Design Patterns in Serious Games: A Blue Print for Combining Fun and Learning

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Abstract. At first glance, the term "Serious Game" seems to be an oxymoron. Indeed, how can we combine the serious business of teaching with the stimulating enjoyment, and excitement, people find in video games? Experience shows that it is often a tall order to make learning an enjoyable, exciting, and enriching experience. In this paper, we present the result of our study and analysis of twenty Serious Games from which we discovered and derived what appeared to us as the most useful practices that could be formulated in Design Patterns based on a Pattern Language. These patterns can be presented in a typology that should facilitate the application of those practices and should favour collaborative projects bringing together game experts, knowledge experts, and other stakeholders involved in the design and production process of Serious Games. We used these patterns to design a Serious Game prototype and were able to test their usability.

Keywords: serious games, game-based learning, design patterns.

1   Introduction: Making Learning Fun

Playing video games is a widespread practice among teenagers and adults alike. The success of game platforms, such as Nintendo DS or Wii with a wide audience, has made video games part and parcel of mainstream global culture. Today, these games influence fields such as communication and more particularly learning as illustrated by the current trend in Serious Games (SG).

Serious Games can be defined as "ways to use video games and video games technologies outside entertainment" [1]. For instance, we find them in advertising, marketing, and military applications. However, we are interested more particularly in the use of Serious Games in instructional and training projects in this paper.

During the design steps of these projects, teams developing Serious Games face a major and recurrent problem, which consists in combining or blending fun and

learning in the same application. Combining these facets is difficult for at least two important reasons:

— Although there are a few theoretical approaches such as [2], instructional design and game design are highly empirical activities because game designers need to experiment, test, and hone before they can complete a game.
— Game playing and learning sometimes seem to be based on principles that are apparently contradictory: games are associated with pleasure and freedom to play when and where one wants to; while learning is more readily associated with constraints and difficulties. Video games are associated with interaction, practice, and immersion in the game environment; on the other hand, learning can require a break in the activity so as to take the time to think about what is going on and what one is learning.

In the projects in which we took part, the problem of combining those two apparently conflicting facets clearly appears when game designers, knowledge engineers, and customers negotiate as to how to write the specifications of a first prototype. From our interviews with KTM-Advance, our partner firm, we noticed a typical type of problem: one game designer provided game goals that would be unlikely to match the pedagogical objectives while the customer insisted on inserting fifty pages taken from a technical guide into the Serious Game. Doing this would more than likely destroy all the fun.

As the widespread development of Serious Games is quite a recent phenomenon in France, those involved do not yet have enough experience in the field to negotiate these tradeoffs. Each project is more a new challenge than the re-use of established and well grounded procedures. Thus, this lack of well-tested practices slows down Serious Game production and probably has a negative impact on the quality of the products.

Our aim is to provide a novel conceptual toolbox to facilitate brainstorming and enhance the creative process. In order to help Serious Game designers, we began by making a list of useful practices used to combine enjoyment and education in Serious Games. These were written in a language of Design Patterns inspired by the work of C. Alexander in [3] (section 2.1). These patterns were taken from the analysis of research papers on games and on Serious Games themselves; and the study of twenty Serious Games (section 2.2). In order to test and illustrate our Design Patterns, we chose to use a Serious Game project, about applying for an American graduate course. We called it *Graduate Admission* (GA) (section 2.3). The result of our study is presented in the form of a synopsis of Design Patterns grouped in six categories. Each category contains patterns solving a general problem such as "How to initiate the reflexive process" or "How to convey information without disturbing game immersion" (section 3.2). Furthermore, we will review some of the most pertinent patterns in greater depth (section 3.3). We will finish by discussing and suggesting ways of assessing SG patterns and validating them (section 4).

2   Design Patterns and Pattern Languages May Be the Answer

2.1   Definition and Motivation

The concept of Design Pattern stems from the work on urban architecture of Christopher Alexander. He coined the term "Design Pattern" to characterize proven solutions to recurring architectural design problems [3]. Influenced by his work, other disciplines adopted the concept, especially Software Engineering [4]. In spite of a few differences, Design Patterns from all these fields share similar traits and goals. Generally speaking, Design Patterns are structured according to elements such as the name, the context, the problem, composed of conflicting interests called "forces" together with a generic or canonical solution.

When Design Patterns are organized by referring to one another, they form what C. Alexander called a Pattern Language. As far as we are concerned, both Design Patterns and Pattern Languages aim at facilitating the re-use of the best solutions or favouring discussion, brainstorming, and exchange of ideas between Serious Game designers and other stakeholders.

