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RDU Model dedicated to evaluate needed counsels for Serious Game projects

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A B S T R A C T

This paper aims at identifying the counsels that are necessary to achieve the Realization, Dissemination and Use of a Serious Game. In our opinion, these counsels are an additional facet for all Serious Game projects in order to target their ownership adoption and appropriate use (as intended by its designers) in a dedicated ecosystem (School, Hospital ...). We propose to classify all these counsels in three main categories: R for Realization, D for Dissemination, and U for Use. By this way, we obtain a model named RDU. In a second step, we explain in detail the methodologies used to identify the fifteen counsels of the RDU model by using seven examples of Serious Games projects taken from a collection of 150.

Keywords:
Counsels
Serious Game
Model
Ecosystem
Typology
Learning

1. Introduction

Achieving the pedagogical objectives associated with any given Serious Game is a complex matter. The design of a Serious Game addresses technical, artistic, ergonomic, educational, marketing, economic, or legal issues, as explained by different authors such as Adams (2006), Bogost (2007), Crawford (2003), Frasca (2001), Salen and Zimmerman (2004), Stolovitch and Thiagarajan (1980), Zyda (2005) and Wee Hoe (2010). Of course, this list is not exhaustive. Designing games in a school context with learners is studied as well, see for instance: Triantafyllakos, Palaigeorgiou and Tsoukalas (2011). Any kind of game could also call specific sub target areas. For instance, teaching medicine involves cardiology, psychiatry, strokes ... Thompson et al. explore, in their case, game designs in the diabetes and obesity domains (Thompson et al., 2008). All these parameters must be understood and dealt with the idea of the complexity of design and implementation for a Serious Game. Most current researches try to optimize the design of such an object by providing engines, dedicated editors and models; see for instance: Arnab et al. (2015), Carvalho et al. (2015), Cano, Munoz, Collazos, Gonzalez, and Zapata (2016). All these models

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are focused on the realization of the Serious Game object and mostly on the technic aspects. But to maximize the success of a Serious Game project, it is not enough: the complexity of the matter does not end there as the study of [Calderon and Ruiz \(2015\)](#) tells us for instance. Indeed, it is necessary at the same time to take into account the issue of the dissemination and use of the object in the ecosystem for which it is intended. It is difficult to imagine that a Serious Game simply introduced into an ecosystem will fulfill its objectives without any form of support as already confirmed in the works of [Smith, \(2006\)](#) or [Bourgonjon, Valcke, Soetaert, de Wever, & Schellens \(2011\)](#). By “ecosystem”, we mean the Gael Gueguen and Olivier Torrès's approach: “*The set of relationships (vertical, horizontal and transversal; direct or not; formalized or not) between heterogeneous actors guided by the promotion of a common resource and an ideology that leads to the development of shared competences (skills ecosystem).*” ([Gueguen & Torrès, 2004](#)). Thus, it is necessary to ensure suitable counsels as explained by [Zellweger Moser \(2007\)](#) for instance. We consider counsels as resources, capabilities, or supports that improve effective Serious Game Realization, Dissemination and Use (by targeted users or ecosystems). In our opinion, a model associating these three domains and detailing different counsels for each of them, in the Serious Game case, does not exist and deserves to be explored. This is what we propose to do within the framework of this paper.

Thus, after defining “Serious Game”, “Appropriation” and “Counsel” terms, this paper aims at identifying the counsels that are necessary to archive the Realization, Dissemination and Use of a Serious Game. In our opinion, these counsels are an additional facet for all Serious Game projects in order to target their ownership adoption and appropriate use (as intended by its designers) in a dedicated ecosystem. We propose to classify all these counsels in three main categories: R for Realization, D for Dissemination, and U for Use. In doing so, we obtain a model named RDU. In a next step, we will explain in detail the methodologies used to identify the fifteen counsels of the RDU model by using seven examples of Serious Games projects taken from a collection of 150. After the discussion, we will present conclusion and research perspectives.

