

## How to create a serious game?

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### Abstract

Serious games are video games designed to achieve an educational effect and achieve some degree of training in a certain area. They are nowadays used in industries such as defense, education, scientific exploration, health care, emergency management, city planning, engineering, and many others. As it still a nascent subject who doesn't follow exactly the same rules and practices than the commercial video games industry, questions remain about how to create and use serious games. This article presents some know-how on the subject of creating serious games.

**Keywords:** design cycle, game based learning, game design, serious games.

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## 1. The concept of serious games

### 1.1. Definition

There are many different existing terms floating around to define the concept of a game designed to provide an educational content alongside a pleasing experience. Despite this concept being very likely as old as games themselves (to win a game you need to learn and understand the rules of the game), serious games are a relatively recent trend in the educational world. The term "Serious Games", coined in the 70s [1], is now widely accepted, but it does contain a semantic contradiction very symbolic of some issues serious games are facing. The expression "serious games" is by itself an oxymoron, as games are defined as a recreational and fun activity, to a sharp contrast of what the word serious conveys.

Indeed, the concept of using games in an educational framework is sometimes not an easy thing to see acknowledged and accepted, there can still be some resistance.

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### 1.2. Educational games

Educational games can be defined as games with an educational purpose. As it is the case for any game, educational games contain a play and pretend dimension, clear goals and rules to follow to achieve said goals. Those games have a gameplay, aesthetics, a story, a risk and reward system, some novelty; provide immersion, a degree of socialization, a need for creativity and things to learn. Those games could be of any type (physical, board games and computer games) but in this paper we will limit ourselves to computer based serious games.

### 1.3. Game based learning

Serious games are used in the framework of the game based learning methodology. The games used in this methodology have a gameplay predefined by a clear learning outcome. The prime interest here is to learn something and the entire gameplay is articulated around this need. In game based learning, the players need to be able to retain and apply in their real lives what they just learned in the serious game they played.

## 1.4. Gamification

A recent idea derivative of the serious games concept that has been gaining a lot of traction recently is the concept of gamification. Using gamification means using hand-picked game concepts and elements in a typically non-gaming situation. For example an intranet website for a company could provide some medals and badges according to the employee's frequentation of said website. Those rewards, viewable by everyone in the company, will provide some emulation and a sense of competition driving the employee to perform better in the task concerned. Gamification can be a very powerful tool if it used correctly and in the right environment.

## 1.5. Challenges

Currently, serious games face some challenges in the education world. Some people still associate games and futility, and it's sometimes difficult to convince that games can be useful in a learning environment. Besides, as computer based serious games are a relatively new thing, there are not enough studies proving the benefits of using them in a long term process. As learning concerns all possible subjects, a whole range of very different methodologies can be applied. The serious games used to enhance the learning need to reflect those subjects and methodologies, but given it's still a nascent tool, it might be sometimes difficult for the ones willing to use serious games to find the software perfectly adapted to their needs. Quality of the products can also be a concern, as available serious games can sometimes be of debatable quality.

## 2. Considerations about serious games

### 2.1. Definition

Commercial off the shelves videogame are conceived with the dual goal of creating a fun and enjoyable activity for the players while earning money at the same time. The more the game is fun and engrossing, the more it will be played and the more it will sell. For serious games, matters are entirely different.

The main driving force of a serious game, the reason why the game even exists is its educational content. It's a complete change in paradigm in the design phase: the educational content and methodology largely govern how the serious game will be designed. Revenue is not always a prime concern and fun, albeit important, is not the most important aspect anymore. A serious game is by essence an answer to a problem.

### 2.2. Communication issues

The first issue becomes to identify and define the problem that needs to be solved as well and extensively as possible.

From a teacher or educator point of view, the main concern is to find out what the problem is and to manage to define it very clearly.

From a game designer point of view the problem is to actually be able to understand the problem as it is explained and find the best possible solution adapted to it.

