

Health-care Games and the Metaphoric Approach

by

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ABSTRACT

Many Serious games dedicated to the health sector have been identified. Within this wide range, we have explored the Serious games offering an educational dimension and targeting either individuals or health-care professionals. Based on a corpus built around this orientation, our goal is to determine whether or not we find a use, targeted or not, involving metaphorical contexts among different titles. Once the results have been obtained, and after having defined the methodology used, the objective will be to offer answers to analyze the results.

Keywords

Serious game, Taxonomy, Health, Prevention

INTRODUCTION

Although the use of metaphors seems attractive, can this approach address all types of audiences when designing Serious games dedicated to the health-care professions? To study this issue, we will focus on existing titles that offer an educational dimension and are aimed at health-care professionals or individuals, among whom we include patients. With such a corpus, it is of interest to verify whether or not metaphors can be found exclusively for a given public. From the results, we will seek answers to nourish the discussion of this issue.

In this context, we will begin by defining an approach to the concept of metaphor and defining what we mean by the term "Serious game". Then, we will present the methodology used to constitute our corpus of Serious games dedicated to health-care.

DEFINITION OF "SERIOUS GAME" AND "METAPHOR"

Definition of Serious games

Various designations and definitions exist with regard to the term "Serious game." The oldest is probably that of Clark C. Abt, who in 1970, defined Serious games as adding an educational aspect to outdoor games, board games, role play and even computer games. In the context of this chapter, we choose however to focus on computer-based games and to exclude those played only in a non-computer environment, such as "PROTIX,"¹ Université de Saint-Etienne (France) - CIRCO (Centre Interrégional de l'Organisation Hospitalière) France) a non-computer board game similar to Monopoly, devoted to the management of patient flows in hospitals. The computer has been the preferred medium for the focus of scientific work since the rediscovery of the term in 2002 by Benjamin Sawyer. In addition, given the diversity of definitions suggested by Clark Aldrich, Richard Van Eck, and Michael Zyda, we must establish our position. To facilitate the implementation of our analysis, our study will not cover Serious games which take place within mixed realities as defined by Paul Milgram and Fumio Kishino. This excludes such set ups as operating theaters pedagogically outfitted with virtual patients in the form of electronic dummies (human patient simulator with pulse, blood pressure) lying on a hospital bed with real monitoring devices (respirator, drip feed systems) (Figure 1).



Figure 1: Anesthesia Simulator

We have chosen to use the following definition developed by Alvarez and Djaouti (Alvarez & al, 2010) which seeks to combine several approaches:

"A computer application whose intended purpose is to coherently combine both serious aspects such as, but not limited to teaching, learning, communication, or information, with game playing aspects from video games. Such a combination, functioning according to a utilitarian scenario, which in computer terms implements a sound and graphics package, a story and appropriate rules, and is therefore distinct from simple entertainment. This distinction appears to be based on the prevalence of a utilitarian scenario whose objectives, in formal terms, overlap with those of a video game."

This definition can be summarized by the following relationship:

Utilitarian scenario + gaming scenario => serious game

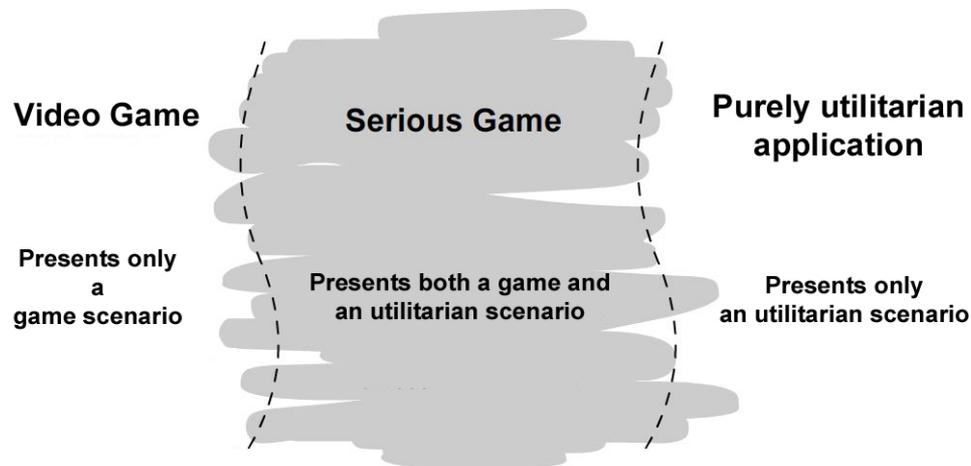
It should be emphasized that this implementation of the utilitarian scenario in relation to game playing must be done coherently. It is not a question of simply putting them side by side. On the contrary, they must converge (Tricot, 1999) so that the user can simultaneously enjoy the gaming experience and utilitarian aspects. Otherwise, if the two scenarios are not really linked, the application will very likely present an imbalance causing one of the two scenarios to take precedence over the other (Kelner, 2000). In such a context, a Serious game would not really offer a utilitarian aspect. For example, if the purpose of a Serious game is to educate

users on the dangers of driving too fast, it would be counterproductive to introduce a Driving game in which one of the challenges would be to reach relay steps within a time limit. On the contrary, in this case the game should propose rather to establish the relationship between the factors of risk and speed: in other words, the faster the user drives, the greater the risk of having an accident and thus losing the game.

For the same reasons, we have only selected games in which both scenarios have been defined at the design phase of the game. Although there are many examples of a posteriori adaptations of a video game to give it a utilitarian dimension, and such an approach can always be integrated within a scenario, we have chosen not to focus on these adapted video games in our definition of Serious games. (

Figure 2)

To constitute our corpus based on this definition, we will therefore exclude titles dedicated solely to entertainment or solely to utilitarian objectives, while using the criteria of balanced integration of a utilitarian scenario and a video-gaming scenario at the design phase of the game.



