LEARNING AND VIDEOGAMES:
AN UNEXPLOITED SYNERGY

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Abstract

In a social context marked by the crucial relevance of the development of the individual, it is of primary importance to focus the attention on those social phenomena that can contribute to it and are often underestimated and underexploited in terms of learning processes. Videogaming (i.e., the activity of playing a videogame) is certainly one of such phenomena, and its importance and popularity in our contemporary society is a good reason to analyze its relevance of learning processes.

What are videogames? What is their relationship with learning processes? Is the didactic potential of videogames fully exploited? This paper is an effort to answer these questions analyzing how the current approaches to educational game design underexploit the didactic potential of videogames, which naturally engender important learning processes. Additionally, the work proposes an alternative approach that might lead to the creation of products capable of offering a better gaming experience and richer possibilities of development for the player.

1 Introduction

In a social context marked by the crucial importance of the development of the individual, most of the efforts devoted to the understanding of the concept of learning and the increase of the efficacy of learning processes are often based on outdated assumptions that limit their effectiveness. These assumptions bound the concept of learning to traditional schooling and training contexts and, consequently, quite often speaking about learning means speaking about how to design controlled processes aimed at deliberately teaching specific contents to a learner, and about pedagogic tools that can somehow benefit such processes. The important consequence of this situation is that neglecting that learning is not bound to schooling and training contexts implies underestimating all those learning processes implicitly embedded in other activities (often of very great social importance) whose primary goal is not directly related to learning. This, in turn, leads to a poor understanding and exploitation of the potential of such activities, and how they may contribute to the development of the individual.

The case of videogames is a very interesting example of the underexploitation of a phenomenon remarkable both in terms of its relevance in our contemporary society and its tremendous potential in terms of learning processes. As for the social relevance of the phenomenon of videogaming (i.e., the act of playing videogames), according to data revealed by the Interactive Digital Software Association (IDSA) during the 1998 Electronic Entertainment Expo, the videogame industry has managed to become the fastest growing segment of the entertainment industry in America, exceeding the motion picture and recording industry [Rina98], Although this clearly speaks of phenomenon of gigantic proportions in terms of the popularity of videogaming, and hence the size of the community of videogamers, nowadays speaking of videogames and learning processes means speaking of the edutainment niche (characterized by products are generally designed with the purpose of educating while entertaining through the use of ludic applications), a market whose size is very small compared to the size of the videogame market, and whose users generally belong to a very specific target segment (i.e., children). This situation makes it hard to speak of videogaming as a massive phenomenon that contributes to the development of the individual, and even more insinuates doubts about whether videogames not designed with educational purposes have anything at all to do with learning processes.

Why is that? Is edutainment really the best, or even the only formula to exploit videogames to benefit learning processes? Have non-educational videogames anything to do with learning processes? This work addresses such questions with the ultimate purpose of analyzing whether videogaming can be considered a massive phenomenon of any relevance in terms of learning processes that contribute to the development of the individual, particularly focusing the attention on how videogames are currently exploited in learning contexts (which means analyzing the phenomenon of edutainment), in order to understand whether it is proper or not to speak of cognitive underexploitation of videogames. In order to do that, the next sections provide important bases to understand what a videogame is, what is the relationship between videogames and instructional processes, how videogames are

currently exploited and how they should be in order to fully understand and, eventually, exploit the way videogames can benefit the cognitive development of the individual.

2 Of play, games and videogames

In order to analyze the phenomenon of videogaming it is important to understand the nature of videogames as ludic products, and their relationship with the concept of play and other games in general.

2.1 What is play? A brief analysis of the concept of ludic activity

There is a comprehensive literature dealing with the topic of play (for example, the reader may refer to the anthology edited by Bruner, Jolly and Sylva [Brun76]). Most definitions regard play as an intellectual activity engaged in for its own sake, with neither clearly recognizable functionalities nor immediate biological effects [Beac45], and related to exploratory processes that follow the exposure of the player to novel stimuli [Berl50].

Exploration and play are two different things, although almost always exploration goes along with play. Play often involves the manipulation of objects that requires a level of proficiency achievable through a learning process, and the starting point of such processes is the exploration of the characteristics of the objects [Brun72], which are used in the game only when the player feels she has understood their properties [Hutt66].

The objects involved in the act of playing are commonly referred to as toys (or playthings) [Craw82]. The use of the toys (both in terms of modes and purposes) and their relationships are regulated by rules [Brun76a], which organize the set of ludic activities turning it into complete gaming activity. Rules can be previously defined or formulated during the game. The latter happens when new situations change the spatial-temporal structure that is the core of the rules themselves.