In our opinion, the designing of Serious Games is ideal for developing a pattern language because this field of innovation:

- is intrinsically made up of two major forces that must be balanced: fun and learning;
- is expanding quickly and, given the diversity of products, stakeholders need to share a common vocabulary and knowledge corpus.

Patterns can be applied at different levels. C. Alexander listed patterns to solve large-scale problems (for cities) as well as small-scale ones (for houses). In Software Engineering, the most famous patterns such as MVC (Model View Controller) can be implemented by classes and instances quite easily. For Serious Games, we try to provide macro, for instance Fun Reward, and micro patterns, for example Serious Boss, but we do not aim at coding implementation. Nevertheless, our main target audience is made up of people such as game designers or vocational education trainers, not IT developers.

2.2   Methodology: our Approach

Types of Sources.

In order to discover patterns, we used different types of sources and studied their content:

- Five Serious Games created by our private partner KTM-Advance, an e-learning company, located in Paris, which has been developing Serious Games for three years. Unlike many SGs, these ones are not based on quizzes but use quite advanced interaction to enhance learning. For example, a builder game (like Sim-City) is used to teach the ins and outs of banking;

— Twenty Serious Games from GameClassification[1] [1] chosen according to the following criteria: popularity, diversity and accessibility on the Web. Some of these Serious Games will be referred to in the footnotes given with our Design Patterns;
— Research papers about Games, Serious Games and Game-Based Learning: GOM II by A. Amory [6], K. Kiili [7], but we also looked at Design Patterns in education and e-learning fields. For example, patterns were found about active learning [8], Learning Management Systems [9], Intelligent Tutoring Systems [10] or about analysing usage in learning systems [11]. In Game Design, the most complete work has been done by S. Björk and J. Holopainen [12].

How patterns were extracted or discovered.

We used an empirical method to understand the difference in pattern use between video games and Serious Games. We tried to discover what both had in common, how fun was created, how learning emerged in a fun environment. We had to distinguish which elements of the game were ludic, which were conducive to the learning process.

Once the patterns, discovered intuitively and implicitly, were identified and given a name, we endeavoured to organize them according to the type of problem an SG designer might meet. To do this, we carried out a study of papers written about game design on one hand and TEL on the other (cf. Types of Sources).

At the same time, we discussed these sources and patterns with knowledge engineers, game designers, and developers working for our partner KTM-Advance.

Finally, the pattern language was inspired as much as possible following the advice and principles formulated by G. Meszaros and J. Doble [13] such as *Noun Phrase Name*, *Evocative Pattern Name*.

2.3   Case Study: Applying for an American Graduate Course

The following example of a Serious Game project will allow us to illustrate the advantage, from a designer's point of view, of our Pattern language. This project, called *Graduate Admission* (GA), is hypothetical as it may not be funded although it could be realized as there is a real albeit small demand for the type of service proposed. We started the project from scratch and used Design Patterns to explore game design possibilities. We began by using the pattern *Game-Based Learning Blend*, thus following the procedure used by KTM-Advance game designers.

We first clearly formulated the educational objectives of the game before designing the storyboard:

— Acquiring the skills and knowledge needed to be admitted to an American graduate course.
— Understanding the American higher education system and the attitudes that Americans have about study and college life.
— Pitfalls that must be avoided (main, most commonly made mistakes)

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[1] Online repertory of five hundreds Serious Games

The following list sets out the main components of the skills and knowledge acquisition. Knowledge: US higher education, American academe (people), Life at university, Studies, Vocabulary related to life on the campus, American outlook or attitudes to studies; Skills: Writing letters, Writing CVs or résumés, Writing statements of purpose, Making telephone calls, Preparing an interview.

Then we invented a *Narrative Structure*^{GD} i.e. a game scenario: A French student in his/her last year at a French university (Bachelor's degree), has met an American visiting Paris. They fall in love and decide to live together. However, the American has been admitted to a graduate school in the US. The French person has decided to apply to the same university. The game consists in acquiring the necessary skills and knowledge to be selected for admission.

We used this maquette to experiment with our corpus of Design Patterns. The latter will now be presented.