The boundaries between these three categories are porous because determining the gaming and utilitarian dimensions is a subjective act.

Figure 2: Definition of a serious game

Although our definition requires the utilitarian and game-playing scenarios to be in synergy, it does not require them to use the same universe. The universe of the utilitarian scenario is predefined by the utilitarian target, while game designers have complete freedom in choosing a game-playing universe.

This freedom of transposition between the reference context of the utilitarian scenario (therefore the context of the medical world in our article) and the game-playing universe in which any fantasy is possible, will allow us, in the following paragraph, to define what we mean by metaphor or a metaphorical universe in a Serious game.

Definition of “Metaphor” in a Serious game

Before defining the term “metaphor,” we need to clarify the concepts of “universe” and “fantasy.”

According to the definition adopted in the previous paragraph, a Serious game is the alliance of a utilitarian scenario and a game scenario. The term “scenario” includes several

fundamental concepts which we will not elaborate on here but which in particular include the concept of “universe.”

The context of reference or utilitarian universe is understood as the set of social practices of reference (Martinand, 1981). In the context of games dedicated to health care, it will therefore be a medical or paramedical environment.

The game universe is linked to the narrative framework (Bizzocchi, 2010). It is presented as an essential element of the narrative, called an imaginary world by Bizzocchi, and is defined as the environment in which the game’s action takes place.

The work of Malone & Lepper [Malone 81, Malone & Lepper, 1987], concerning the world of digital games for learning, defines a fantasy universe as "one that evokes mental images of physical or social situations not actually present".

The Oxford Dictionary defines metaphor as "a figure of speech in which a word or phrase is applied to an object or action to which it is not literally applicable."

In rhetoric, a metaphor, "from the Greek μεταφορά (metaphora, literally “transport”), is a figure of style based on analogy and/or substitution." It is a particular type of image, without a comparative object, which associates one term with another which belongs to a different lexical field in order to render a richer and more complex idea than that expressed by concrete, descriptive vocabulary."

Victor Hugo used metaphor when he wrote "this sickle of gold" in reference to the waxing or waning moon.

In the framework of Serious games, we define metaphor not as the substitution of one word for another, but as the substitution of a game universe for a context of reference, in which it is possible to use fantasy and abstraction to motivate or immerse the player. This universe of substitution will then be called a metaphorical universe.

A few examples will illustrate this definition.

If we take the example of “Mecagenius,” a Serious game in the industrial sector, its educational purpose is to train students in mechanical engineering and particularly the optimization of production using digitally controlled machine tools, by reproducing the universe of the mechanical engineering industry.

The game universe is situated in a relatively distant future. The human race has left the planet Earth to live elsewhere in space. Many mother ships scour the Galaxy for planets which can be “terra-formed,” to serve as suitable habitats for human settlement. The player takes the role of an apprentice engineer whose spacecraft is marooned on an unknown planet. The player’s mission is to repair the hovercraft that will allow him/her to travel around the planet. To do so, the player is confronted with a number of missions leading to several mini-games to earn equipment or materials to manufacture parts to repair the craft. This is a metaphorical universe because it overrides the industrial context of mechanical engineering.

There are two types of mini-games in Mecagenius: some in which the universe is realistic, while others use a metaphor. For example, the player can drive a high-power race car thanks to the digital control of a machine tool. In this case, the context of reference of a digitally controlled machine tool is transposed to the universe of auto racing without any link to the actual context of using a machine tool.

In the context of health, the purpose of the Serious game “Pulse!!” (Figure 3) is to confront the user with a series of virtual patients for whom a diagnosis must be established to provide appropriate treatment.

The context of reference is identical to the proposed game universe. Consequently, no metaphor is used here.



Figure 3: The serious game "Pulse!!"

On the other hand, some game universes seem to have no link whatsoever with the context of reference.

Take the example of the game "1,2,3: Asthma Breathe!" The player moves colored pawns within a digital setting resembling that of traditional board games. Here, the game universe is metaphorical. In this universe, pawns symbolize the characters embodied by the players. We can therefore refer to an abstract, metaphorical universe.

In the same register, the Serious game "Re-mission" [Re-mission, 2006], is aimed at teenagers with cancer. It is an arcade game whose decor is set inside the human body. The player controls a personified chemotherapy, and the goal is to eradicate the different types of cancer cells in the body of various patients. It is a transposition of the concepts related to the spread of the disease into a metaphorical universe, since in the context of reference, the patient is not in control of the chemotherapy, but is rather subject to it. In the context of this game, the player embodies a virtual character and we refer to a fantasy metaphorical universe.

STUDIES AND CLASSIFICATION

Now that we have established what we mean by the terms "metaphor" and "Serious game," we will outline the methodology chosen for our body of Serious games dedicated to the health-care sector.

Our methodology is as follows:

- 1) Identify systems of classification of Serious games
- 2) Cross-reference the systems identified to classify Serious games dedicated to health care
- 3) Establish the Serious games corpus

Existing Classification Systems

With regard to the taxonomy of Serious games, we identify taxonomies which use a single criterion [Chen & Michael 2005], [Zyda 2005], [Bergeron 2006], [Despots 2008], [Alvarez & Michaud 2008]. But the most comprehensive and transversal approach appears to be "Serious Game Taxonomy" by Ben Sawyer and Peter Smith (2008) which classifies Serious games according to two criteria: the "market," which refers to the scope of application of the title, and the initial "purpose." This approach relies on previous classifications, all based on a single indexing criterion: either the field of use, or the designer's original intention. The Sawyer and Smith approach therefore emphasizes complementarity and the need to combine these two criteria in order to better understand the classification of Serious games.