The ludic behavior occurs in conditions free of functional pressures [Brun72]. The absence of negative consequences allows the exploration of situations that would otherwise be considered risky, and therefore ignored. This can lead to the development of unexploited skills [Beac45].

The possibility to explore and experiment with alternative meanings of objects and actions within an imaginary and safe environment is what allows considering play as a source of development [Vigo76]. In this sense, the concept of "as if" is extremely important: this is what allows the player to transcend the aprioristic meanings that objects have, and to attribute them semantic connotations that depend on the context in which interactions with objects occur (for instance, during a simple broom can become a horse if used by children when playing "cowboys and Indians"). Believability of the aforementioned semantic connotations depends on the so-called suspension of disbelief, consisting in the ability of abstracting from the semantics and functionalities commonly attributed to objects and facts, and accepted by the social environment. Thus, suspension of disbelief is what makes the context of the game the only relevant reality.

To recapitulate the situation, it is proper to propose a list including the main elements that define a behavior as ludic:

a) Involved activities have neither functionalities nor biological effects, and are engaged for their own sake.
b) Ludic behavior only occurs in a context free from functional pressures.
c) Ludic behavior always implies elements of emotional pleasure.
d) Ludic behavior is normally accompanied by exploratory activities.
e) Play, together with exploration, implies a learning process to master rules and manipulative skills.
f) Play is always regulated by rules.
g) The concepts of "as if" and suspension of disbelief make the context of the game the only reality important to attribute semantic connotations to things.

It is important to remark that the elements included in the list are not the only ones that characterize ludic behavior, but they certainly are very important to answering a fundamental question: when is play not such anymore? It is possible to say that the violation of any of the conditions listed above characterize non-ludic activities. In particular, pressure has to be considered a very important discriminating element to differentiate what is play from what is not, since the presence of functional pressures may determine the violation of other conditions that characterize any ludic activity. In fact, play is not such anymore when functional pressures, which are not part of the game, impose a behavior to accomplish certain functionalities or to avoid undesired consequences. If there is no risk of such consequences, pressures are perceived as part of the game and will not alter a player's amusement.

2.2 The relationship between games and videogames

What is the relationship between play and videogames? More specifically, is a videogame an ordinary game? According to existing sources, the answer to such question is that a videogame is not any game [Craw82, Cost94]. Playing a videogame is more than a ludic activity engaged in for its own sake. In videogames players always face a challenge and have a specific goal, for the accomplishment of which they must struggle with some kind of opposition. Additionally, videogames provide not only the means (i.e., the toys) and the rules to play, but also an interactive gaming environment, as opposed to many other games, and, additionally, the gaming environment is always virtual (to understand this characteristic, suffice it to think about football: in the real world, you can have the equipment, the teams and know the rule, but if you do not have the field you cannot play the game; in a computer game, the videogame itself provides the player with contenders, teammates and playing field, all of which constitute a complete playing environment). Furthermore, the environment is always interactive, capable of responding to the gamer's choices and actions [Craw82, Cost94]. Consequently, when dealing with videogames, the list of characteristics proposed above must be extended, including other two elements that are distinctive (although not exclusive) of videogames:

h) Videogames always include an interactive virtual playing environment.

i) In videogames the player has always to struggle against some kind of opposition.

Therefore, it is possible to consider videogames as a subset of games in general, characterized by all the set of characteristics (a) to (i) (Figure 1).