2. Definitions

Serious Game

Serious Game application fields are related nowadays to many sectors such as health, defense, education, policy, training and ecology, and keep on expanding as exposed by [Sawyer and Smith, \(2008\)](#). Serious Game therefore addresses a set of markets. This position is counseled by a very rich typology to refer to the object: Advergames, Political games, News games, Educational Games, Edutainment, Datagames, Digital Game Based Learning, Immersive Learning Simulations, Social Impact Games, Persuasive Games, Games for Change, Games for Good and so on. This inventory reflects the numerous actors showing interest in the Serious Game and the different ways to name the concept according their point of view. Despite this diversity of names, several contemporary definitions of Serious Game are proposed. The more general definition seems to be the definition proposed by the game designers Sande Chen & David Michael: “*games whose first purpose was not mere entertainment.*” ([Michael & Chen, 2005](#)). At the same time, Professor Michael Zyda, currently Director of the USC GamePipe Los Angeles laboratory, proposed a more specific definition: “*A challenge brain against a computer involving compliance with specific rules, and based on the entertainment to achieve goals related to institutional or professional training education, health, domestic policy or communication.*” ([Zyda, 2005](#)). In the early ‘70s, Clark Abt ([Abt, 1970](#)) offered a definition of the term “Serious Game” which not only concerns video games (computer games): it could also be a board game, a role playing game or even outdoor games ([Michael & Chen, 2005](#)). Today, this link with computer support appears to be a constant in the Serious Game industry. Nevertheless, professionals do not agree around common definition of the object.

Aware that there are a multitude of different approaches to the Serious Game, we know that to register in one of them implies limits. However, to move forward in our discussion, we must find our position. Thus, in the context of this paper, a Serious Game is understood as a digital object involving gameplay associated with an utilitarian function. A market segment that deviates from sole entertainment sponsors it. In this paper, we propose this definition of the Serious Game, developed during our previous work ([Alvarez & Djaouti, 2012](#)):

“A Serious Game is an artifact, digital or otherwise, for which the original intention is to combine with consistency, both serious aspects such as non exhaustive and non exclusive, teaching, learning, communication, or the information, with playful elements from the game. Such an association is made by embedding the utilitarian functions within the story, graphics and audio elements of the game, which no longer only focuses on pure entertainment”

We can extract three conditions from this definition:

Formally, we could thus define Serious Games as follows:

- 1) Serious Games combine utilitarian functions and game;
- 2) Serious Games escape from the pure entertainment market;
- 3) Serious Games are artifacts, digital or otherwise.

The symbols used for the equation mean:

(Artifact \subset Utilitarian functions and Artifact Game
and Artifact \notin The pure entertainment market)
 \Rightarrow Artifact Serious Game

\notin : Does not belong; \subset : Includes; \Rightarrow : Then

Appropriation and counsels

In our previous work (Alvarez, 2014), we studied the appropriation of the Serious Game in an educational context. In our opinion, this notion of technology appropriation refers to the four conditions of Serge Proulx: “a) *Technical and cognitive control of the artifact*; b) *Meaningful integration of the technical object in the daily practice for the user*; c) *The repeated use of this technology opens creative opportunities*; d) *Social appropriation*” (Proulx, 2005, pp. 7–20). If these four conditions seem relevant, we asked ourselves the question of how to promote them. We think that proposing a set of dedicated counsels could be a good approach to support the technical appropriation process. As said in the introduction, we view counsels as being resources, capabilities, or supports that improve effective Serious Game Realization, Dissemination and Use. Realization (R), Dissemination (D) and Use (U) refer for us to three main families of counsels. Thus, we have established correspondence between them and the four conditions of the technical appropriation of Proulx. For instance, the related condition “a) *Technical and cognitive control of the artifact*” refers for us, to the Use of the Serious Game (U). The second condition, in connection with “b) *Meaningful integration of the technical object in the daily practice of the user*,” necessarily refers to the Dissemination family (D), etc. Table 1 summarizes the correspondence that we could establish between the conditions of Proulx and the three main families of Serious Game counsels.

Table 1 shows that the four conditions of technical appropriation of Proulx could be associated to each type of main counsel family R, D and U. But in detail, what types of counsel includes all these three main families? For answers, we base our methodology on a collection of 150 projects of Serious Games, targeting diverse ecosystems and markets, in which we were involved. Let us explore these aspects now.

