

Introduction¹

Play is a universal human activity that begins from the youngest age as a means to discover and to acquire information on the world that surrounds us. From war trenches to battle simulators (Macedonia, 2002), play becomes a place of simulation, of strategy and skills development without having to deal with the risks of the real world (Hainey and Collab., 2014). Games are observed in different spheres, both private and public, educational and professional. Since Antiquity, various games have been based on the same mechanisms that can mix luck and rules in order to reach a goal in a competitive manner. Indeed, historians have been tracking down games that date back to ancient civilizations from Egypt and Mesopotamia (Flanagan, 2009) and from Indian-American cultures (Culin, 1973).

With the introduction of information and communication technologies (ICT), the development of new digital game modalities has emerged, especially the creation of audiovisual game universes that include different levels of immersion and interactivity, as well as the development of server-based network multiplayer games. With the evolution of the video game field, gamification activities that use video game mechanics in non-recreational contexts were developed in order to improve the user's experience and involvement (Deterding, Sicart, Nacke, O'Hara & Dixon, 2011). Digital games are so popular that the video game industry has become almost as popular as the film industry (Broekhuizen, Lampel & Rietveld, 2013; Kaplan, 2013).

In the last two decades, the use of digital games for learning (DGL) has grown significantly. DGL integrate both serious educational games (SEGs) that were created with pedagogical intents and the use of digital entertainment games in an educational context (i.e., the use of *Minecraft* in architecture or of *Angry Birds* to learn parabolic trajectories in mathematics). The goal of using DGL is to actively engage the learner in a play activity.

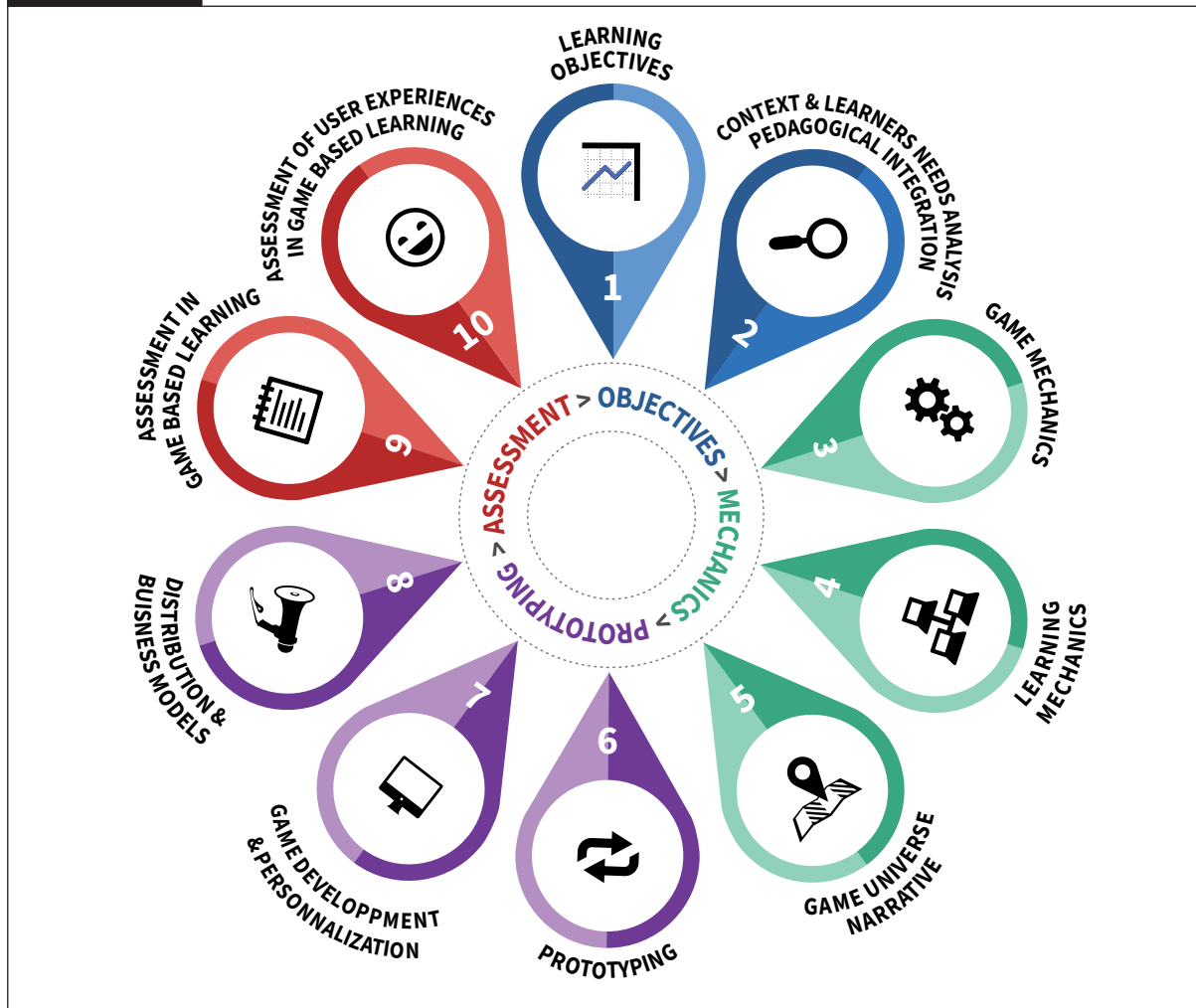
This book will examine various play approaches supported by digital games for learning (DGL): serious educational games (SEGs), the use or the pedagogical modding of digital entertainment games in educational contexts and moreover, educational gamification strategies. This book will also introduce a reflective procedure to create and integrate digital games for learning (DGL). The Asteraceae approach falls into ten steps and was developed within the Games and Learning course (Romero and Lambropoulos, 2015). This approach allows to analyze, design and integrate digital games for learning throughout life.