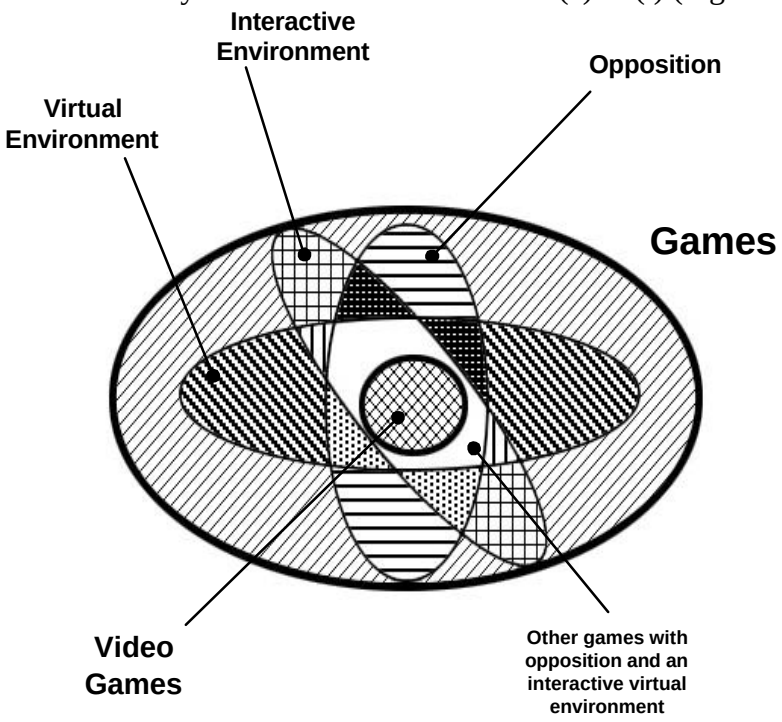

Figure 1: Relationship between games and videogames

3 Videogames and learning processes

Once understood the basic structural characteristics of the videogaming activity, it is now possible to analyze the relationships that exist between videogames and learning processes. In first place, as said before, videogaming is a particular form of play, and hence all that has been written regarding the relationships between play and learning most certainly stands for videogames. However, the purpose of this work is not dealing with general issues regarding play and learning processes, but rather specifically focusing on videogames in order to analyze those learning processes implicitly embedded in every videogaming activity. The first step that must be taken in this sense is to analyze the basic characteristics of the process of playing a videogame, and what player-games interactions occur during the game-playing. Then, it will be possible to understand what learning processes are implied by such interactions, in order to comprehend the potential of videogames in terms of cognitive processes.

3.1 Understanding the basics of player – game interactions

With the purpose of analyzing the essence of player-game interactions, in 1999 I conducted a series of experiments in order to formulate a qualitative inductive

model of human-computer interactions that occur during the game-playing. The study was based on the *Grounded Theory* qualitative method [Stra90], and involved expert Chilean players and commercial videogames. Information regarding player-game interactions was gathered during and after gaming sessions, through informal conversations and semi-structured interviews, and the data analysis process revealed regular patterns of player-game interaction that allowed me to elaborate the analysis presented in the reminder of this section.

A typical game-playing session is characterized by the basic interactive cycle shown in Figure 2. During the game-playing, the player gathers information regarding the gaming world, analyzes it, makes decisions based on her analysis and acts changing the status of the gaming world and thus initiating a new interactive cycle. Therefore, information management processes are crucial in terms of the game-playing, during which the player receives and manages two kind of data: ambiance and functional information.

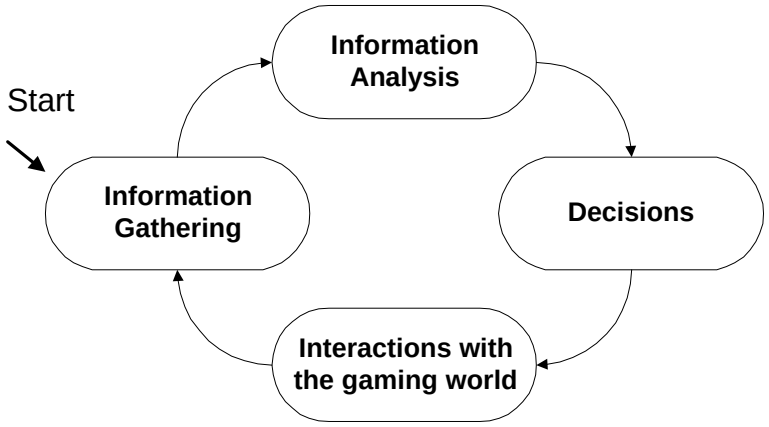

Figure 2: Interactive cycle in the gaming experience

Ambiance information encompasses merely perceptual elements that contribute to create an atmosphere capable of drawing and maintaining player's attention on an emotive basis (for instance, the visual information necessary to make the player believe that she is playing a game placed in the world of the STAR WARS saga). Therefore, it has mostly to do with the feeling of the player about her being part of the gaming world during the game-playing, and hence it can be considered very relevant in terms of immersion but quite disregardable in terms of functionality.