3. Methodology and collection description

Since 1998, we have participated in more than 150 Serious Game projects. These projects, presented in appendix were carried out in partnership with or on behalf of various public and private organizations: the National School of Civil Aviation (ENAC), schools of dentistry, engineering schools or institutes (INSA), Orange Labs, publishing houses (Dupuis, Milan, Bayard), IDATE, Pôle Images Nord Pas de Calais, Publicis and TF1 (a TV channel)), etc. These partnerships have led to 150 projects of different sizes and natures: advertising games (advergames), educational games (edugames), informative games (news games), games dedicated to health (health games) and to produce experimental or academic works. These experiences have allowed us to explore diverse ecosystems while encountering both success and failure, are the soil from which we extract the body of our study. In order to identify a typology of counsels, we have adopted a praxeological approach based on a qualitative analysis of our 150 Serious Game projects. The methodology consisted of five main steps.

First, we identified the 150 projects that are linked to Serious Game in order to build the collection.

Secondly, project by project, using a reflexive approach, we have listed the problems or the limits we have met. This reflective approach is explained by the fact that we have been involved as a designer, writer, developer, project manager or even author, for all of these 150 projects. As we had to make scenarios, technical specifications, development and evaluation of all these Serious Game projects, we have been in contact with their different sponsors and project teams. Thus we expected to have a fairly comprehensive view of the 150 projects to track their history, from genesis to final distribution. To trace this history, we have used our memory related experiences and were able to complete our introspection by consulting archives as documents produced during the various projects and tracks such as emails exchanges. This approach allowed us to

Table 1

Links between the four conditions of technical appropriation of Proulx (Alvarez, 2014) and the three main families of counsels dedicated to Serious Game: Realization (R), Dissemination (D) and Use (U).

Conditions of technical appropriation of Proulx	The main families of counsels associated
a) Technical and cognitive control of the artifact	U + potentially R
b) Meaningful integration of the technical object in the daily practice of the user	D + potentially U
c) The repeated use of this technology opens toward creating opportunities	U + D + potentially R
d) Social appropriation	R + D + U

resurface weaknesses, failures and risks associated with each project: e.g. unhappy customers or users, inability to produce the expected product aborted projects, lower sales or broadcasts than expected, targeted effects not listed, targeted population not met, investments larger than expected, product not working as desired ...

Third, for the qualitative analysis of data we have coded separately and checked for intercoder agreement. So, we have identified similarities or differences in our respective projects that allowed us to separate counsels that have been used successfully from counsels that were clearly missing. Fourth, after an iterative approach, we regrouped the different items in 3 main families of counsels: Realization, Dissemination and Use (RDU), which are the 3 key steps to build a Serious Game.

Fifth, we have experienced the counsels, sweeping all the 150 projects to check the titles of counsels, consistency and relevance of their positions within the three main families. We have thus eliminated duplication, clarified or renamed some titles and repositioned some types of counsels in other families. In the end, we get 15 types of items that fall within the three main families. We propose now to present all of them in detail.

4. Description of the 15 types of counsels

In this section, we describe successively the counsels associated with: (i) the Realization of Serious Games (R family, 8 types of items), (ii) the Dissemination of Serious Games (D family, 5 types of items), (iii) the Use of Serious Games (U family, 2 types of items).

4.1. Counsels associated with the realization of Serious Games – R family

The counsels listed here are intended to facilitate the design, development, evaluation, project management, financing and legal protection of Serious Games. Having sifted through our whole collection, we have identified 8 items that fall into this first category.

R1 Gaming culture and artistic support

This counsel aims at developing the creativity of Serious Game authors. The goal is to develop applications likely to generate flow among users. Areas to be explored here include game design, level design, computer graphics, use of metaphors, and sound design.

R2 Project management support

This counsel aims at optimizing the effective implementation of the production process of Serious Games, from the design phase to distribution. It embraces the management of the project, its planning, the use of methods, such as the agile Scrum method for instance.

R3 Design support

Writing the script of a video game is complex because one often has to handle aspects of both game play (ludology) and narratology. This approach still has to be improved. When Serious Games are involved, complexity increases, since one has to include an utilitarian dimension as well. Many parameters and constraints have to be taken into account: target audience, use context, existing IT, budget, etc.

R4 Legal assistance

Any structure has its internal regulations and must comply with specific laws. This is also the case for Serious Games: one must ensure they comply with regulations. There are also rules related to intellectual property. It is tempting to use well known licenses to attract the attention of an audience of users. On the other hand, perhaps a creator will perhaps demand to protect his/her Serious Game.

R5 Financial and administrative support

Serious Games involve costs up to hundreds of thousands or even millions of euros for the most ambitious projects. Fundraising through the establishment of co productions or application for calls for national or European public projects are often appropriate. When applying for such funds, a suitable counsel is necessary.