This paradigm corresponds to the approach of Djaouti and Alvarez. In their previous work (Djaouti & al. 2011), they consequently proposed to pursue the approach of Sawyer and Smith in the form of a taxonomy called "Gameplay / Purpose / Sector" (G/P/S).

This taxonomy attempts to classify Serious games according to three criteria:

Gameplay: this identifies whether the video game has explicit objectives or not.

Purpose: this criterion tracks the nature of the utilitarian function of the serious game.

Sector: this refers to the fields of application of the serious game.

Gameplay

The presence of rules, objectives, notions of conflict, duel/competition, or universe are characteristic of games.

Purpose

While the gaming scenario is designed to provoke pleasure and immersion, it is necessary to identify the functions associated with the utilitarian scenario. Indeed when we state in the definition of a serious game that it concerns "*in a non-exhaustive and non-exclusive way, teaching, learning, communication, or information,*" it may seem that there is a wide range of utilitarian functions. However we point out that in our opinion there are in fact only three types for these functions:

Broadcast a message: According to the "market" aspect, these messages may have very different characteristics: educational (edugames), informational (newsgames), persuasive (advergames), etc.

Dispense a training course: this involves improvement of cognitive performance (for example serious games dedicated to brain training) or the user's physical motor function (such as serious games dedicated to fitness).

Enable the exchange of goods: a Serious game may also serve as a medium to distribute or share (earnings, etc.) real or virtual property.

A Serious game can be focused on one of these three functions, but may also combine them: broadcast a message while providing training for example. This is the case of some Serious games dedicated to the health-care sector that we address in this paper.

Sector

In the context of this chapter, our focus will be limited to the health-care sector. However this in itself is a very broad field with many niches. It embraces for example, in a non-exhaustive manner, informative and awareness campaigns targeting individuals (obesity, STDs, etc.), professional software providing teaching or training dedicated to medical practice, therapeutic patient games, etc.

Smith and Sawyer, recognizing the need for greater precision, have proposed a taxonomy specific to each "market" in addition to their general taxonomy. All of these taxonomies are based on two criteria. Those dedicated to health-care are:

"Function" of which the different items are: preventive, therapeutic, diagnostic, educational, information processing.

"Type of public" of which the different items are: individuals, professional practitioners, researchers and academics, institutions.

The audience of individuals includes: patients, the families of patients and the general public.

In the health-care sector, there are various types of applications, some of which may be related to Serious games and others to simulators. Kaufman (2010) distinguishes six types of simulators used:

The first two involve solely human aspects:

- role play
- actors taking the role of patients

The next two do not fit the context of our study either, because the computer is used only for multimedia purposes:

- scripted video simulations
- computer simulations of multimedia and interactive case study

The last two use a computer in staging the simulation:

- Realistic interactive simulations using both a physical reproduction of the human body and measurement instruments simulated on computers
- Complex interactive simulations involving both a physical human body replica and intelligent computer systems.

We will classify all the applications within three broad categories: 'mixed applications,' 'digital applications,' and 'non-digital applications' according to the virtuality continuum defined by Milgram (Milgram, 1994).

A Classification of Serious games in Health-Care

By cross referencing the classifications of the Serious games from B. Sawyer & P. Smith, D. Djaouti & J. Alvarez & and by using the Milgram taxonomy and the classification of health-care simulators established by Kaufman, we propose to define the corpus of applications that will be studied in this article. The diagram presented in Figure 4 is the result of this cross referencing.

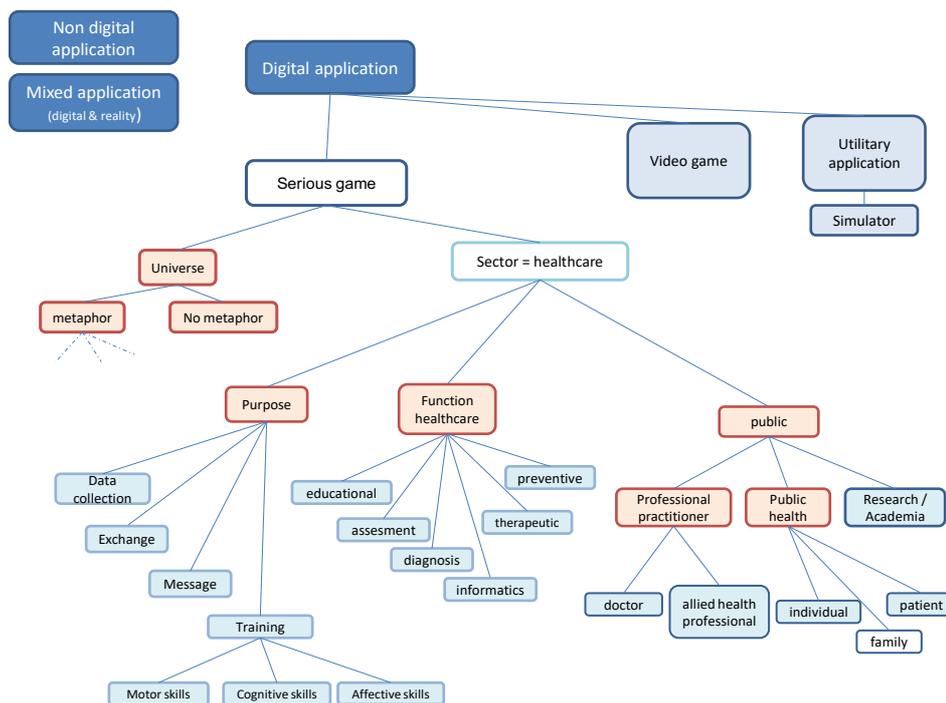


Figure 4: Classification of Serious games in the health-care sector

After excluding applications from our corpus of study which do not correspond to our definition of Serious games (cf. paragraph 2), and of course, having limited the sector to health care, the determining criteria for ranking games selected in accordance with the previous taxonomy are therefore:

- Does the game use a metaphorical universe or is it modeled on a utilitarian universe of reference?