Functional information is inherent to whatever is needed to understand and control the game-play (i.e., what can be done during the game-playing, and the purposes to do it). In order to understand the relevance of functional information, it is important to consider that in every videogame the action takes place in a virtual world, and a virtual world is made of several elements involved in the interactions between player and game (see Figure 3). In first place, the virtual world is inhabited by entities. Among all the entities, the most important one is certainly the player's token, since it is the only one directly controlled by the player, thus being the means that allow the player to interact with and exhort control over the rest of the virtual world. The other entities (non-player entities) can be hostile (in the case of the antagonists), or else their can be variable-attitude entities, whose behavior and attitude toward the player's token may vary according to the circumstances and the

course of action taken by the player (for instance, in many case variable-attitude entities may be helpers in the beginning of the game, and become enemies if they are not satisfied with what the player does). Everything in the gaming world takes place in scenarios, made of inert elements (whose status does not ever change during the game-playing) and active elements (whose status may change as a result of interactions that involve entities and active elements). Whatever happens in the gaming world is regulated by a system of rules, which determine what can or cannot be done within the virtual world, the consequences of all the possible interactions and regulate the happening of whatever cannot be directly controlled by the player (as, for instance, the behavior of the antagonists). Finally, an important part of the gaming world is a set of goals (usually organized in a hierarchy of interdependent goals), which is what motivates the player to face the struggle during the game-playing.

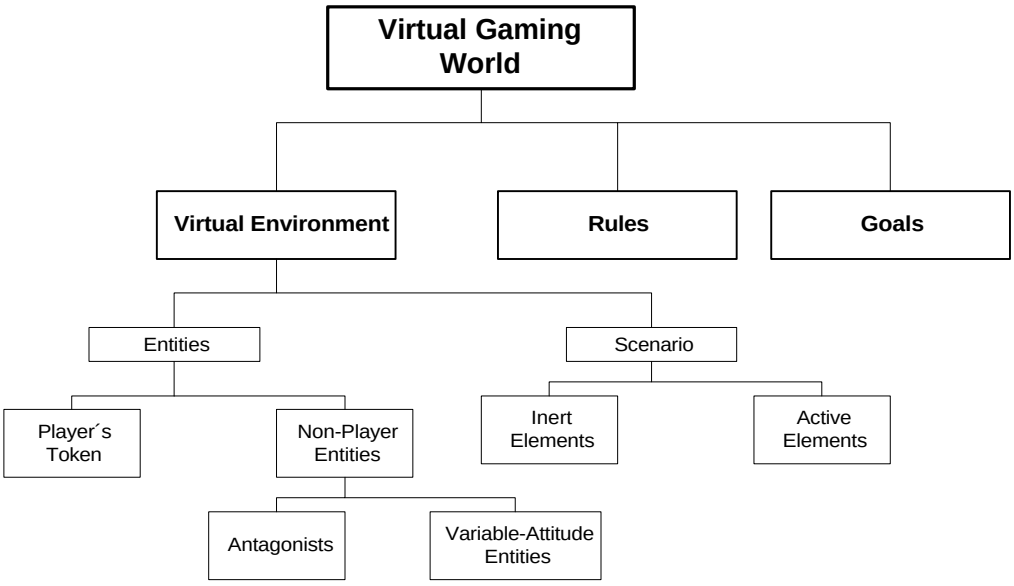

Figure 3: Virtual gaming world elements

All the aforementioned elements can be considered functional elements, since they have some function within the virtual world (for instance, antagonists have to oppose to the player's token) and the player is required to deal with them in order to play the game (i.e., to actually make things happen in the virtual world), as opposed to what happens with ambiance elements, which could be altered without affecting the functionality of the game (for instance, a game based primarily on sword-fighting action could be indifferently placed in a Caribbean pirating environment, or in a middle-age saga).

Functional information inheres the status of all the functional elements, their properties, interactions (in terms of both possibilities of interactions and consequences) and all the happenings that involve them. More specifically, as for entities and scenario elements, functional information is employed to allow the player to understand the current properties of each component of the virtual environment, and how and when changes in such properties may occur. As for actions and interactions, functional information regards whether they are possible or

not, their status (for instance successful/unsuccessful), the agents that have originated and/or participated in an event, and the consequences on the gaming world. Additional information may also be transmitted regarding rules that are not directly related to entities, scenario elements or actions/interactions (for instance, the time-limit to complete a mission).

All the aforesaid give birth to a very simple player – game interaction model, based on the idea that the game-playing can be considered a dialogical activity. In fact, as shown in Figure 4, the activity of playing a game can be compared to a dialog happening between two interlocutors, namely the player and the game.