¹ Margarida Romero and Leslie Dumont, 2016. Edited by Sylvie Barma.

Book structure

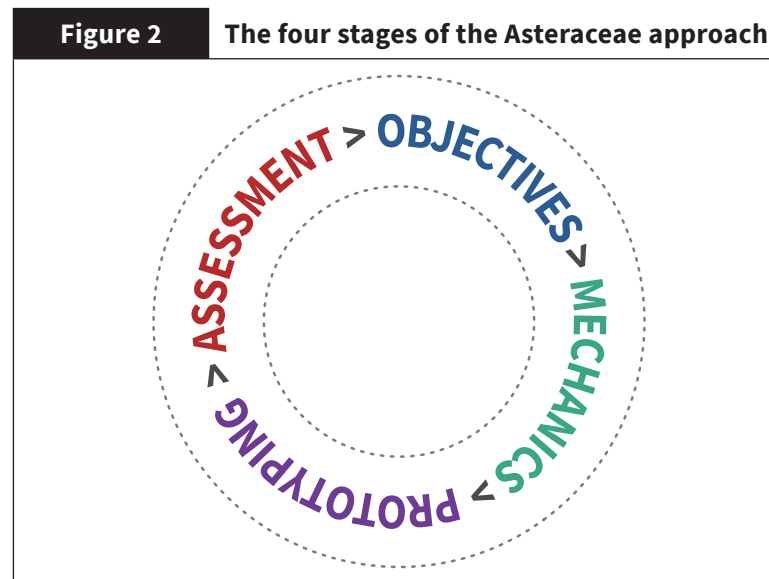
Integrating digital games in education displays a dual challenge: **achieving learning goals** and **making the learning experience playful**. In order to take up these challenges, this book will offer the readers a ten-step approach that will help them choose between different types of digital games, various models of integration in educational contexts and the creation of a new digital game for learning.

Figure 1 Asteraceae approach: Ten steps to integrate Digital Games for Learning (DGL)



The ten steps of the reflexive design procedure are represented on the previous figure through a ten-petal flower. The name of this representation is Asteraceae, which comes from the botanic family of flowers with multiple petals, such as daisies and sunflowers.

The thematic ten-step procedure will allow the reader to develop a full approach of pedagogical reflection that begins with the definition of **the learning goals**, then deals with **the game and learning mechanics**, **prototyping** and ends with **the assessment of the game experience and learning**.