3   Results: a Comprehensive View of our Pattern Language

3.1   How to Read our Synopsis

We must remark that many approaches try to define what a video game is: notably C. Crawford [2], K. Salen and E. Zimmerman [14]. For our propos, we will adopt a high-level approach stating that video games are based on two fundamental ingredients: interaction and pleasure (or fun). Without the former, the video game would be but a passive experience not unlike going to see a movie. As for the second ingredient, the principle of pleasure determines the motivation of the player, be it competition, sensual, or co-operation… This vision, combined with the notion of learning, is implicit in our organization of the pattern taxonomy. Thus SG patterns rely on three main concepts: interaction, fun, and knowledge/skill acquisition. Furthermore, it is important to make interaction instructive while supplying the fun elements to boost the player's advance in the game.

The field of Serious Games is at the cross-roads of a set of wider domains with already existing patterns. In the following selection of patterns, we will sometimes refer to the work of Björk and Holopainen in Game Design [12] and to patterns of Kiili [15]. When we refer to the original pattern, not our own one, we add an exponent notation after the name (^{GD} for Game Design and ^{K} for Kiili). When we re-use an existing pattern taken from another field, but adapt it a little to Serious Games, we add the prefix "Serious" to the name as, for instance, the pattern *Serious Boss*, which has been adapted from Boss Monster^{GD}.

3.2   Pattern Category Taxonomy

Patterns are arranged in six main categories (**Fig. 1**). Each category is named after a basic problem when we try to instruct or teach in an amusing and stimulating way.

- **Category A** presents us with the context we are especially interested in, focused on the concept of the *Serious Game* and the sub-concept *Game-Based Learning Blend*, where educational and instructional aspects are put in the forefront more than in other types of Serious Games, for instance those dealing with advertising or awareness oriented campaigns.
- **Category B** describes those patterns capable of turning interaction – the first ingredient of games - into knowledge/skill acquisition. These patterns appear in games during intensive action phases.
- **Category C** suggests patterns to help learners go beyond simply training so that they are able to understand what they are doing and learning. Most of these patterns crop up in games during less intensive action phases, which we can call reflective phases, when learners can step outside the game and take time to think about their actions, strategies, and what they are learning and hopefully assimilating. We could refer to this as a meta-learning level.
- **Category D** contains patterns for conveying information to users during what can be considered extra-game phases, such as introductive videos or loading screens.
- **Category E** exhibits patterns to provide users with incentives to encourage them to advance in the game, and consequently, in their knowledge and skill acquisition. Incentives are based on reward, enjoyment, fun, and pleasure - the second ingredient of games.
- **Category F** also contains patterns to help learners advance in the game and in their skill or knowledge acquisition. However, unlike those in category E, these patterns should ward off possible frustration in case the challenges become too difficult, and they should eliminate the danger of boredom in case the challenges become too easy and the pace too slow.

In the following synopsis, patterns are organized according to their level of abstraction, generic ones on the left, specific patterns are indented to the right.

CONTEXT
A - When do you need to combine entertainment and learning?
-   *Serious Games*
o *Game-based Learning Blend*

LEARNING ASPECTS	FUN ASPECTS
B - How to make interaction instructive	**E - How to motivate users**

- *Instructive Gameplay*
      o *Questions-Answers*
      o *Pavlovian Interaction*
      o *In Situ Interaction*
      o *Microworld Interaction*
      o *Social educative Interaction*
      o *Teachable Agents*[K]
      o *Varied Serious Gameplay*
    - *New Perspectives*
    - *Rapid Feedback*
	- *Fun Reward*
	      o *Serious Boss*
	      o *Graduation Ceremony*
	      o *Object Collection*
	      o *Local Competition*
	      o *Protégé Effect*
	      o *External Competence*
	        Validation
	    - *Fun Context*
	      o *Fantasy Worlds*
	      o *Comic relief*
	      o *Serendipity*
	      o *Narrative Structures*[GD]

C - How to initiate the reflective process	**F - How to help users advance in the game**

- *Time for Action / Time for Thought*
      o *Debriefing*
      o *Reified Knowledge*
    - *Advanced Indicators*
	- *Smooth Learning Curves*[GD]
	      o *Tutorials*
	    - *Pace and path choice*

D - How to convey information without disturbing game immersion	

- *Hollywoodian Introduction*
    - *Museums*
    - *Informative Loading Screen*
    - *On the Grapevine*	

Fig. 1. Synoptic view of our pattern taxonomy for Serious Games. Patterns are in Italics. Game Design patterns are noted [GD], Kiili patterns with a [K].