Between all the actors involved in the creation of a serious game, communication can sometimes be very difficult. All have their own experience and expertise, and semantics can sometimes vary widely. If the team is a multinational one, things can be even harder. Aiming for efficient communication is almost akin to having to manage the Babel Tower. A sentence like "teaching programming as a mean for developing early analytical, structural and critical minds" might be very clear for someone with a pedagogic background but undecipherable for an IT specialist.

### 2.3. Identifying the problem

A few questions can help tremendously in narrowing down the issue and making it clear for everyone involved, and need to be asked and answered before undertaking any design of a serious game. In a general fashion, the more a problem is clearly specified, the more the software answering it is going to be adapted. While sometimes adequate, blanket solutions might not be useful in all situations. For example, teachers might be using a videogame from the Civilization series in the framework of a history lesson. But it's a workaround at best. Besides obvious technical issues such as getting several paying copies of the game or having a lab with computers powerful enough to have the game run, teachers will need to adapt their lesson to the videogame. If the lesson theme is about the industrial revolution, the learners will need to start the game via a save done just before this period of time and will only have a small amount of playtime to learn limited historical contents. On the contrary, if the teacher would use a specific serious game dedicated to the industrial revolution, the software and its entire content would be directly adapted to the lesson.

#### What about?

The exact subject of the game needs to be defined. Beyond a clear definition of the general theme, a comprehensive list of learning items that have to be transmitted to the player has to be established. Two games might be targeting environmental education for the first grade while at the same time having very different learning items – they will end up being two different games.

#### Who for?

The importance of knowing the end users is a very important factor to be aware of while designing a serious game. Contrary to commercial videogames, there are actually several types of end users for a serious game. The teachers and the students both have to be taken into account and sometime students' parents and the decision makers are also to be factored in. It's capital to know the age level of the

learner but also the environment in which the teachers are evolving. To further on the example above, two serious games might target environmental education for the first grade but differ widely as they are used in two different educational methodologies.

### Where is it going to be used?

For commercial videogame, the answer to this question is quite trivial; the game will be played on the gaming apparatus the player possesses. In the framework of serious games, the answer may be very different according to the users. Some users might use the game in a dedicated school lab, where each student will have their own brand new computer. But some other users might have access to a few very old computers for a whole classroom. Or worse still, some schools could be so poor that they only have one laptop in their entire premises. Confronted to such a wide array of possible usage, a serious game has to be very flexible.

### When is it played?

A game can be played for minutes or hours, the length of the playing session is an important factor. In commercial videogames, it has a small impact as the players play as long as they wish to, but for serious games, the time allotted to gaming itself is strictly defined by outside constraints like the length of a typical learning session, the availability of IT labs, and so forth. It's therefore very important to know the ideal length of a gaming session before starting to design a serious game.

### How is it going to be played?

With the success of mobile computing (smartphones and tablets) and its ever-climbing adoption rate, mobile serious games have become a perfectly good alternative to desktop-based games. But designing a game for a mobile platform is entirely different from designing a game for desktops, so this is a decision that has to be taken at the inception of the project of creating a serious game. There are also multiple available solutions for a given platform, a mobile app can work on Android, iOS, Blackberry or others, a desktop software for Windows or Mac, a console game could be for the Wii, the Xbox One or The PS4.

Likewise, many games require the integration of an Internet connection, be it for a connection to a database or for adding a social dimension, or other usages. But serious games cannot take for granted an easy access to Internet. The conditions in which the game can be used vary considerably, especially from country to country. Hence integrating or not an Internet usage is also a strategic decision to be taken as early as possible in the design of a serious game.

### Why a game?

This question is positioned as the last one, but it should really be at the top of the list. Serious games are not created for the sake of creating a serious game; they do fill a very specific purpose. There are multiple possible educational solutions in order to teach a certain subject or skill, and

serious games are only one of the tools available in a huge toolkit.

Before starting to invest time, money and manpower to create a game, all possible solutions have to be explored, and maybe there might be a better solution to the question at hand than to create a serious game.

## 2.4. The pitfalls to avoid

There are several very common mistakes to avoid while starting to design a serious game, especially when the development team has little of no experience about such an endeavour.