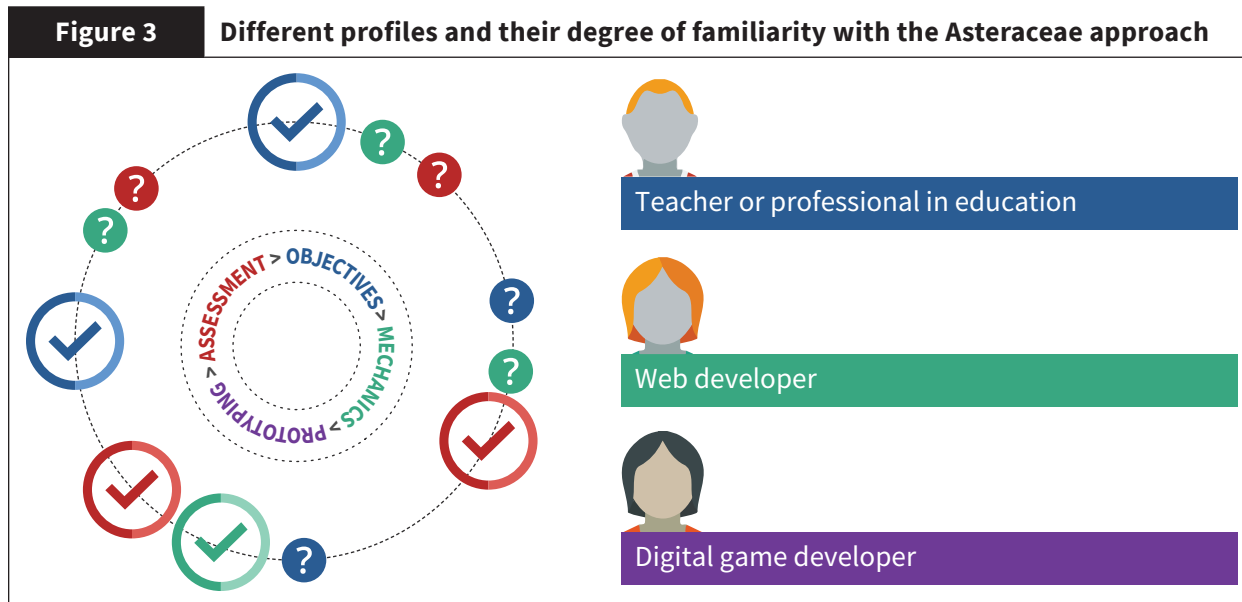
Target audience

This book is made for anyone interested in using digital games in a learning context: digital game professionals (educational or not), parents, teachers and any other educational professional. It also deals with the use of digital games for learning throughout life, from childhood to adulthood, whether in a professional or in an informal context, intergenerational or for a specific age group.

The book will be available for all those who want to get a better understanding of the digital game opportunities when it comes to learning and to developing aptitudes. It does not require any prior knowledge of digital games or education.

According to your profile or prior experience, some content of the book may be more familiar to you. The following figure (3) shows the familiarity degree of three professional profiles within the different phases of the Asteraceae approach.

- If you are a teacher or an educational professional (in blue on the following figure), you will be more familiar with how to define the learning goals (step 1) and with how to assess (step 3); step 2 (game mechanics) and step 3 (prototyping and development) were described in a way that will help you understand them no matter your current level.
- If you are a web/IT developer (in green), you will be more familiar with step 3 that deals with prototyping and development. If you are an IT developer and you already create digital games (in purple), you will probably be also familiar with step 2 (game mechanics).