3.3   Patterns

The following sub-sections explain some of the patterns and examine them in detail when appropriate. We will use the schematic pattern, context, problem, force, and solution first proposed by C. Alexander. We will add our comments after describing each pattern. In these sub-sections, we will examine our case study in the light of what has been said about Design Patterns. Details concerning some of the games studied are given in footnotes.

3.3.1   Pattern: Serious Game

Context: Let us suppose that we are starting a communication project. The customer has just outlined what he or she requires. Those include the need to provide advanced interaction to end-users and/or the need to make them highly motivated.

Problem: How can we design an application both containing advanced interaction elements and aiming at particularly motivating users, without making its development too complex?

Force: Developing an application with advanced interaction is more risky than developing a simple e-learning one with go-to-the-next-page buttons and academic quizzes. Moreover, motivation characteristics can highly disturb the main objective of the project. For instance, learners may have a lot of fun but in the end they may not be any wiser.

Solution: Design an application inspired by technologies, methods and gameplay theories taken from video games.

The video game industry has devised a lot of tools and concepts in order to master and manage the creativity process of game development. If possible, try to recruit experts from this field. For example, in the ELECT BiLAT project [16], which is a simulation application allowing soldiers to learn how to conduct bilateral negotiations with civilians, students and teachers from an interactive media school took part in designing and testing the gameplay.

If the communication project is instructional, then you will need to introduce a *Game-Based Learning Blend*.

Commentary: Let us look at our Serious Game project (cf. case study, section 2.3). We must entice the player into acquiring extremely new knowledge for a French student, knowledge that in a normal learning context (classroom) may seem dull and fastidious or is never broached at all. Writing letters, CVs, and statements of purpose are not done in the same manner in France and in the USA. Entry to university is not selective in France; French *grandes écoles* require competitive exams alone, based on maths, science, French, and a second language. Character, personality, team spirit, sport, leadership are not part of the equation. Our project consists in presenting French students with an entirely new cultural and intellectual background. The game aspect implies that the student steps into this new universe, *terra incognita* for him or her. What can be more fun than indulging in a virtual romance while learning the ins and outs of US college life!

3.3.2   Pattern: Game-Based Learning Blend

Context: Suppose we start a Serious Game where users must learn more than just a simple message (for instance in a marketing game).

Problem: How can one combine fun and learning in an application without losing the qualities of either or even both?

Force: If the educational objectives are too constrictive, creativity will be greatly diminished in the game design and fun aspects will be unlikely to emerge in the application. If, on the other hand, educational objectives are not detailed enough, it will be difficult to evaluate what the SG can teach.

Solution: Make the knowledge expert and game expert work separately before combining their suggestions.

Recruit a knowledge expert to analyse the customer's environment and field of knowledge and list the pedagogical objectives. Make the game expert put forward game designs according to a list of high-level learning objectives. Do not give the game designer over-detailed and constrictive objectives in order to allow him/her scope for creativity. Then combine and negotiate educational objectives and game concepts when drafting the specifications for the prototype.

If the educational objectives contain high-level knowledge, it will be necessary to incorporate *Time for Action/Time for Thought* i.e. practice moments and reflective moments separating action phases and reflective ones.

During action phases, *Instructive Gameplays* will allow one to link game interactions to the different learning processes. By offering *New Perspectives*[2] and *Advanced Indicators* to players, the application will enrich and enlarge their vision of the field of study, putting things into a new perspective.

It is highly unlikely that users will read long documents during action phases, consequently it is better to provide *Rapid Feedback* (one or t lines of information). However, the designer can benefit from extra-game phases to convey information with *Hollywoodian Introduction*[3], *Museum* or *Informative Loading Screen*. To motivate users, one can imagine *Fun Rewards* and *Fun Contexts*. Finally users will be more engaged in the game if the Serious Game allows them to progress in it with the help of *Smooth Learning Curve*GD (gradual progression) or even better with *Pace and Path Choice*[4] allowing them to select their rhythm of advancing in the game.

Commentary: In our game, we first defined the educational objectives and the fun scenario which would belong to the *Narrative Structures*GD (section 2.3). The game designer has the scope necessary to invent dialogues, introduce gossip and chat in order to convey information *On the Grapevine*. As for gameplay, we introduced a character, the dean of studies, receiving and criticising candidate applications. This scene would correspond to the pattern *New Perspective*. In this case, the dean would shed light on the errors or pitfalls to be avoided.