- What is the nature of the utilitarian goal (psychomotor or cognitive training, informative)?
- What is the function (we only focus on educational, preventive or informative functions)?
- What is the audience, distinguishing individuals (patients, families or general public from health-care professionals)?

At this point, we can begin to identify an initial set of Serious games dedicated to health-care. To do this, we rely on the data proposed by <http://serious.gameclassification.com> which specifically classifies the Serious games according to the G/P/S method. As of July 2011, 184 titles of serious games dedicated to health care have thus been identified. These titles are available online at the following address: <http://bit.ly/offhAf>. They cover the period from 1983 to 2011. From this pool, the titles must be sorted to form a corpus that matches our requirement criteria.

CHOICE OF CORPUS

Rules of the Game

There are digital applications in the field of anesthesia: “Virtual Anesthesia Machine (VAM)” from the University of Florida. VAM is used to show future practitioners how the internal structure of an anesthesia machine works to facilitate learning how to use it (Florida - USA) (<http://vam.anest.ufl.edu/>).



Figure 5: Virtual Anesthesia Machine (VAM) from the University of Florida

Even if this type of tool has a utilitarian goal, it nevertheless has no game-playing scenario, or predefined rules. Consequently simulators will be excluded from the corpus of study since they do not possess rules other than those related to utilitarian objectives.

Diversion of Video Games from Entertainment to Utilitarian Purposes

Conversely, any video game can be diverted for utilitarian purposes. For example, “Pacman” (Namco, 1980) might turn out to be useful in the psychomotor field, since this arcade game prompts the user to exercise dexterity by the rapid flow of a series of movements. In line with this paradigm we have noted the work of psychologist Michael Stora, who has used video games such as “ICO” (Sony, 2001) in therapies for children. This title features a character controlled by the user, who holds the hand of a princess. When the player has to release the princess’s hand in order to accomplish a task within the game, the doctor notes the reactions. Some children balk at doing so and are disoriented. Stora then attempts to establish dialogue in transposing the family life of the child through the situation presented by the game. (Stora & al., 2006)

With such approaches many video games could be diverted from their initial recreational purposes to utilitarian ones. This raises the question of substance: given that a Serious game is based on a videogame diverted from an entertainment objective, what difference can be established between an adapted video game and a Serious game?

The answer lies in the type of diversion. In the examples of “Pacman” and “ICO,” diversion, occurs only at the level of usage: it is a physician who decides and sets his own objectives for the patient. Such an objective is not originally intended by the authors of the video game, or the result of after-market integration in computer terms. In the case of a Serious game on the other hand, starting with its design phase, or by modifying the original program, a utilitarian dimension is implemented. This approach implies integrating a utilitarian or pedagogical scenario within the application that will be associated with the videogame base. Thus, the presence of this utilitarian or pedagogical scenario characterizes the Serious game and distinguishes it from the video game which is simply used differently from its initial purpose. This principle of diversion is defined by the term "Serious gaming" (Alvarez & al., 2010). Subsequently, applications with no rules specific to achieving utilitarian objectives will be excluded from the corpus of study for example the 'video game' category.

Origin of Utilitarian Purpose

In the effort to distinguish "Serious gaming" from Serious games, we will exclude from the corpus of study all video games which have been diverted after the fact on a purely cognitive level for use in a medical context.

However we must keep in mind that the boundary between video games and serious games is a very fine line. There is no existing tool to determine that a video game is free of a utilitarian dimension and vice versa.

In our previous work, we found that within a formal system, a Serious game did not possess intrinsic characteristics differentiating it from a video game. The distinction between these two types of objects occurs only in cultural or pragmatic systems (Alvarez, 2007).

Thus “Trauma Center Second Opinion” and “Dark Cut 2” (<http://bit.ly/nz4KYL>) are video games which both enable the user to interact with a patient via a more or less realistic approach. The object of the game here is to provide appropriate care within a time limit. The player scores points for speed and finesse of execution. Can we consider that these videogame titles are to be taken into account in our corpus of Serious games dedicated to the medical sector?



Figure 6: On the left: *Trauma Center Second Opinion*, Atlus, 2006, on the right: *Dark Cut 2*, ArmorGames, 2007

While “Trauma Center Second Opinion” and “Dark Cut 2” (Figure 6) are both in the field of pure entertainment, they also have a medical theme and feature therapeutic techniques which have existed or are currently in use. In this context everyone is free to see a utilitarian dimension or not. We propose classifying ambiguous cases of this sort according to the original intentions of the application’s authors.

Intermediate Assessment

By cross-referencing the various criteria and by analyzing the proposed classification in Figure 1, we observe that for the health-care sector, several "submarkets" exist and that they can all be developed in relation to different types of audiences. In light of these observations, to address our problem associated with the concept of metaphor, we have chosen to include Serious games in our corpus whose purpose corresponds to "Educational", and to identify applications in either the "Individuals" or "Professional Practitioners" category. Using this approach, we would like to determine whether or not the use of metaphors in the Serious games dedicated to health care corresponds to the educational function for these two types of users.

STATE OF THE ART OF SERIOUS GAMES FOR EDUCATIONAL PURPOSES IN HEALTH CARE

At this stage, we have defined the framework of our corpus. It covers Serious games dedicated to educational purposes in the health-care sector, either for "Individuals" or "Professional Practitioners." The next step is to illustrate these two subdivisions with examples of titles present in the field. The applications submitted are obviously not intended to be exhaustive but simply to illustrate the wide variety of topics covered by Serious games dedicated to health care. You can find a more complete list of games at the following address: <http://bit.ly/rgaX9t> .