### Trying to create a game for the sake of it

A serious game is supposed to be a part of a bigger picture, one more tool in a toolkit. Some teaching will be best adapted to oral communication, some to audio-visual communication and others will fit very well to serious games, or rather serious games will fit very well to them. If the idea is to create a serious game as a pet project, it might be better to start with a more limited task or to create a pure video game.

### Trying to have foremost a fun game

Fun is a very important factor in videogames, even in serious games. Having a fun and interesting game is the guarantee for the player to keep playing. But in serious games the most important factor is the knowledge acquired while playing the game. Sometimes, this knowledge will be the main factor contributing to the player being engrossed with the game. Having a fun serious game is a very good objective, having a serious game that fully manages to deliver the intended knowledge to the players might be a better one.

### Creating a game without thinking about the end-user

As developed above, a serious game might be used in a wide variety of possible situations, sometime unforeseen by the developers. So the games need to be adaptive enough. But beyond that, a serious game has to be thought about as an integral part of the existing tools used by the teachers. To help them use the game in the simplest possible way, to blend the serious game into the existing educational methodologies, support is paramount, especially in education. It has to be thought of from the very beginning of the project.

Everything has to be done to provide an as smooth and agreeable experience as possible for everyone involved, users and trainers. Manuals, explanative videos, tutorials and learning sheets are all excellent ideas and contribute to help the teachers know the software well and use it in their classroom.

### Thinking that the game is going to be the be-all and end-all

The serious game is part of an educative package and needs to be considered as such. Sometimes a limited tool that

excels in what it is doing can be more useful than a very inclusive and exhaustive one that does everything adequately but is difficult to master.

### 3. Creating a serious game

#### 3.1. The role of teamwork

Now that the original problem is known and has been presented in the most exhaustive and understandable way, the development team needs to start elaborating a solution [2]. The question to solve now is how to solve the problem in the most efficient manner.

Because there are so many possible factors going to influence the design of the game, especially the factors depending of the trainers and trainees, teamwork is a capital way of working. Working with several points of view can help define the best possible solution via a slow polishing process, where many possible answers are examined and rejected or refined, in an incremental way up until a final design is agreed upon.

Everyone has to be kept in the loop of design, including the teachers and decision makers.

#### 3.2. Software development

##### Concept stage

The very first thing to find is the general idea for this serious game. Something short, like one or two sentences that can be pitched when needed. Afterwards a genre should be decided.

There are many different existing genres in computer games. Action games with physical challenges, strategy games with tactical challenges, role-play games including tactics, logistics, exploration, sports games with physical and economical dimension, construction and management games with an economical focus, adventure games with a lot of exploration and logical puzzles, artificial life games that require management skills, puzzle games which are conceptual and require logics, and many more.

Defining the actual genre of the serious game will have a great impact on the rest of the design decision and stems from the exact problem there is to solve. Puzzle games are well adapted to teach critical and lateral thinking, adventure games to tell a story, and so on.

After the genre, the gameplay has to be crafted. A gameplay is a combination of two things: the challenges given to the player and the actions the player can take to overpass those challenges. A rough description of a platform game such as SuperMario would be that the players encounter challenges in the form of rolling barrels and they can react by moving in all directions and jumping.

The game also needs to have a rough description of its main characteristic, a feature list presenting its main highlights.

Another important aspect of a serious game is its settings and the story that is going to be told to the players. Some games actually present only an embryo of settings and story,

or even no story at all. This depends heavily on the game genre, some genre being heavily story driven (such as adventure games) and others not at all (such as racing games).

As presented earlier, the target audience of the game is also a capital point, along with the game's requirements.

The points presented here are fundamental decisions for the game which can very hardly be changed afterwards. The greatest care has to be taken into choosing the most optimal solution for each point, as a mistake at this stage can be very costly in the future. Again, constant dialog and coordination with all the actors involved with the serious games creation is capital to ensure the best possible outcome for the project.

##### Production stage

Once the concept stage is over, the game enters in a preproduction phase. A tight schedule, along with estimates about total budget and staff cost are important tools to master at this point.