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[2] For instance, *New Perspectives* are frequently offered in the SG *Interim Mission 3D* when the learner plays the same dangerous situations according to three different characters in order to understand professional risks: http://serious.gameclassification.com/EN/games/13264-Interim-Mission-3D/index.html

[3] For example, the SG *The Great Flu* starts with a *Hollywoodian Introduction* where the learners discover the objectives, issues, and possible actions of the game in one minute, thanks to a fast-tempo video supported by a thriller soundtrack: http://serious.gameclassification.com/EN/games/14857-The-Great-Flu/index.html

[4] Offering *Pace and Path Choice* to players/learners is put forward by Chen Jenova, designer of the award-winning game *Flower,* and experimented in the prototype *ActiveQuiz* about math quizzes: http://www.jenovachen.com/flowingames/math.htm

3.3.3   Pattern: Instructive Gameplay

Context: One is using *Game-Based Learning Blend* with a list of high-level educational objectives. It is necessary to define possible game designs for action phases.

Problem: How can one exploit interaction that is conducive to learning?

Force: Not all types of interaction are instructional. Not all types of knowledge can be assimilated with interaction.

Solution: Use modes of interaction adapted to the type of knowledge to be acquired. If the project has a constrictive budget or if one is not sure of all the knowledge that must be inserted into the Serious Game, one can implement *Questions-Answers*[5]. If the educational objectives consist in having the learners memorize simple and factual knowledge, one can apply *Pavlovian Interaction* based on repetition and time-pressure, what teachers traditionally refer to as hammering it in or cramming it in.

To make learners more aware of abstract concepts, it could also be useful to implement *In Situ Interaction* i.e. plunging the user into detailed, narrative, and emotional contexts where concepts are reified. If the pedagogical objectives contain a complex system, which is difficult to understand, *Microworld Interaction* can be implemented where users/players can build or modify the system in order to perceive it clearly and become aware of the components that make it up, and the relationships between them. If the educative objectives include the discovery of different points of view, one can design *Social Pedagogical Interaction*, where several players can reveal their different attitudes and standpoints towards the topic.   If educative objectives focus on different types of knowledge, it is useful to implement *Serious Varied Gameplay*, where a diversity of gameplays appears to inform the players in a different manner; yet, closely connected to the type of knowledge required.

Commentary: How could these patterns help us to design our SG? As far as our game is concerned, it is not necessary to use *Questions-Answers* since we, the designers, know the knowledge content of the game. On the other hand, *Pavlovian Interaction* could be useful to ensure the basic campus vocabulary (fifty keywords related to university life) be assimilated by the player. For instance, a fictitious former student could make a presentation (oral understanding) about faculty and course organization. The player could then be asked to fill in blanks in a document reusing the terms given beforehand. A drag and drop exercise could be given to verify knowledge acquisition. If he does not reach a threshold score, the exercises will be generated over and over again until the desired objective is reached.

A virtual visit of the campus could be designed using *In Situ Interaction*. A map of the campus site, pictures or video could allow the player to move from place to place in order to witness the most significant and outlandish aspects of campus life (from a

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[5] For instance, *Questions-Answers* are the main *Instructive Gameplays* in *Educational-Games-Central*, a set of game shells adapted from traditional games such as Parcheesi or Tic-Tac-Toe. Indeed, the role of these shells is to allow teachers to supply questions (whatever their disciplines)   then   to   be   played   by   their   students: http://serious.gameclassification.com/EN/games/14872-Educational-Games-Central/index.html

French point of view) : trophy rooms, halls of fame, fraternity halls, commencement day ceremonies, sporting events.

To give an example of *Microworld Interaction*, we could devise a sub-game where the student, once he has learnt about what constitutes an American campus, could assemble the main ingredients in a virtual site. Where should he put residence halls with respect to libraries, bookstores, restaurants, sports amenities, and classrooms, lecture halls or laboratories? Thus he will acquire knowledge about the complexity of human affairs on the campus.

If we have different players, *Social Pedagogical Interaction* could allow some role playing activity. The students could be given role playing cards outlining the points of view of the different characters to be found on the campus: the teaching assistant, the coach, the faculty advisor. However, although this type of learning technique is often used in the real-world class room, it may be a tall order implementing it in a computer environment. One reason may be that not all the players are on line at the same time.

Serious Varied Gameplay[6] comes in handy when it appears interesting to diversify the modes of interaction related to the type of knowledge acquisition. In our case, we have suggested the virtual visit, role play, assimilating terminology, and the campus planning game. The drawback of this pattern (explicitly mentioned in the pattern itself) is that the more gameplays we introduce into the Serious Game, the more time consuming it will be for the game designers to manage and fine tune all these sequences at the end of production.