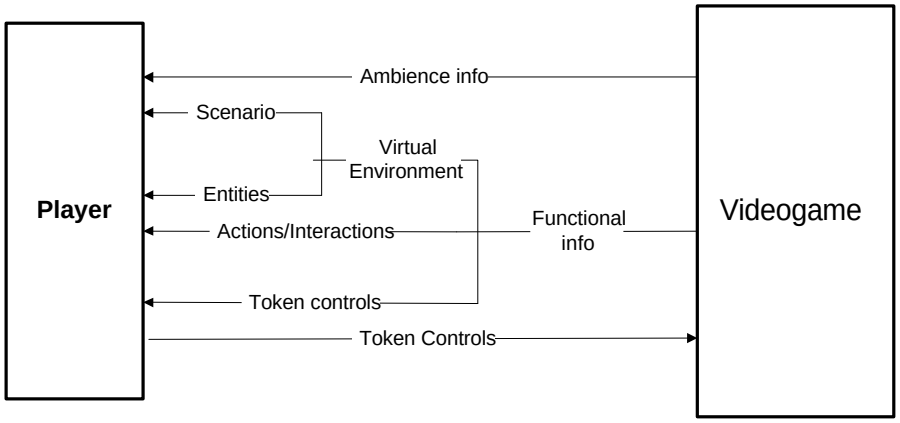

Figure 4: Player – game interactions as a dialogical activity

In fact, metaphorically speaking the game "tells" the player important things through the transmission of functional information, things that regard the status of the virtual world. Then, the player "listens" to what the game has to say by gathering part (eventually all) of the information transmitted (all of which happens during the information gathering stage of the basic interactive cycle). After "listening", the player thinks about what she has heard (during the information analysis stage), makes decisions (during the decision making process) and "talks back" to the game, by means of interactions based on her decisions (directly controlling her token). After that, the game reacts to the interaction changing the status of its virtual world, and then transmitting new information of the player, which initiates a new interactive cycle, and gives continuity to the dialogical activity.

One last remark is due apropos the interactive cycle: the time required to complete it is remarkably variable and depends on the style of the game. In fact, it ranges from a mere heartbeat in very simple situations (as, for instance, in a soccer game, where a player analyzes the situation, and decides what teammate to make a pass to in a matter of instants), to an arbitrarily long time in complex situations (as it may happen in turn-based strategy games, where the player has all the time she wants to carry out a complete interactive cycle).

The analysis of the dialogical interactions that occur between player and game stress the importance that information management processes have in terms of game-play: without processing functional information, the player would to be able at all to make decisions (due to the lack of knowledge about the virtual world), and therefore he would not be able to interact with the gaming world. Consequently, the most important conclusion that can be drawn from the analysis of player-game interactions regards the crucial importance of information management and decision-making processes, without which there would be no game-playing at all.

3.2 Learning and videogaming: one, but not the same

Having discussed the essence of player – game interactions, it is now possible to focus back on videogames and learning processes. What is the nature of their relationship? The key to answer this question is the basic interactive cycle underlying the game-playing, and analyzing the learning processes involved in each stage of the interactive cycle is the approach to find the answer.

As written in the previous section, during the first stage of the interactive process the player has to gather information regarding the gaming world. Since challenge is an essential element of every videogame genre, the information-collection process is never completely straightforward. Some of the pieces of information necessary to play the game are usually easily perceivable as transmitted through the standard game interface (which includes aural, visual and physics-based devices), such as, for instance, in the case of the look of a wounded enemy. However, as part of the challenge the player is often required to find some pieces of information deliberately "hidden" in the game. In this case, the player have to use insight, visual-spatial skills, logic and strategic thinking in order to decide what information is needed, and where and how to obtain it. Therefore, it is possible to safely affirm that in the first stage of the interactive cycle the player undertakes learning processes that contribute at least to the development of her insight, visual-spatial perception, strategic thinking and logical reasoning, all skills/abilities whose development certainly does not benefit the mere game-playing. Additionally, there is the information itself. The relevance of much of the information learned during the game-playing is certainly limited to the context of the game (for instance, knowing how to operate a laser sable is of little relevance in the real world). However, depending on the contents of the game, there may be valuable information that is not related solely to the context of the game (for instance, there are several strategy games that require the player to learn information about civilizations that were very important in the history of mankind). In such cases, the player has the opportunity to enrich her knowledge base adding to it new information or modifying previously acquired information (for example, erroneous concepts regarding the working of a catapult).