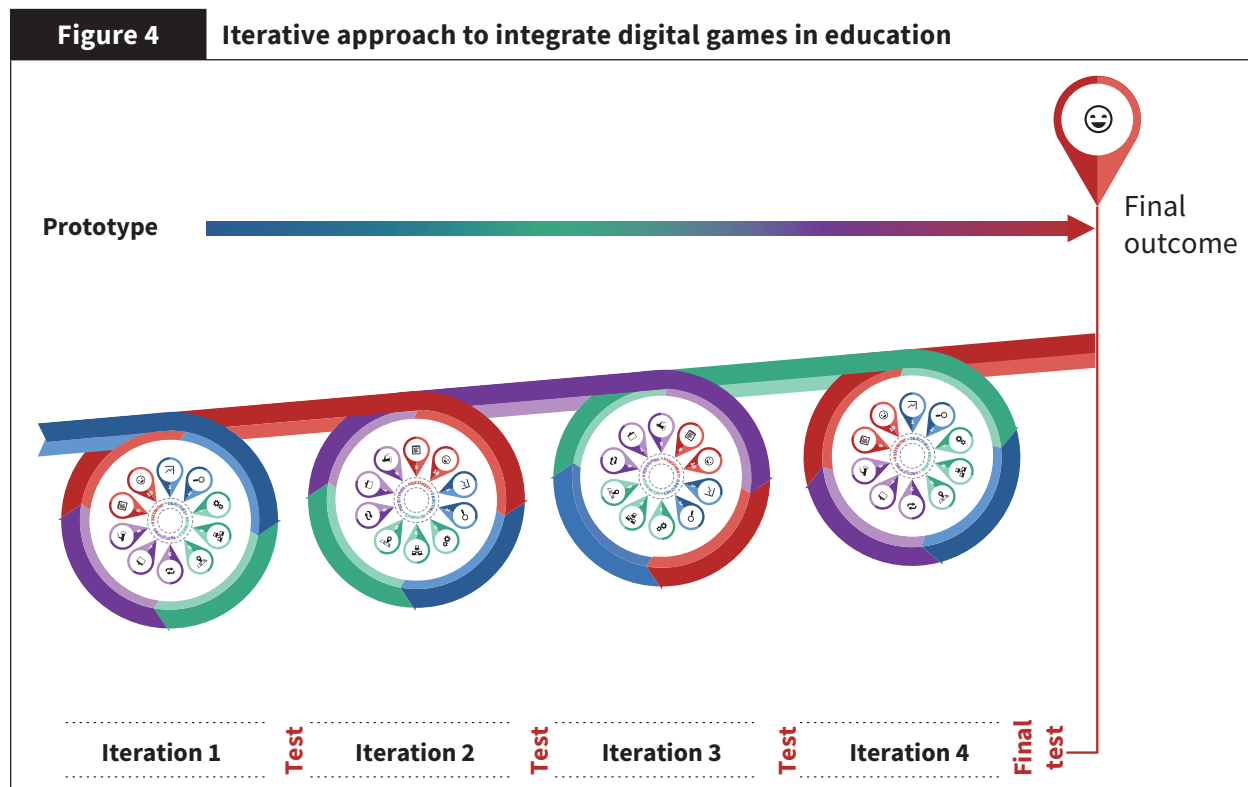


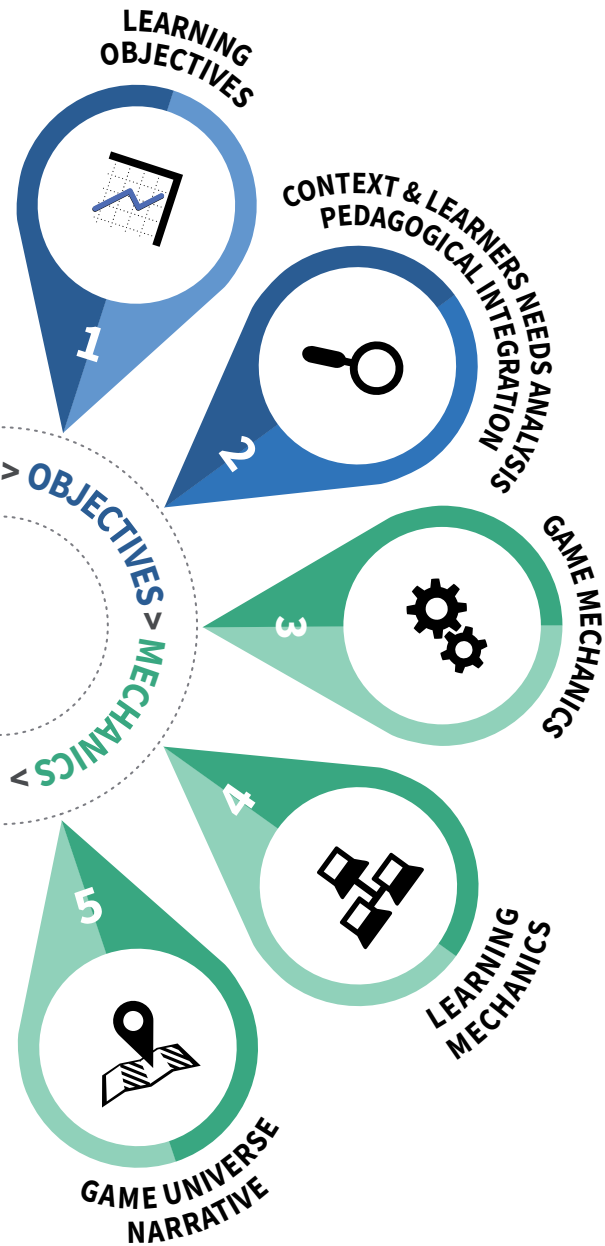
If none of these profiles corresponds to yours, it is possible that your degree of familiarity with the different steps is variable, or perhaps even inexistent. However, this book is also made for you. The glossary you will find at the end of the book has been created to make the approach available for everyone.

Iterative approach to design digital games

To make sure that the digital game corresponds to the goals set, the design teams often follow an iterative design and development approach (Abeele et al., 2012).

This approach helps you go further throughout every element of the game, based on how the different players react and it allows you to go back, if needed, over prior steps in order to improve them, which contributes to putting forward a product that corresponds better to the initial needs and goals.