A prototype of the software is first created and tested in the field. After modifications, an iterative process of new versions along with tests and feedback is put into place, up until the final version of the serious game.

### 4. The design process

#### 4.1. Game design documents

Alongside the development process, some documents need to be authored in order to map out the game design and act as a reference for the game production team.

##### Concept Paper

This document sums up the game genre, the target audience, a description of the game, its most compelling features, some market information, the cost and time to develop it. The concept paper aims to define the concept, scope, worthiness and feasibility of the serious game's project to sell the idea to a client, a publisher, an employer, a user or so forth.

This paper is relatively short and concise.

##### Design Document

On the contrary the design documents aims at writing down everything about the project, in great details. This will ensure that the game designer will actually get what was wanted in the first place. It's always difficult to convey exactly an idea, hence great caution should be used when describing an idea or an asset to leave very little place to interpretation. For example if some game designer has a tall black horse in a lush green field in mind but only writes down "horse in a field", they might very well get in the end a multicolour unicorn in poppy field.

The design document has to describe the body and soul of the game while at the same time being readable. It also has to define priorities while still describing the important details. Some things also must be demonstrated clearly, not

only what but also how. Sometimes this document also has to provide alternatives if some solutions might not be actually possible to implement.

In summary, the design document does give some life to the project; it has to cover everything and has to do it in good condition.

### Production Document

Finally, a more financially oriented document also needs to be drafted, the production document. A complete time management schedule, a detailed budget, technical specifications and a description of all tasks.

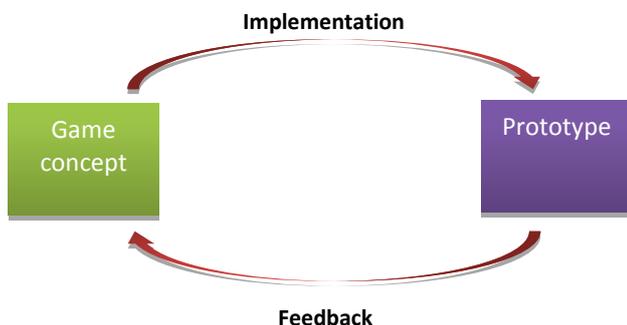
## 4.2. Unknowns of the design

It is very difficult to predict everything that can happen during the creation of a serious game. But somehow, according to Murphy's Law, you can always count on something going wrong somehow, or on something impossible to predict to happen, leading you to reshuffle your plans.

In consequence, even if (or rather because) this unknown factor, is unpredictable it has to get factored in the development plan. Rigidity is the enemy of a good game designer, adaptability is the key word.

## 4.3. Design Cycle

The entire process of the design and creation of a serious game can be summed up in a very simple diagram (see figure 1). The game gets defined as a concept, which spawns a first prototype. This prototype is then tested and used by selected users or testers. Users' feedback is used to refine the prototype into a much better design. This new design gets implemented into a new prototype, which gets tested and brings feedback and the cycle continues.



**Figure 1.** A simple design cycle representation.

This virtuous cycle is virtually endless. Even after the software is officially released, the cycle continues and the software gets incremental enhancements. The difference

between a pre-release and a post-release software design cycle resides in the type of changes realized after the feedback is received. During the pre-release phase major changes might happen and some missing functionality can be added, whereas during the post-release phase the main concern is on bug-fixing and minor improvements

## 5. Conclusion

Let us present a few conclusion words about the design process of creating a serious game. The design is driven foremost by the task to accomplish, the problem to solve, the transmission of knowledge to the students.

Creating a serious game is everything but a trivial process. It does take some time, a lot of preparation and efforts.

The process of creating and designing a serious game has to be both organized and participative, constantly gathering the feedback not only of the whole team, but also of at least a sample of the possible end users.

In the process of creating a game, and especially during the design cycle, there will be lots of hits-and-lots of misses; the cycle form is the way to go.

One cannot underestimate the importance of communication. A good mantra would be something like "consult, consult, consult", as feedback is essential for the software in its lifetime.

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