In the second stage of the interactive cycle, the player is required to analyze the information gathered. More specifically, analyzing information regarding the gaming world means at least interpreting available data (which is not always straightforward, since many times the difficulty of interpreting data can be deliberately employed as an element of challenge) and identify relationships with previously acquired information in order to draw conclusions regarding the status of

the gaming world (as, for instance, when in a war-game the player has to forecast the behavior of her opponents based on the information gathered by scout units during the whole game-playing). Therefore, the information-analysis stage is clearly an excellent opportunity to develop analytical capabilities part of reasoning processes whose importance is not limited to the context of the game (as, for instance, in the case of relational analysis).

The third stage of the interactive cycle is characterized by the need of making decisions. In this stage, the player has already gathered and analyzed all the information that she considers necessary to "make the next move", has drawn all her conclusions about the status of the virtual world, and consequently she faces the task of deciding what to do. In this context, strategic thinking is very probably the most important talent required. In videogames very few decisions are made based on the certainty of their outcome, and usually the player decides based on her belief of how the results of her course of action will affect her struggle to achieve the goals of the game, and based on the resources available and needed to act. Therefore, making decisions usually imply managing risks and resources, which in turn stresses the importance of strategic thinking, and how the decision-making stage is an ideal context to develop it. Additionally, decisions are never free: as mentioned in the previous section, every game as rules, and whatever the player wishes to do, she will always be subject to the rules. Therefore, known rules are always considered as a fundamental element to make decisions. Furthermore, unknown rules may be a good teacher to refine strategic thinking, once the player analyzes a strategy that did not lead to the expected outcome, and determines why and how the unknown rules (and eventually other unexpected events) determined the failure of her strategy.

Finally, there comes the action time. Once made the decisions, the player has to exert control over her token in order to interact with the gaming world. Controlling the token the most important (if not the only) task that the player has to perform during this phase, and it implies using an input interface (for example, a combination of keyboard and mouse in a computer game, or joystick in console game) in order to "tell" her token how to interact and what to interact with. Consequently, psychomotor skills are crucial in this stage, and the pace of the game determine how seriously they are put on trial (for instance, in fast-paced action games the need of excellent psychomotor skills is crucial to achieve a good performance, while in a chess game the demand in terms of psychomotor skills is usually limited to point-and-click sequences that can be performed without serious time constraints). Hence, the fourth and last stage of the interactive cycle is certainly relevant in terms of psychomotor development of the player, but that is not all. Since the outcome of any decision cannot be seen until the decision becomes action, the action stage provides the player with the feedback necessary to understand whether her decisions were right or wrong, and therefore it has to be considered a fundamental part of trial-and-error processes that lead the player to refine her skills/abilities and allow her to improve her mastery of the game.

In order to recapitulate, the analysis of the learning processes embedded in each stage of the interactive cycle that underlies the game-playing leads to conclude that such processes contribute to the development of the player at least in terms of:

1) Analytical capabilities.
2) Strategic thinking, insight and logical reasoning.
3) Psychomotor skills.
4) Enrichment of the players' knowledge base (both through the acquisition of new information, or the modification of previously acquired data.

Furthermore, it is important not to forget the issue of moral values (and even anti-values). Videogames have a potential to transmit issues related to moral values (such as the traditional topic of the supremacy of good against evil) at least as good as other entertainment forms' (such as books and movies). However, this work will not enter in details regarding values and videogames, since I consider that the topic deserves an extensive and accurate analysis that transcends the scope of this paper.

In conclusion, the bottom-line that can be drawn from all the aforesaid is that not only videogames may contribute to the development of the players, through the learning processes embedded in the playing activity, but that learning is actually required in order to play, since there is no stage of the basic interactive cycle that does not require developing or practicing some of the player's skills/abilities. Moreover, videogames benefit the development of the individual through contexts that, through the use of virtual environment, allow the player to experiment situations that the player would have no access to through any other means (remember that although traditional means such as movies and books have a great potential to render fictional environment, they lack the gift of interactivity, which determines the unicity and most of the power of the videogaming experience), and to do that in an environment absolutely free of functional pressures and negative consequences (to understand the importance of this, just imagine the difference between using a flight simulator and trying to fly an airplane without proper training).

The last important thing that must be stressed is that the conclusions regarding learning processes and videogames are by no means related to the so-called educational videogames. As a matter of fact, all the analysis that led to the conclusions presented in this section was based on videogames designed with the sole purpose of entertaining, and not as pedagogic tools.