R6 Testing support

Tests are a vital step in the realization of a Serious Game. There are several types of tests to perform during the various iterations of a Serious Game: the study of usability, the study of the reception, impact assessment, the evaluation of gameplay, the evaluation of flow, and so on. Each type of test requires the development of suitable protocols that should be well prepared in advance. After testing comes the time for data analysis. The counsel to the tests is plural and takes place at key stages.

R7 Pedagogical support

The experts' knowledge should be transmitted through a Serious Game. But these experts are not necessarily teachers. It is therefore necessary to provide support throughout the transfer of knowledge, assured by key people such as multimedia engineers. If the content is an important point, it should also take into account the evaluation methods: it is highly important

to assess or measure whether the user of the Serious Game has received, read, retained and used a given content. Finally, it should be noted that educational support should not be limited to the construction of the Serious Game in question. It should also consider the implementation of the game in the existing or newly created curriculum.

R8 R&D, technology and digital artifacts support

The Serious Game must not be enclosed in a modality limited to keyboard and mouse. There are indeed different types of games: board games, playing outdoors, role playing games, computer games, etc. In this context, Serious Games should be open to all possible approaches: digital social networks, tangible objects, virtual reality, augmented reality, robotics, etc. In addition to this, all the different modalities offered by the video game industry, such as the *Kinect* and the *Wiimote*, must be considered. These technologies offer many opportunities that require counsel, especially in the technological surveillance, the choice of authoring systems or terminals, the promotion and the transfer of protocols or methodologies coming from research.

4.2. Counsels associated with the dissemination of Serious Games – D family

The five counsels recorded in the second family are dedicated to the issue of ensuring the widest possible dissemination of a Serious Game within a given ecosystem. Indeed, many Serious Game projects stop after the production of the object itself, indicating a failure in one of these areas.

D1 General adoption

The adoption of new technologies or practices within an ecosystem requires dedicated support. Indeed, it is not only necessary to know how to use the object; one should also ensure that it fits with the entire system and may sometimes need to modify the latter. An example would be to develop a training program to ensure that the Serious Game finds its place. Counseling the general change means making sure that mentalities change. Indeed, the term “video game” very often has negative *a priori* connotations. These obstacles must be removed. If this is not possible, it is likely that the Serious Game is doomed to failure.

D2 Coaching marketing

At the very beginning of a Serious Game project, the marketing dimension is central. It is important on the one hand to properly address the heart of the intended target, and on the other hand to consider how to make the application be used. Thus, it may be appropriate to consider a strategy that ensures a buzz around the Serious Game, or to recommend it through a buzz strategy. Communication techniques and suitable approaches require spin, which can not be improvised and should therefore receive appropriate counsel.

D3 Economic support

So far, apart from B2B¹ and B2B2C² contexts, models and selling techniques related to Serious Games need to be defined. B2B2C contexts form a base for the moment, but the majority does not respond to the B2C³ approach and its variations across different market segments (health, education, media, etc.)

D4 Political support

Political support is often strategic when trying to deploy a Serious Game within an ecosystem or to cleverly position a project, particularly in the context of broadcasting an application in public institutions or pilot structures.

D5 Experience feedback support

Once the Serious Game has been completed and disseminated, one should capitalize on the experience gained during the development of the project and, several months later, explore the impact of the object on the ecosystem. It is crucial to engage in other projects in order to avoid pitfalls and maximize the chance to get Serious Game adoption. This approach can also be used to promote the consortia involved in the project. Hence, development of post mortem studies, development of knowledge management systems (or expert systems), and publications of scientific articles are strategies to record and disseminate experiences.

4.3. Counsels associated with the use of Serious Games – U family

Two counsels are identified in this third family target users.

¹ Business to Business.

² Business to Business to Consumer.

³ Business to Consumer.

U1 Use of the Serious Game support

At first, not all users are equal before Serious Games. Since gaming is a key component, users who have a good practice activity (e.g., users who play games) may present a better level of skill (skill play) than non players. One should also take into account the variety of knowledge and skills required by different users to understand the utilities offered by the application. In this context, it seems necessary to help users trying to provide the best possible exploitation of the Serious Game. Such support should also be provided with mediators so that they can also successfully support and promote the Serious Game. The counsel can also involve helping tutors modify the configuration of the game when the application allows it.