Step 1. Learning goals. The first chapter begins with the analysis of the opportunities and limits of the game-based learning. It also introduces the disciplinary fields and the 21st century competencies as a framework to identify the **learning goals and to develop skills**.

Step 2. Analyzing the needs and pedagogical integration. Secondly, we will analyze the needs as an approach that will link learning goals, pedagogical integration in learning contexts and the type of games to suggest to your learners.

Step 3. Game mechanics. The third chapter will introduce game mechanics, rules, loops of interaction and retroactions, which support the user's engagement in a qualitative play experience.

Step 4. Learning mechanics. Furthermore, the fourth chapter will bring in the learning mechanics that allow the development of the learning goals and the skills targeted in step 1.

Step 5. Game universe and game narrative. The fifth chapter will deal with the potential of the game universe and narratives in order to engage the learner.

Chapters six to eight will present the specific approaches used to create digital games.

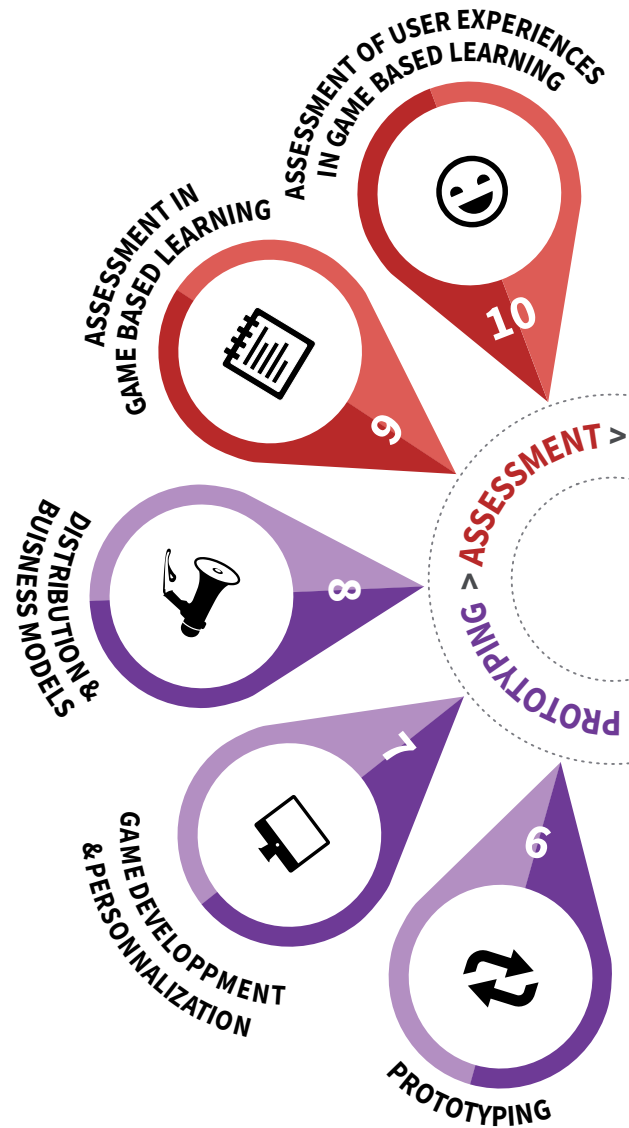
Step 6. Prototyping. Chapter 6 will introduce prototyping techniques to elaborate and to assess the design phase and also a functional prototype.

Step 7. Development. This chapter will deal with the strategies needed to define a development outcome in order to create different versions of the game that will progressively integrate functionalities. It will explain how to customize and adapt it.

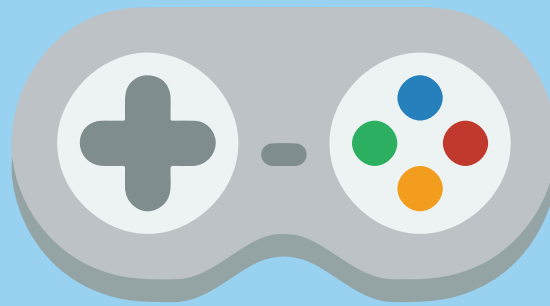
Step 8. Economic and distribution models. The eighth chapter will tackle the different **economic models** of serious games, their dissemination, distribution and essential maintenance for a proper functioning of such products.

Step 9. Assessment and learning transfer. The second to last chapter aims at assessing the learning that was achieved during the digital game, and also the transfer or reinvestment of this learning in other contexts.

Step 10. Assessment of play experience and usability. This chapter will describe the use of digital games for learning (DGL) assessment in terms of play experience and usability.