Serious games targeting individuals

Among the many Serious games dedicated to education on topics relating to health-care, we have selected first some productions of the US company Raya Systems. In the first half of the 1990s, this company published a series of health-related retro-serious games on Super Nintendo and PC. All of these games offer a "Video-game" type gameplay (with an objective), and have a dual serious purpose to "Broadcast a Message" while "Providing Training.

The first of their titles, "**Captain Novolin**, (*Figure 7*) was released in 1992 to help educate children with diabetes. As a diabetic hero in a board game, they learn to control their rate of glucose and use insulin injections. We also observe that players must pay attention to the glycemic index of food bonuses that they pick up. This type of mechanism, which combines gaming and a serious dimension, is the essence of the philosophy inherent in Serious games.

The game "**Bronkie the Bronchiasaurus** (*Figure 7*), released in 1994, is aimed at asthmatic children. This is also a board game. In this case children learn to control their breathing to avoid triggering an asthma attack, as well as basic actions to perform in case of an attack. If the player finds that the breathing evaluation of his or her avatar is insufficient to complete the current level, the player can call for help to get out of the level, in order to let the avatar rest before starting again.



Figure 7: on the left: *Captain Novolin*, 1992, on the right: *Bronkie the Bronchiasaurus*, 1994

It should be noted that these games, or more precisely their influence on patients, has been the subject of academic studies by Brown (Brown & al., 1997) and Lieberman (Lieberman, 1999 and 2001). For example, one reported that diabetic children participating in the game "Packy & Marlon" (Raya Systems, 1994) had a decrease in medical visits for "critical conditions" of over 75% (Brown & al., 1997).

In the mid-2000s, the Serious game "Re-Mission" (Hopelab, 2006) (Figure 8) was released, aimed at teenagers with cancer. Set inside the human body, the user controls a personified chemotherapy, and carries out the mission of eradicating the different types of cancer cells in different patients. This Serious game has been used with some success in hospitals to explain treatment principles to young patients. The objective is to initiate a dialogue with these patients about their disease.



Figure 8: On the left: Re-Mission, right: Fatworld

There are also games that deliver both an educational and preventive message, such as Serious games which focus on a balanced diet. In this context, "Fat World" (Persuasive Games, CPB / ITVS Interactive, 2007) (Figure 8) is intended to educate children on the harmful effects of an unbalanced diet. This message is integrated into a game structure in which the user takes the role of a virtual avatar living in a city where there are few opportunities for activities or entertainment, and consequently, eating becomes a way to pass the time.

More recently we listed "My Quit Kit & Khemia" (Hoozinga Game Media, 2010) (Figure 9) aimed at helping smokers to give up tobacco. The product consists of a tool kit and a game. The tool kit provides the means to measure the user's progress and attempts to understand the reasons for tobacco addiction. In "Khemia," a game designed to aid in dealing with a craving, the gameplay is a simple timing-based arcade game. The player uses the mouse to aim at a target. A mouse click sends a burst of energy towards the target. The targets travel in slow moving patterns. The challenge is to time the release of the target to intersect the pattern.



Figure 9: My Quit Kit & Khemia aimed at helping smokers to give up tobacco

In 2011 we listed “Out of Time” (Les diablottes, 2011) (Figure 10), an edugame for Type 1 diabetic patients treated by insulin pump and using the method of functional insulin therapy. The gameplay is based on a point and click adventure game. The purpose is to help the main character resolve a murder mystery. At the same time, the player has to help the main character manage his Type 1 diabetes.



Figure 10: Out of Time, an edugame for Type-1 diabetes patients

There are also games delivering a double message: an educational message for patients and an awareness-raising message aimed at the general public. The game “Asthma 1,2,3...Breath!” (

Figure 11), published in 2009 by the Parchési company (Canada) offers an example. It targets 15 to 17 year-olds to raise awareness of asthma problems, and make them more attentive to asthmatic people in general, and in particular, to young asthma sufferers (Sauvé & al., 2011). In this game universe, the player moves pawns around the game board using virtual dice. Depending on the color of the pawn, the game features activities in relation to four themes: asthma and prevention, triggering factors, asthma and allergies, asthma control.



Figure 11: Asthma 1,2,3...Breath!

This game features specific rules and well-identified cognitive objectives:

- Raise awareness of asthma and symptoms
- Differentiate asthma treatment and be aware of the effects
- Identify factors triggering asthma to better prevent attacks
- Identify allergies affecting young asthmatics.

When we explore all of these titles over time, we see that most of them employ a metaphoric approach to present their message. But it is not systematic. Some Serious games present also a realistic universe like “Pamoja Mtaani”(Together in the Hood) (

Figure 12). This game carries both a preventive and educational message. Aimed at Kenyans between 15 and 19 years of age, the game was published to raise awareness of HIV risks and prevention strategies (focus on 5 key HIV prevention behaviors): delaying the start of sexual activity, abstinence, avoiding multiple partners, correct and consistent condom use, and uptake of voluntary counseling and testing (VCT). Published by the Virtual Heroes company for Warner Bros Entertainment in partnership with the US President's Emergency Plan for AIDS Relief (PEPFAR), the game was launched in December 2008 at four sites in Nairobi. Following a review in June 2009, the game was also made available in more sites around the city and throughout Kenya.

Players assume the identity of one of five characters who find themselves car-jacked in a matatu (taxi minibus) and attempt to recover their stolen goods and save an injured woman. Through a series of sub-plots, the players are put into situations where the decisions they make can either put them at risk of contracting HIV or help to prevent it.

Unlike the other examples, the universe of this game is a realistic replica of the Kenyan capital, Nairobi.