3.3.4 Pattern: Time for Action / Time for Thought

Context: Suppose one starts the *Game-Based Learning Blend* with a list of educational objectives, including high-level knowledge, (which is not necessarily the case for all Serious Games.)

Problem: How can one teach high-level knowledge?

Force: It is difficult for learners/players to concentrate on the interactions of the game and be engrossed in high-level thinking at one and the same time because of cognitive over-load. We must point out here that video games are often based on instantaneous interaction while some knowledge acquisition requires standing back and taking time to ponder over what is to be learnt.

Solution: It is a good idea to use intensive action phases for practice and training; and create less intensive phases for thought and reflection.

Frequent comments compare and contrast playing and learning; whereas, the real antithesis may well be between action (doing something) and reflection (thinking about what one is doing or evaluating what one has done).

In [7] analysing problem-based gaming, Kiili highlights the need for reflective phases. The latter are for "personal synthesis of knowledge, validation of hypothesis laid or a new playing strategy to be tested". During action phases, users are engaged emotionally, or focused on a goal, thus they are unlikely to be able to revise or re-structure knowledge acquired during the game.

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[6] The SG *FoodForce* may be the best example of *Serious Varied Gameplay* because of its six sub-games. Each one illustrates a part of the process of delivering food aid to an area in crisis: http://serious.gameclassification.com/EN/games/1211-Food-Force/index.html

Video games, like thriller scenarios in the cinema, often provide less-intensive phases for relief purposes. Even if the former are based on interaction, the progression often alternates tension phases and more relaxing, relieving ones: e.g. before a mission, when there is game over, when a goal has been reached, or a level is completed. Peaceful phases are habitually found in *Narrative Structures*[GD], because they allow users to relax before the next action phase. These peaceful moments are all the more necessary since the action becomes more intense and more challenging as the game progresses.

So one can implement *Instructional Gameplay* during action phases to make the player discover, experience emotionally, or experiment with new knowledge. During reflective phases, one can use *Debriefing*[7] to explain or return to what has been happening during the action. *Reified Knowledge* and *Advanced Indicators* (useful supplementary information providing food for thought) incorporated into the action phases can give the player a bird's eye view of the action.

Commentary: In our game project, the thought or reflective phase could come after the failure to write an acceptable letter or CV. The player should be guided towards understanding the cultural differences, the usage gap between France and the US. Subsequently, the statement of purpose (SOP), which does not exist in France, would probably be a major drawback and a terrible pitfall for a French student. *Debriefing* could be implemented by showing the learner examples of bad SOPs, or by showing his SOP and getting advice from American friends. Some ways to show how to write a letter: putting blocks of a letter in the right place and the right order, idem for the SOP with five paragraphs (out of a set of eight possible ones) that must be assembled logically. Errors made could be pointed out, especially ones related to the form or the cultural substance. This is the main role of *Debriefing*. For instance, salutations, the position of the address, date, the general layout, and beginning of the letter differ between the two countries. If the user makes the wrong choice in any of the details listed above, he should be told why he made the mistake. In other words, debriefing consists in making the player/learner aware of his/her errors and presenting him with the required knowledge necessary for accomplishing the specific task, and especially understanding a higher level cultural trait in depth.

3.3.5 Pattern: Reified Knowledge

Problem: How can one help users become more aware of their acquired knowledge?

Solution: Represent items of knowledge or competencies (skills) with virtual objects to be collected. If the player has acquired the requisite skill or piece of knowledge, he/she will be given an object symbolizing the knowledge acquisition.

For instance, in *America's Army 3*[8], medals can be won when special deeds are done. For example, a user wins a "distinguished auto-rifleman" medal when he/she

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[7] For instance, the SASO-ST application [17] use advanced *Debriefing* tools to teach negotiation skills though reflection with virtual humans.

[8] America's Army is a famous SG provided by the USA army to recruit soldiers: http://serious.gameclassification.com/EN/games/758-Americas-Army/index.html

has won 50 games as a rifleman in combat. Medals, however, do not further player progress in the game; and are more a way of reifying the playing style by rendering it concrete. The user can see his/her acquisitions either in knowledge or skills embodied in medals awarded. Every medal is placed in a showcase, and thus is exhibited as a means of recapitulating what has been acquired.