Game-based learning¹



¹Margarida Romero, 2016. With Leslie Dumont's contribution

Before introducing the ten Asteraceae steps towards integrating the pedagogical use of digital games, this chapter will present the game-based learning as a pedagogical strategy.

Playing, a universal activity before and after the digital era

Playing is one of the most important activities within human development and learning process. It was noted throughout history and different civilizations that playing is a universal human activity (Haight, Wang, Fung, Williams & Mintz, 1999). Humans, and some other animal species, use play as a way to communicate, interact, have fun and develop (Burghardt, 2005). This is how we socialize, either as characters of the game, as audience to the game (i.e., athletes), or as other people or teams. The games we play are part of ourselves, they allow us to grow and learn the common features we humans share: do you prefer *Candy Crush*, *SimCity* or *Warcraft*?

Play is known to be an essential activity in the child's development process from his or her youngest age. There's no doubt when it comes to its educative value during childhood years (Bouchard, Charron, Bigras, Lemay & Landry, 2015; Brooker, Blaise & Edwards, 2014). We have all played when we were kids, and a growing number of people keep on playing as adults and even as elders. Research made in the past few years show that game-based learning is effective for both adults (Pivec & Dziabenko, 2004; Romero, Usart & Ott, 2015) and elders (Charlier, Ott, Remmele & Whitton, 2012).

Among the pedagogical methodologies used in class, game-based learning (GBL) situations combine playful aspects with learning goals. The introduction of information and communication technologies (ICT) made the development of new digital games possible on very diverse supports: from game consoles with or without a controller (i.e., *Microsoft Kinect*) to games with augmented or virtual reality (Barma, Daniel, Bacon, Gingras and Fortin, 2015; Daniel and Barma, 2015).

Currently, digital games offer a large array of game modalities that give the player a lifelong learning. The chapter dedicated to development (step 7: Development and Customization) will present different types of technologies, for both development and educational digital game support.

Play as an activity and game as a device

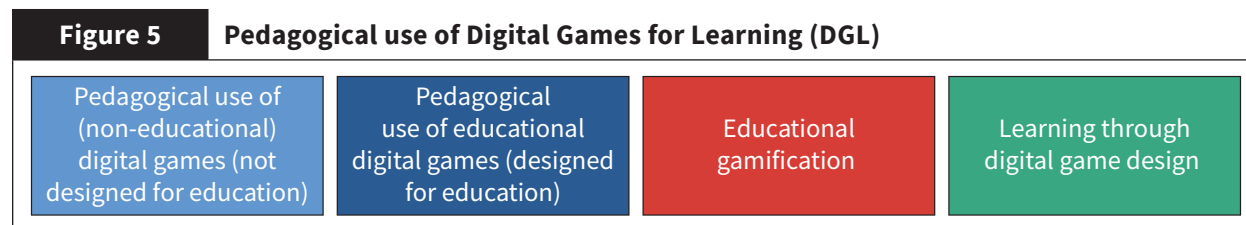
In English, there's a clear difference between a game as an activity (play) and a set of rules to develop the activity of playing (game), as opposed to the French language where there is only one word for both *jeu/jouer*. Playing with dolls or playing an open game such as *SimCity*, is a play activity (play) without any preestablished rules, while *Tic-Tac-Toe* or *Tetris* are designed within a framework of rules (game). According to Prensky (2001), games represent a way to organize the activity of play. Therefore, a game is "an activity in which participants follow prescribed rules that differ from those in real life while trying to reach an ambitious goal" (Heinich, Molenda, Russell & Smaldino, 2002, p. 10).

Digital game-based learning (DGBL) engages the learner in an interaction with a digital artefact that sustains the play action, and which aims at developing the learning goals. This digital artefact sustaining the activity could be a serious game, an entertainment game adapted for educational purposes, or a gamification platform. The latest introduces game mechanics in everyday-life contexts. Their common point is that they all offer a playful game experience to the learner by using digital technologies.

Furthermore, the complexity and diversity of digital game-based learning require an interdisciplinary analysis (Mäyrä, 2009). Indeed, as far as game studies are concerned, digital game-based learning (DGBL) embed computer sciences, human computer interactions (HCI), but also social sciences such as psychology and education sciences. Because of their complexity and diversity, the different phases of a game (from design to game experience) and the different perspectives for each phase: learning, game universe, gameplay and user experience also need to be taken into account.