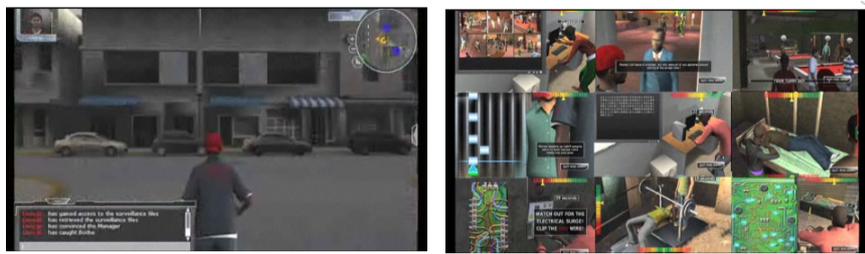


Figure 12: the game Pamoja Mtaani; <http://hivfreegeneration.warnerbros.com/>

Serious Games for Professional Practitioners

Among the serious games to train health-care professionals, one of the most publicized is “Pulse!!” (BreakAway, Department of the Navy's Office of Naval Research, 2007) (Figure 3). This application resulted from a U.S. Government order and is to date the most expensive Serious game on the market: 10 million USD have been invested in its development. “Pulse!!” provides training in the clinical skills needed to deal with one of 25,000 emergency situations, such as traffic accidents, bio-terrorist attacks, etc. This title puts the user face to face with a series of virtual patients for whom a diagnosis must be established in order to provide care.

In the same register, the Serious game “CliniSpace” (Innovation in Learning Inc, 2010) (Figure 13) places players in the role of a doctor who may consult a patient’s medical records, plan an operation or provide a clinical consultation.



Figure 13: The Serious game CliniSpace; the player takes the role of a physician

Some Serious games focusing on health-care professionals target paramedical personnel: such as physiotherapists, nurses, pharmacists, and first aid providers. “Triage Trainer” (TruSim, 2008) is a Serious game of this type designed to train health-care professionals: emergency response teams, fire fighters, medical students, in order to prioritize the different care to be administered following a terrorist attack.

Within the health-care professions, pharmacists are the target audience for certain Serious games and in particular for “Alphega Game” (KTM Advance, 2010) (Figure 14): the purpose of which is to improve European pharmacists’ knowledge of diseases and their treatment, emphasize prevention and encourage intelligent patient compliance.

- Analyze order and deliver drugs based on the patient’s profile
- Prevent self-medication

The player embodies a pharmacist in a pharmacy who receives customers and carries out a preliminary interview when delivering medications.



Figure 14; Alphega Game: The player embodies a pharmacist in a pharmacy

Some Serious games focus on expert professionals in the administration and management of public health system rules (health-care establishments, official approval to put drugs on the market).

Following new recommendations from the health authorities in France, (*Haute Autorité de Santé*, an independent guarantor of a system of solidarity-based health care and quality benefiting patients), a Serious game was published to train expert medical sales representatives in the drafting of a certification report of health-care facilities to meet the new standards and thus to characterize them and strengthen their expertise.

In the game “HAS”(KTM Advance, 2010) (Figure 15), the user must analyze and evaluate information from realistic situations to gather relevant data and write a final evaluation report. The user can consult his or her choices throughout the process of analysis and interviews. Indicators are displayed after the report is produced, concerning the analysis of documents, interviews, and the quality of the report.



Figure 15: the serious game "HAS" provides training in drafting a certification report for health-care establishments

Code Orange™ (Emergency Medical Management Training for Mass Catastrophe) (Breakaway, The Washington Hospital Center, 2010) is also an example of a Serious game intended for medical and paramedical health-care professionals.

This real-time, 3D, multiplayer Serious game enables an entire team of hospital personnel to train to handle the flow of patients in critical condition from their arrival at the hospital entrance (via ambulance or helicopter) to transport to the operating room.

In another register, we find the Serious game “Hospital Waste Disposal” (unknown, 2007 ?) (Figure 16) whose purpose is to train health-care professionals in the management of hospital waste. The user must sort different types of waste (human waste, used equipment) into the appropriate recycling containers.



Figure 16: Hospital Waste Disposal

Example of Serious games addressing two audiences

In our corpus of study, only three titles are intended both for professionals and individuals. One is “Ludomedic.”

The objectives are to:

- De-dramatize hospital procedures for children.
- Inform parents about the progress of treatment
- Train health-care professionals in clinical reasoning (including nurses) via a Learning Management System (LMS) system.
- Welcome different productions of Serious games, those of CCCP French Serious game studio, as well as those from other companies.

In fact, “Ludomedic” consists of both a set of games and a board game that allows for the use of games created with Flash and the download of gaming applications with other game engines. In this case, we notice the use of a metaphor.



Figure 17: serious game Ludomedic

Review

The table below summarizes the study, limited to an extract of the corpus presented in this chapter:

	Serious game title	Date created	Target Audience	Metaphor used Y/N
1	Captain Novolin	1992	Mass market	Y
2	Packy & Marlon	1994	Mass market	Y
3	Bronkie the bronchiasaurus	1994	Mass market	Y
4	Re-Mission	2006	Mass market	Y
5	Asthma: Breathe 1,2,3	2009	Mass market	Y
6	FatWorld	2007	Mass market	Y
7	My quit kit & Khemia	2011	Mass market	Y
8	Out of time	2011	Mass market	Y
9	Pamoja Mtaani (Together in the hood)	2009	Mass market	N
Result				8 Y – 1 N
10	HAS	2010	Professional	N
11	Triage Trainer	2008	Professional	N
12	Alphega Game	2009	Professional	N
13	CliniSpace	2011	Professional	N
14	Pulse!!	2008	Professional	N
15	Code Orange™	2010	Professional	N
Result				0 Y – 6 N
16	Ludomedic	2011	Mass market & professional	Y
Result				1 Y – 0 N

The corpus of the Serious games studied includes 133 occurrences:

- 14 occurrences relate to Serious games for professionals published between 2001 and 2011

<http://bit.ly/pt5rKc>

We noticed no metaphor in all these titles

- 116 occurrences relate to serious games for 'Individuals'

<http://bit.ly/qu5tZh> and <http://bit.ly/r5GUz4>

We noticed 76 metaphors out of 116 titles

- 3 serious games in the corpus are intended for both individuals and professionals:

“Ludomedic,” “Flower” and “Emotion 1.0”

We noticed 2 metaphors out of 3 titles.