4 Current trends in the educational exploitation of videogames

The previous sections led to the conclusion that, in order to play a videogame, the gamer has to learn things, independent of the specific contents of the game and whether it was designed with educational purposes. In other words, learning is a natural part of videogaming. Now, is this exploited by those who use videogames with educational purposes? Are the formulas currently used to design educational ludic applications the more suitable to exploit the didactic potential of videogames? Addressing such questions means turning the attention to the *edutainment*, since it is the only phenomenon that targets a massive community of users (thus being of great social importance) employing videogames with educational purposes.

Before continuing with the analysis, it is opportune to remark that it will be focused only on products that belong to the edutainment industry and claim to be

videogames (thus, the analysis does not consider the cases of peculiar applications such as the interactive books), since it would be absurd to analyze products that have no pretension of being videogames in order to see whether they exploit characteristics proper of videogames.

What is the edutainment? The concept is derived from a combination of the words “education” and “entertainment”, which allows me to safely define the edutainment as the activity of educating while entertaining through the use of amusing computer applications. Why did I not say: “through the use of videogames”? Because most of the products that crowd the educational games market cannot be defined videogames at all since they lack the element of struggle, which deeply compromises the challenge that the player faces during the game-playing. This situation makes it necessary to analyze what is the relevance of the concept of game in the edutainment industry, and engenders the roots of the underexploitation of the relationships that exist between videogaming and learning processes.

During my latest experience as a game designer, working in an educational project I had a chance to review quite a remarkable amount of edutainment products, and analyzing their characteristics I reached the conclusion that the purpose of teaching specific contents makes the game too often considered a servant of the educational process, which causes the gap (in terms of popularity and richness of learning experiences) existing between educational ludic applications and videogames created merely to entertain. Since the goal of an edutainment application is teaching some carefully selected didactic contents to a group of target users, the impression that you can easily draw from the analysis of many edutainment products is that designers primarily focus on how well the application facilitates the learning tasks. Consequently, the game is considered a mere tool whose purpose is making the learning process easier, ensuring at least that:

a) The game provides a motivating environment to make learning more amenable to the player;
b) Whenever possible, the game is used to provide some kind of help to the learner while she is facing cognitive tasks or to provide positive and/or negative reinforcement to increase the effectiveness of the learning process; and
c) The game does not interfere with the cognitive tasks (meaning that during the learning process the only difficulties faced by the player are those engendered by the learning tasks themselves, without any interference coming from gaming elements).

The last point is clearly related to the role of struggle in videogames, and to why educational games are marked by its absence (or at least a very faint presence). The preoccupation of preventing gaming elements from interfering with the cognitive tasks (sometimes due to the underestimation of players’ skills and abilities) creates a barrier between instances of learning and instances of playing that contributes to make the player perceive the cognitive task as an element of disruption in terms of game-playing. And this is just part of the wall created between learning

and gaming. The conviction that the game has a role ancillary to the learning processes creates an unnatural separation between game-playing and learning which prevents the proper exploitation of the didactic potential of true videogames. In fact, the game is commonly considered nothing but a wrap for the cognitive tasks that must be performed by the player, a wrap that must motivate the gamer and eventually provide amusing means to help the player and provide her with some kind of reinforcement. In other words, the most common picture in the edutainment market is that there is the game and the cognitive task, and usually there is no cohesion between the two, meaning that the cognitive task has little or no contextual relevance in terms of game-play.

The paradox that arises from this situation is that, with the purpose of using a videogame to benefit a learning process, edutainment designer often produce applications that in first place are not videogames at all, and in second place, due to the forced separation between learning and gaming processes, do not take any advantage of all the learning processes naturally embedded in every gaming activity (previously discussed in this work). In fact, it is quite difficult to find edutainment products that give any importance to the basic interactive cycle that underlies the game-playing, and to how it is a natural contributor to the development of the individual. The result is what I call the "going to the groceries store around the corner with a Ferrari" phenomenon: you can certainly do it, and a Ferrari is at least as good as any other car to do the job. But, is buying groceries worth using a Ferrari? Couldn't you do anything better with a car like that? As for videogames and learning processes, in my opinion something better can certainly be done, and that something has much to do with reconsidering the role that the game-playing has in terms of the development of the player.

5 Conclusions: edugaming as a new paradigm in educational game design

All the things discussed this far lead to two important conclusions:

a) Videogaming is an activity that naturally engenders learning processes that contribute to the development of the player in many areas.

b) Nowadays the approaches followed to design educational ludic applications are not suitable to fully exploit the potential that videogames offer in terms of learning processes, and moreover lead to the creation of products too often poor in terms of gaming experience (due to the lack of engaging elements of challenge and struggle).