A broad spectrum of terms around Digital Game-Based Learning (DGBL)

The wide variety of terminology in the digital game-based learning field is a sign that the use of approaches including digital games in education has increased. In this book, we will favor the term of Digital Games for Learning (DGL), adapted from the term Digital Game-Based Learning (DGBL), which tackles a plugged learning process through game. The DGL includes a diversity of pedagogical uses of digital games. The pedagogical use is referred here as a pedagogical use that integrates pedagogical intents through digital technology that withstands the activity of playing.



Among the DGL, we distinguish four types of uses:

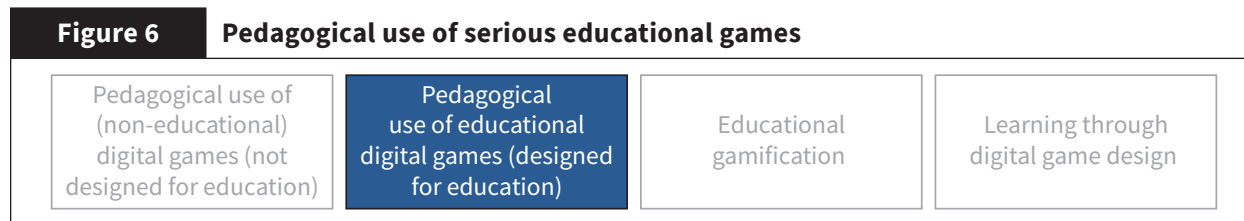
- The pedagogical use of digital games that were not actually conceived for learning or **pedagogical uses of games without any educational intent**, for example, using *MineCraft* to work on mathematical concepts such as solid figures or measurements;
- **The pedagogical use of serious educational games (SEGs)** that were created with a “serious” educational goal;

- **Gamification** in an educational context, which requires the use of game mechanics in non-educational contexts;
- Fourthly; in this case, **the pedagogical purpose is embedded in the interdisciplinary design process of a game as a knowledge shaping process** (Kangas, 2012; Romero and Lambropoulos, 2015).

Serious educational games (SEGs)

Among the four uses of digital games for learning (DGL), we are going to tackle in the following section, the games that are created for learning, also nowadays called, serious educational games (SEGs). According to our educational perspective aiming towards the 21st century curriculum (Dede, 2010), every game considered as “serious” is a potential game for education purposes.

Thus, even though a game is said to be a serious health game, without specifying its educational interest, from an educational perspective and according to the 21st-century skills, a game that aims at improving health is a game that could be used in educational contexts. To make it simple, we consider every single serious game as potentially educational. In this book, the terms of serious games and serious educational games will be used in an indistinct manner to name all digital games that were conceived to reach goals that are said to be *serious*.

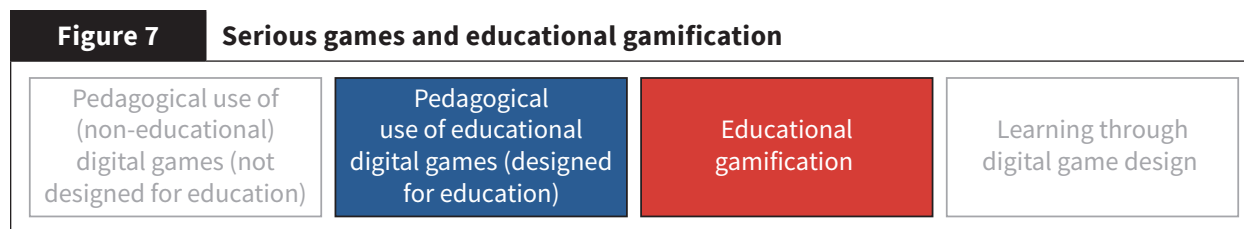


Within the concept of “serious games”, the term “serious” is sometimes based on the need to emphasize the useful nature of playing for grown-up learners. In our culture, playing is well approved during childhood; it is considered as an essential activity in the child’s development, but it is often perceived as a hobby or as a waste of precious time when it comes to games for grown-ups (Mackereth and Anderson, 2000). Throughout the past few years, writers, editors and researchers in the game-based learning field have implemented the term “serious game” to underline the serious nature of a game and its impact on learning goals, health and professional development, as well as in other fields considered by adults as profitable. Berry (2011, p. 2) defines serious games as “playful visual products for education”. Serious

games balance both a playful visual and a useful dimension (Alvarez & Djaouti, 2008). They “allow users to interact with a computer application whose goal is to associate teaching, learning, and training aspects, as well as elements of communication and information; all of these features within the playful field of video games. Such an association results in a playful (game) approach within a useful context (serious)” (Michaud & Alvarez, 2008, p. 11). Serious games allow to develop playful learning situations related to disciplinary fields and to 21st-century skills such as collaboration, problem solving and creativity (Barma, Power & Daniel, 2010; Connolly, Boyle, MacArthur, Hailey & Boyle, 2012; Romero, Usart & Ott, 2014).