In a KTM-Advance game for a bank (not yet completed), knowledge about home loans is reified by beautiful trading cards (as in the game *Magic The Gathering*). Once having learnt a new piece of knowledge, players obtain the related card, which they can use later in the game to meet new challenges. If *Reified Knowledge* is also used to motivate players who like to collect things, the pattern is completed by *Object Collection*.

Commentary: As far as GA is concerned, which objects would best embody the American university experience and how could they be used to reinforce knowledge acquisition? The following objects might be associated with knowledge acquisition: baseball glove or bat, an American football (knowledge of US sports), a college pendant (social life), a fraternity ring (networking, charity work), and a mortar board and gown (ultimate success, graduation).

3.3.6 Pattern: Museum

Problem: How can the players be made to discover knowledge that is not related to the game objectives?

Force: Some items of knowledge cannot be easily inserted into the game as it unfolds or be related to game objectives without impairing the rhythm and diminishing the feeling of fun.

Solution: Exhibit this knowledge in virtual places consistent with the game world. One could design exhibition places that players can visit without coming under game pressure. It is important that this particular place (museum) evokes the atmosphere and prolongs the environment of the game world in order not to be perceived as a totally separate location. If players enjoy the game world, they could be interested in visiting the museum as if it were a bonus. For example, in *America's Army 3*, a virtual recruitment office could be accessed from the main menu. The player visits this place from the same perspective and using the same mode of locomotion as he/she has in the game. This place provides information about the army with posters on walls or characters who can be interviewed.

Commentary: In GA, we could devise a place where famous inventions or discoveries, made either by a university, or by one of its alumni, are exhibited and annotated. It is important to note that the *Museum* remains an option for players so as not to slow down the unfolding of the game. Its aim is to enhance knowledge and favour intellectual curiosity.

3.3.7 Pattern: Fun Reward

Problem: How can one provide players with incentives to help them advance in the game?

Solution: Entice players with the promise of rewards. The latter would bring some form of satisfaction or pleasure.

Experiencing fun or enjoyment can be caused by many things (as listed in [18] [14]) to which people are more or less sensitive. For example, some people can find pleasure in competition and others can not. So offer rewards based on different sources of fun in order to motivate the player to progress in the game.

Use the difficult activities described in the pattern *Serious Boss9*, which challenges players emotionally. In a video game, a boss monster is a character who appears at the end of a level or at the end of the game. He himself constitutes a greater difficulty than what the player has encountered so far. On one hand, the boss monster is often mentioned beforehand in the storyboard; on the other, he appears as a challenge and he possesses traits that establish an emotional link with the player. If the player manages to pick up the challenge and beat the boss, he experiences a very special feeling of personal satisfaction, a little like David beating Goliath.

Offer a *Graduation Ceremony* when high levels of achievement have been reached. For example in *America's army 3*, when the player has sufficiently advanced in the game, he watches a ceremony with speeches and an applauding audience to encourage him and egg him on to greater feats.

Use *Object Collection* to stimulate players who like collecting things by inviting them to find hidden objects dispersed in different places inside and throughout the game.

Use *Local competition10* to avoid discouragement. Thus we should provide matches or competitions between players with similar skill levels. If the level difference were too great, this might lead to frustration and hinder the progress that the weakest of the players is making.

External Competence Validation consists in sending the player to a site outside the game to validate his/her knowledge acquisition before being able to move on. This can be done using a Learning Management System (LMS) such as Moodle or Sakai. The player's results are then fed back to the game platform and the player is allowed to continue. In this case, the game is a means of motivating the player to carry out tasks outside the game space.

Beyond *Fun Rewards*, one can consolidate the player's engagement in the game if some action takes place in a *Fun Context* such as a *Fantasy World11* satisfying the need to escape from reality or if *Narrative Structures^{GD}* based upon characters and dramatic events are added. The *Comic Relief* can be used to relieve tension and help

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9 The SG Mind'Up offers ten enigmas to discover IT. The main originality of this SG is to present us with a contemptuous character who challenges the user and illustrates perfectly the notion of *Serious Boss*: http://serious.gameclassification.com/EN/games/1316-MindUp/index.html

10 Facebook applications frequently use *Local Competitions*. For example, in the SG GeoChallenge, players are tested about basic geographical facts such as national flags or monuments. Then their scores are compared to those of friends, which are just above or just below: http://serious.gameclassification.com/EN/games/14873-Geo-Challenge/index.html

11 A simple example of *Fantasy World* is the SG StarBank, a builder game teaching the ins and outs of banking. The first part of the name ("Star") reveals the idea of the designers to place the game in outer space, with aliens, to make the game universe more attractive: http://serious.gameclassification.com/EN/games/14090-Starbank/index.html

the player to relax after a period of intense activity. *Serendipity* allows the player to discover by chance an interesting item that would boost his/her score. This daemon would only be implemented if the player reaches a specific score in one of the sequences of the game.