U2 Reading and interpreting the Serious Game support

Reading and interpreting messages sent through a Serious Game may strongly depend on user perception filters (these are parameters specific to each of us, such as culture, education, knowledge, skills, mood, and neuroses) and a whole range of factors such as the influence of frames, issues and groups brought together. In addition to this, the game itself can be an additional filter that may change the way a gamer receives messages. According to the Shannon diagram (Shannon, 1948), these parameters can be noise and interfere with the reception of the message as initially expected by the developers of the application. Establishing a tool to help the gamer decipher the messages associated with the videogame objects seems an appropriate strategy to maximize the chances of good reception of the message as expected by users. This is an approach that can be achieved by the establishment of debate after the use of the game.

RDU Model

In the end, these 15 types of counsels fall within the three main families: R for Realization, D for Dissemination and U for Use. Thus we get the RDU model applied to Serious Game. Table 2 presents the RDU model.

5. Case studies: Description of 7 examples extracted from the collection

In order to explore the RDU Model and its 15 counsels, we have selected the following seven representative titles extracted from our collection of 150 Serious Game projects: *Technocity*, *ECSPER*, *Flee the Skip*, *Dentistry Kid*, *ATC*, *Gargas* and *Auto Junior* (see Fig. 1). All of them are related to educational aspects but present different costs, domains, production contexts, numbers of users and team sizes. The main idea is thus to be the most representative and meaningful possible.

All these projects have been associated to serious problems of counsels or have been used as case studies/experiments in previous scientific work we have undertaken. For instance both *Technocity* and *Flee the Skip* projects were the subject of receipt studies with semi structured interviews and crossed confrontations thanks to quantitative and qualitative questionnaires. The *Gargas* project was used in a context of a scientific experimentation (Djaouti, Alvarez, Rampoux, Charvillat, & Jessel, 2009). These three projects were part of scientific work that we used to explore the lack of counsels, through collection of formal data and semi structured interviews with participants in the projects. We expand our insights by a detailed exploration of seven cases (including these three initial scientific studies) because these seven projects also differ significantly from each other in terms of budget, thematic, production context, size of production team or number of users. We briefly summarize these projects in Table 3. We also provide a summary of all 150 projects in our appendix, providing information on: year of project, project sponsor, URL to access the project. Critically, the appendix analyses each of the 150 projects classifying missing counsels by our three major categories: realization, dissemination and use of Serious Games.

We have selected these projects as put together they combine all the cases of counsels that we have identified. In appendix the different lacks of counsel are exposed under items referring to Table 2. For each of these seven projects, we will detail:

Table 2
The RDU Model dedicated to Serious Game counsels.

Families	Counsels	Items
R	Realization of Serious Games	R1- Gaming culture and artistic support R2- Project Management support R3- Design support R4- Legal assistance R5- Financial and Administrative support R6- Testing support R7- Pedagogical support R8- R&D, technology and digital artifacts support
D	Dissemination of Serious Games	D1- General Adoption D2- Coaching Marketing D3- Economic support D4- Political support D5- Experience feedback support
U	Use of Serious Games	U1- Use of the Serious Game support U2- Reading and interpreting the Serious Game support