The table below summarizes the study

Target Audience	Number of titles	Number of metaphors	Percentage
Mass market	116	76	65%
Professional	14	0	0%
Mass market & Professional	3	2	66%

We notice in our corpus that metaphors can be used when the Mass market is targeted. No metaphor is used for the professional public.

Our first task is to determine the reasons for this dichotomy.

The second issue concerns the origin of this choice, including the influence of the target audience. Our exact question is:

"Is a fantasy universe chosen for individuals because it is believed to be more efficient, or because individuals are considered unable to receive information in a realistic context?"

In addition:

"Is a realistic universe chosen for professionals because it is considered to be more effective or because it is believed that they would not take a fantasy environment seriously?"

The next paragraph will consider this issue in the light of conventional theories linking serious games, motivation and metaphorical universes.

USE OF A METAPHOR IN SERIOUS GAMES DEDICATED TO HEALTH CARE

We are aware that there are a multitude of possible factors (economic, social, etc.) affecting the use of metaphors in games for health-care. Social codes associated with games, on the one hand, and disease or death on the other, may explain the reluctance to introduce a playful dimension into hospital social habits, but this approach will not be explored in this study.

In agreement with J. Alvarez's premise that one of the characteristics of Serious games is to stimulate the desire to learn (Alvarez, 2007), we hypothesize that the choice of a metaphorical environment, depending on whether the game is intended for individuals or health-care professionals, is dictated at least in part by didactic differences (learning) and the source of motivation (desire).

To address the use of metaphors in Serious games dedicated to health care, we therefore consider two aspects. The first seeks to examine the relationship to knowledge among health-care professionals and individuals, while the second seeks to investigate the effects of the metaphor on these two audiences based on theories of motivation.

Concerning "knowledge," we refer to the process of external teaching (Chevallard, 1985) which deals with the distance between the knowledge of reference and pedagogical skills. For health-care professionals, this distance is not the same as for individuals. Indeed, for individuals, it is necessary to popularize the knowledge to make it accessible and attractive in a media sense, and we can talk about media transposition (Martinand, 1981). The objective is to target a much wider population with highly variable cultural and educational objectives. This implies creating a positive relationship with knowledge when using media. It is therefore necessary to have an impact in terms of motivation, information transmission, and attractiveness. All of this can be achieved by incorporating important gaming objectives and a significant use of metaphor.

With regard to health-care professionals, we will also rely on a report of reference concerning social practices (Martinand, 1981). From the point of view of professional teaching practices, the knowledge reference forming the foundation for the training is extracted on the basis of modeling professional practice. We have determined in our corpus that 100% of the games for professionals are not metaphorical games, but rather simulation type games. Undeniably, one

of the objectives of the use of these simulators is justified by the motor or cognitive training of future health-care experts. Activities and objects are derived from work situations and are proposed in a teaching-learning situation, while retaining the criteria relevant to their field. One of the aims of simulators is also to maintain a professional identity in relation to the practices of health-care professionals. As Pastré points out (Pastré, 2005) "simulation-based learning is learning through action and work situations." The simulator offers more or less partial reproductions of a professional situation, with a certain level of fidelity, which allows learning applicable to a situation taken as a reference. It also provides future practitioners with training in technical objectives, such as an "ability to conceive, carry out, and use associations of knowledge, which have all been tested in practice, such an aptitude being inseparable from behavior conducive to understanding and the use of techniques" (Combarrous, 1984). This technical skill is shared and promoted within the culture of the profession.

This first didactic approach to knowledge refers us to another facet of activity: motivation.

Although Fenouillet et al (Fenouillet, 2009) identify 101 theories of motivation, we will limit our approach to the theories of Malone & Lepper, and Csikszentmihalyi. In the 1980s, Malone & Lepper (Malone, 1987), (Lepper, 1987) proposed a model featuring the basic characteristics of a motivating game. They began by distinguishing intrinsic motivation (free and self-determined by the pleasure to practice (fun), characterizing the relationship between oneself and the game) of extrinsic motivation which is not determined by the game and its features, but rather dictated by the external environment (to please one's mother or show off one's strength to others, etc.).

Malone, restricting his studies to the case of intrinsic motivation, selected four features of motivating games: challenge, curiosity, control and fantasy (see table 1).

Challenge Goals, Level of certainty, Feedback Self-esteem	Control Cause and effect relationships, Free choice, Feeling of power	Curiosity Sensory curiosity Cognitive curiosity)	Fantasy Endogeneous fantasy Exogenous fantasy
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The challenge can be better seen in Csikszentmihalyi's flow theory (Csikszentmihalyi, 2005). The experience of flow (which we can compare to that of a surfer riding a good wave) is observed when the player's skills are adequate to achieve the goals of the game. Figure 18) Below this level, the player feels bored, and above this level the player experiences anxiety. On a "good wave," the player forgets time and fatigue.