Commentary: In our game, the dean could play the role of the *Serious Boss*, who is present throughout the game, reviewing letters and SOPs, or speaking on the telephone; the dean who looms ahead all the more so as the final decision will be taken after an interview with him. The dean is an important challenge as he has to be convinced that the player is the right student to join the programme. However, the dean also belongs to *Narrative Structure^{GD}*. We can imagine the dean welcoming the student when he/she arrives on the campus giving a more positive touch to the character. How could we introduce *Comic Relief* to reduce the tension as the game unfolds? As we know the target audience of the game, we can anticipate the type of humour that would be understood and enjoyed by the participants. Humour could be created through the use of faux-amis (rubber/eraser etc;) or situation humour (the student arrives at the airport in Miami and the customs officer questions him/her in Spanish, one of the official languages of Florida).

3.4   Patterns, negotiation and implementation

All the patterns described above allowed us to fill in a grid, recapitulating the patterns and the solutions they provided us with (**Table 1**).

The following table shows the type of document that one could give to SG stakeholders to allow them to write down their ideas and negotiate the specifications of a project prototype. The file gives information about the pattern and its conceivable implementation and allows room for commentary and decision making.

Table 1. Example of a synoptic table used for discussion on projects by stakeholders based on Design Patterns

Pattern	Implementation	Commentary
In situ interation	Virtual visit to the campus Learning about campus life	
Pavlovian Interaction	Repetitive exercises to learn campus lexicon	
Museum	Discovering the history of innovation in US academe	
Serious boss	Confronting the dean of studies, a major challenge	
Reified knowledge	Collecting symbolic objects identifiable with concepts	

4   Discussion and Related Works

Basis for Work In Progress

Our objective was first to discover the most appropriate patterns useful for stimulating game design, then to organize those patterns in such a way as to leave room for new patterns as they emerged serendipitously. Our corpus provided the basis for future development. It is not limited to educational SGs, but could provide food for thought for other types of Serious Game implementation. However, Patterns must be adapted to the type of game, and not all are adaptable to every circumstance. For examples, in some SGs, designers say they prefer to avoid *Questions-Answers*.

Similar Projects

During our research, we discovered a similar project [15] by K. Kiili exploring patterns on Game-Based Learning. For the moment, this incipient project proposes six patterns in six categories. Contrary to our work, all the examples are based on the same game. Only two categories ("Cognition" and "Engagement") correspond directly to our categories (C and E). It must be noted that pattern creating is highly subjective and difficult to compare in a few lines. However, this will be an objective of future research.

How to validate the patterns?

In order to validate patterns, we suggest two ways. First, we created a Serious Game project and tried to illustrate the use of pattern designs as a means of gradually building the Serious Game project with solutions to problems as they cropped up. However, a more objective way would be to furnish designers with the table given below (**Table 2**) and, once they have experimented with it, to ask them to fill in a questionnaire, which would then be analysed to provide effective feedback. This would allow us to rate the patterns as C. Alexander suggests, using stars, three being for the most robust patterns.

Table 2. Pattern score sheet

PATTERN	Overall Score: - Not useful 0 - Useful 1 - Very useful 2	In-depth feedback: - General (G) - Specific (S) - Original (O)
In Situ Interaction		
Museum		
Serious boss		
...		

5   Conclusion and Further Works

Pattern design seems to be a promising field of research and a promising solution for people involved in Serious Game design. We have endeavoured to present a typology of possible Design Patterns after studying a corpus of Serious Games and analysing current literature on the subject of pattern writing. We also worked with a Serious Game company, which provided us with valuable insights into their game designing process. We have listed 35 patterns included in six categories. Each category corresponds to a design problem. We have illustrated the use of Design Patterns by using a hypothetical Serious Game of our own creation in order to validate the process internally.

However, our taxonomy needs external validation. We intend to create a toolbox for this purpose with a questionnaire and design sheets, which will be given to game designers and other stakeholders. The feedback should allow us to ascertain which patterns meet with the best response. Those validated could then constitute a set of best practices.

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