keep students engaged and ensure that they effectively learn.

Based on the studies exposed in this paper, future works can be outlined according to the following principles:

(i) to use data collected in digital educational environments to understand the variables involved in the student's learning process and how they can help improve gamification and the learning process itself;
(ii) to work based on empirical evidence, testing conceptual models and frameworks developed in real educational environments, organizing and analyzing data in order to refine and improve the initial models;
(iii) to consider gamification for educational domain as an experience for the student, being concerned with aspects of user experience (UX) and intrinsic satisfaction, both extremely important for improving learning and;
(iv) to bring the involved stakeholders for an active role within research, testing and validating hypotheses through its expertise and seeking methods to present these frameworks and guidelines in a way that they are understood by all, so that their applicability in practice are accessible to all levels of education.

As for the research follow-up, we intend to monitor the emergence of new approaches to gamification applied to education, as they can help in increasing engagement, through literature reviews; the application of new approaches in order to assess their impact through experiments and; the effect of these approaches on engagement in education, carrying out reviews and meta-analyzes to summarize the results.Additionally, we call researchers to centralize studies in this area in an open repository aiming to facilitate the assessment of progressions.

III. Final Remarks

Brazil is a country with several problems in the area of education [40], that were further accentuated with the current global pandemic of the COVID-19. [6]. Regarding the transition from traditional teaching methods to the digital environment, there is still much to be researched and developed, and gamification in this context is very relevant, as it is one of the forms of engagement most accepted by the younger generations, born after the internet and digital games [41]. This paper presented high impact research in the area of gamification developed by Brazilian researchers, and which have obtained international recognition. All the pillars presented on this paper are related between themselves and together aim to tackle a wider scope related to motivation and engagement problems in education. Each pillar works as a gear, which together seek to provide a complete framework that can be socially useful as it is concerned with everyone involved in the process of gamified classes. As future studies, we intend to connect all these gears through an application ontology, which can be used in the creation of intelligent gamified systems. In addition, it is necessary to validate the different approaches through empirical experiments, so that the processes are refined and adjusted to a stage where, once validated, they can be applied in practice.The results of these studies will possibly bring in the next decade new specific frameworks, systems and guidelines that can effectively be used in classrooms and gamified digital environments.

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