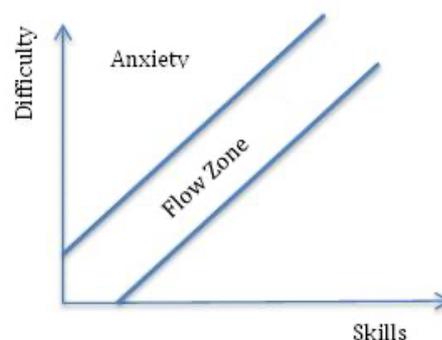


Figure 18: Definition of the flow zone

The task may then be understood as positioning the goals in the upper limit of the flow zone to induce a challenging feeling of being slightly below the skill level, and thus motivating the development of skills, but without creating a stressful state.

Curiosity can be sensory and due to the effects of audio and video, or cognitive when the player is surprised or intrigued.

The sense of control, which is essential for the player to invest in the proposed activity, involves feeling a strong link between the player's actions, decisions and choices and the consequences of these actions. This is what gives a feeling of power.

Finally fantasy, as we defined it in the introduction to this chapter, involves the use of imaginary or fantasized environments, themes, characters or physical laws to stimulate the player's emotional involvement.

We are now able to provide some elements of response to the questions raised in the introduction, by exploring the effect of the metaphor on the parameters of motivation:

"Is a metaphorical universe chosen for individuals because it is believed to be more efficient, or because individuals are considered unable to receive information in a realistic context?"

With respect to games targeting individuals, it seems that both responses make sense in terms of the previous criteria:

Individuals (patients, families) who seek to acquire medical skills via a Serious game are in general not medical specialists and know little about the medical learning process, making motivation all the more important. For individuals, a general lack of knowledge about the medical environment causes development within it to be experienced as a goal unrelated to skills. This is all the more true in that the medical environment, whether in terms of equipment (operating room), instruments (syringes, scalpels), context (white coats, blood) is extremely stress provoking, particularly for patients and their families at the announcement of a disease. This feature is specific to the health care field.

Curiosity is generally completely turned towards the disease, its causes and symptoms, and these are the elements over which the patient wishes to exercise control rather than over the medical environment which seems beyond his or her control.

For all these reasons, the use of a metaphorical universe, where the disease, its causes and its consequences are presented in a less distressing or traumatic way, seems perfectly suited both from the point of view of the effectiveness of the transfer of knowledge and the learner's motivation.

Nevertheless, presenting one's "own" metaphorical medical environment could lead to the construction of a misleading representation of the actual context. Do metaphorical serious games in health care present a fallacy?

"Is a realistic universe chosen for professionals because it is considered to be more effective or because it is believed that they would not take a fantasy environment seriously?"

The answer is less obvious with respect to games for health-care professionals.

Of course we can take the counterpoint to the previous arguments: health-care professionals are experts in the field and have many years of experience in learning the concepts related to their specialty. We can thus easily imagine that a pedagogy of transmission, which sets out the knowledge to be acquired may be sufficient for them.

Their learning motivation is more likely to be of the extrinsic type (not in the relationship between the learner and the game but rather in the relationship between the doctor and his or her specialty or professional structure: staying at the cutting edge of the specialty or becoming the best specialist on the team).

The challenge and the flow zone are also very different in the case of the practitioner: the major skill area and the nature of the challenge are indeed in the medical field. It is therefore reassuring to place the learner in a universe as close as possible to his or her field of competence and aspirations.

Curiosity is also turned to new devices or therapeutic protocols that the learner wishes to see more accurately represented.

Therefore, a reading of the criteria indicates that it is more efficient to use a game universe close to that of the professional world of reference, therefore without the use of metaphor in the case of a serious educational game aimed at health-care professionals.

But this argument only holds if the educational objectives specifically target the medical field and exclude cross-curricular competencies such as communicating with the patient, receiving and informing the family, de-dramatizing a situation, managing conflicts, or managing crises situations.

Consequently, we can imagine that a game universe close to the professional reality is no longer the most effective solution from the point of view of the challenge, motivation and learning efficiency, while a metaphorical universe could offer a solution. The future of Serious games in health care is perhaps a hybrid universe that may, according to the needs of leisure and educational scenarios, immerse the player in a very realistic or entirely metaphorical universe.

Note that this is the approach of the "Ludomedic" game, a product aimed at both patients and professionals whose targeted skills are hybrid: clinical as well as transversal.

CONCLUSION

In this study we proposed to analyse the use of metaphor in Serious games for health care, and in particular the relationship that may exist between the use of a metaphor and the target users. The market for Serious health-care games indeed offers the advantage of having several different targets including "individuals" and "professional practitioners."

As a first step, we have defined our approach to Serious games, identified the object as targeting the health-care sector, defined what we mean by metaphor and presented our criteria to constitute a corpus of study. We then proposed a classification of Serious games adapted to the games for the health-care sector and we have implemented this classification for the 133 games constituting our corpus of study.

This study leads us to conclude that the titles of our corpus targeting "individuals" massively use metaphors (65%), while in the case of games for "professionals," no metaphors are noticed. The game universe is generally modeled on the professional practice of reference. This finding raises a set of questions: Why is there such a difference? What are the factors which generate such a dichotomy? Is it possible to make use of Serious games with a fictional context to train health-care professionals? Conversely, what explains this use of metaphors in Serious games aimed at the general public? We have initiated a discussion in the light of didactic and motivational arguments.

The discussion of these issues indicates that the use of metaphors seems inappropriate when skills covered by the utilitarian scenario are purely clinical. However, the use of a

metaphorical universe could be beneficial from a point of view of both skills transfer and motivation, in the case where more transversal skills are targeted.

Several perspectives emerge for future follow-up and will enable us to expand the scope of this study. It would be particularly interesting to:



- Study the effectiveness of using a metaphorical universe for the transfer of cross-curricular competencies in the field of health.

- Take into account the arguments not covered here concerning the relationship between the use of metaphor and the target audience, for example social and economic arguments.

- Look at the persistence of our findings in another sector than that of health care.

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