A natural question arises in this context: what can be done to improve the situation? In my opinion, new paradigms in educational game design are needed, and, as mentioned in the previous section, the solution to the problem starts from reconsidering the role that the videogame must have in relation to the learning processes. Videogames must not be considered mere pedagogic tools, ancillary to learning processes, but rather it is necessary to acknowledge their importance as

phenomena that naturally engender learning activities, without the need of somebody wanting to teach something through them. In this sense, it is in first place important to understand that a virtual gaming environment is per se a learning environment, since it offers conditions free of any functional pressure and negative consequences, and constantly faces the player to situation that engender changes, thus involving her in an experience that demands learning and developing skills and abilities during each instance and repetition of the basic interactive cycle which the game-playing is based on. Consequently, a good approach to create better educational games is not thinking what gaming experience can be the most motivating frame for some specific controlled learning activities, but rather how the to create a virtual environment and a gaming experience in which the contents that we want to teach can be naturally embedded with some contextual relevance in terms of the game-playing. In 1987 Malone and Lepper [Malo87] already proposed a similar concept, underscoring that the greatest educational effectiveness is achieved when cognitive tasks are relevant (and, even more, necessary) to achieve the goal of the game, thus being part of the activities of the game (intrinsic metaphor), as opposed to when the game is nothing but an amusing wrap for didactic contents completely unrelated to the game (extrinsic metaphor). However, their claim must be taken one step further: the contextual relevance of the didactic contents must not be interpreted in terms of how well the cognitive tasks contribute to the achievement of the goals of the game, since this is not the only case in which players consider that there is cohesion between game-play and cognitive tasks. Rather, learning tasks must be contextual to the game in the sense that they must be perceived by the player as a true element of the game-play. To make this concept even clearer, let us consider a quite famous non-educational example: NINTENDO's SUPER MARIO BROS. In the game, the player has to control Mario (who is perhaps the most famous plumber in the world) to help him make his way in a world populated of fictional creatures such as giant turtles and mushrooms. Winning the game simply means reaching the end of huge scenarios overcoming the opposition of antagonists. However, scattered through every scenario there are bricks that float in the air and which often hide coins that allow to increase the score of the match, or power-ups that enhances Mario's properties (for instance granting him an increased resistance against opponents' attacks). Do the player have to open the bricks in order to win the game? No. Are the bricks disruptive in terms of game-play? Neither. Quite the opposite, actually. They are perceived as an element of fun since their design is consistent with the rest of the virtual world, and since they have some relevance in terms of game-play (even when they merely increase the score of the player). Instead of hiding coins, those bricks could be hiding anything else, for instance letters or numbers, and they would still perceived as part of the game-play.

Now, one final important question: is all that I have written about this alternative way to design educational games mere speculation? In other words, does the proposed approach really work? I applied the principles discussed this far to design and produce six Game-Boy games which where actually tested in classrooms with a significant group of players (approximately 300 children aged between 6 and 8) supervised by their ordinary teachers. I had the opportunity to directly appreciate the reactions of player through methodical observations conducted during the

gaming sessions, and I could see what I hoped to see: gamers playing true videogames, and learning things just because the games required them to. To my knowledge, no children ever complained about having to perform boring cognitive tasks that disrupted her game-playing, and all the difficulties, all the struggle that they had to face (even the obstacles represented by the difficulty of the cognitive tasks themselves) were perceived as part of the game, and therefore accepted as an element of challenge. Furthermore, it was very interesting to see how the supervisors, besides making obvious comments regarding how well the games served to teach the didactic contents deliberately embedded in the games, spontaneously reported a development of the children in areas not directly related to the contents the games were supposed to teach (for instance, they explicitly mentioned general improvements in terms of discipline, concentration and eagerness to understand technologic issues related to the games they were playing). This was in my opinion the practical proof that the contribution of real videogames really goes far beyond the learning processes directly related with deliberately embedded didactic contents.

Finally, it is proper to underscore that the alternative design approach discussed until now has a name, and the name is *edugaming*, a word which I derived from merging "education" and "gaming" and definable as the activity of educating exploiting the learning processes implicit in every gaming activity. I chose the word edugaming to stress the importance of the fact that educational ludic applications should not have the sole goal of educating while entertaining the learner, and that the learning processes must not be framed by an entertaining activity, but rather embedded in a genuine gaming activity, with no unnatural barrier separating learning from gaming.

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