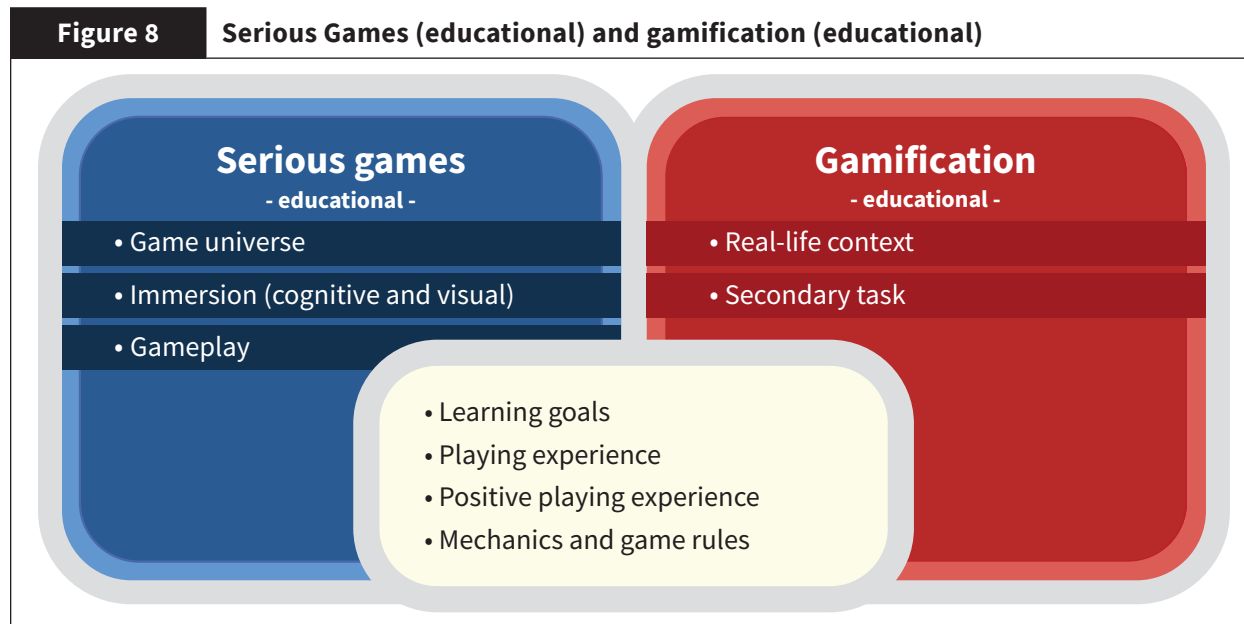
Differences between gamification and serious educational games (SEGs)

There are different ways of using games for educational purposes. This section will deal with the differences between serious games and educational gamification.



The various types of game-based learning activities integrate serious games designed for educational goals or gamification: using game elements in contexts that are different from game contexts (Deterding, Dixon, Khaled & Nacke, 2011).

The following figure represents the elements shared by digital games for education. All of the games used for educational purposes (serious games and gamification) are linked to learning goals, user’s game experience, positive learning experience and to the use of game mechanics and rules. This figure also shows the main difference between serious educational games that embed a game universe and offer a certain cognitive and visual immersion, and gamification experience, which integrates the game components as secondary tasks in real-life contexts.



Is digital game-based learning effective?

Serious educational games (SEGs) are educational technologies designed to put together the advantages of the games, such as engagement, immersion and simulation, while achieving learning goals and developing skills, such as problem solving and decision-making (Kirriemuir and McFarlane, 2004) in a safe environment that allows several degrees of realism (Leemkuil, de Jong, de Hoog and Christoph, 2003) and maintains the learner’s engagement in the learning activities (Romero, 2012).

Among the educational advantages of SEGs, Barma, Power and Daniel (2010, p. 2) report on the impact serious games have on the young people development of “complex cognitive skills, such as the capacity to invent various scenarios or to discuss over investigation approaches needed in order to solve an important problem”.

However, despite researchers’ various initiatives and their growing interest in the serious educational game field in the past few years (Connolly and collaborators, 2012, Crookall, 2010), the regular use of SEGs in educational contexts remains exceptional in most educational contexts of many countries, in spite of ICT growing accessibility in the education sectors (Cuban, Kirkpatrick and Peck, 2001).