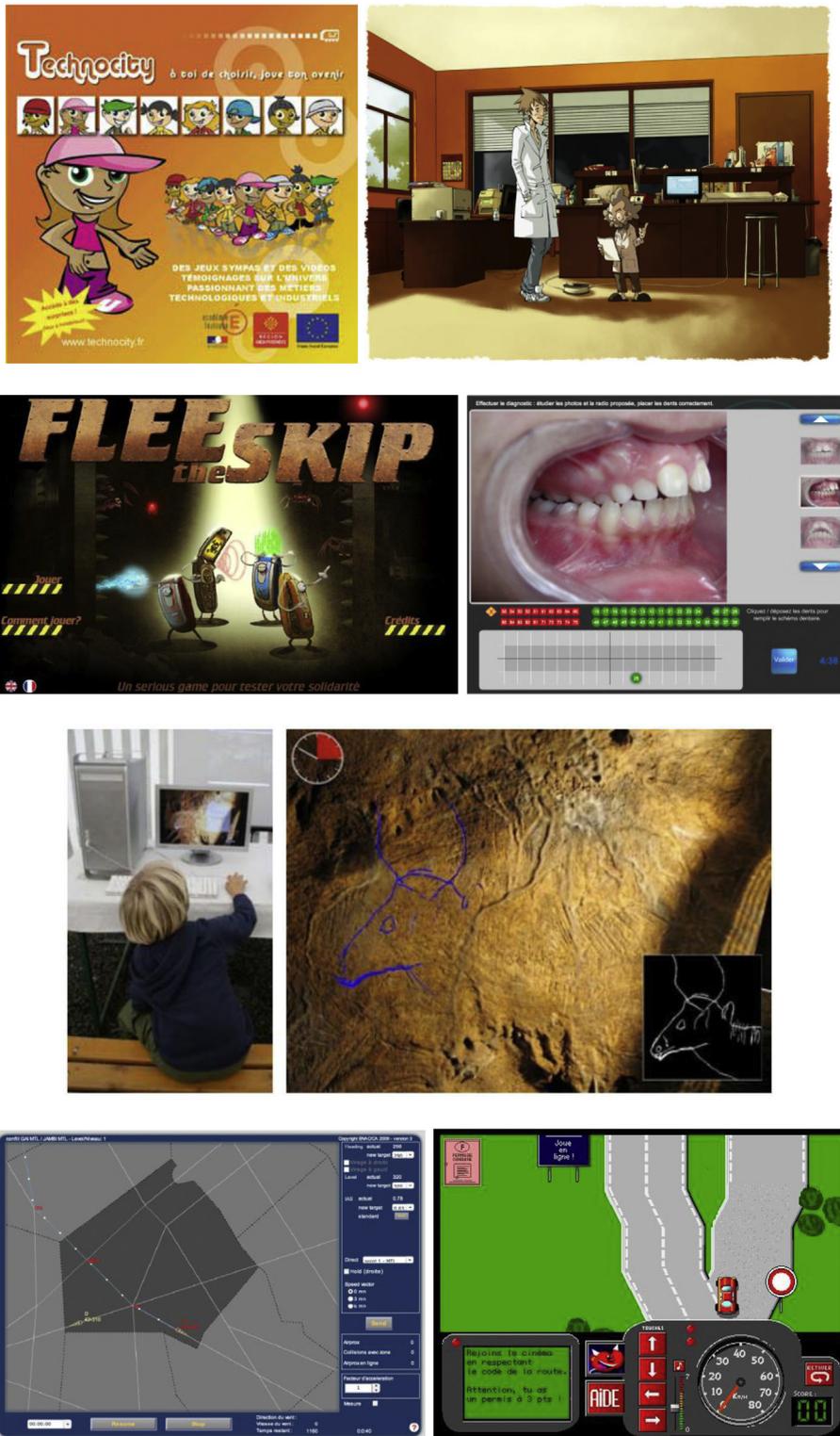


Fig. 1. Pictures of the 7 examples of Serious Games: Line 1: *Technocity*, *ECSPER*, Line 2: *Flee the Skip*, *Dentistry Kid*, Line 3: *Gargas*, Line 4: *ATC* and *Auto Junior*.

Table 3

The RDU Model dedicated to Serious Game counsels.

Project	Cost (€)	Domain	Production context	Team size	Users	Number of missing counsels according RDU Model
Technocity	100 000	Education + Marketing	Call for proposal Ministry of Education	7	~10000	6/15
Les ECSPER	20 000	Education	IMT Lille Douai school	5	~1000	2/15
Flee the skip	20 000	Marketing + Corporate	Private Company	5	~40000	5/15
Gargas	5000	Culture	Culture & Sciences	7	~100	5/15
Dentistry Kid	10 000	Health + Training	Toulouse University	3	~500	5/15
ATC	50 000	Aeronautic + Training	Engineering School	4	~1000	5/15
Auto-Junior	5000	Edition	Private Company	10	~500000	3/15

The objectives of the game and the frame of use;
 The feedback observed;
 The weaknesses as far as counsel is concerned according the RDU Model.

Example #1: Technocity

Description of the project

Technocity was a Serious Game launched in March 2006 on CD. 1000 copies were distributed as free products in 600 schools, colleges and career centers in the Midi Pyrénées region (southwestern France). This Serious Game was also freely available on the Internet. *Technocity* aimed at participating in the promotion of technological learning with young people ranging from 15 to 18 years old. This experience was the first of its type for the Administration of the Midi Pyrénées region, who also decided to assess the impact of the game. Such a choice was also motivated by the urgency of the situation: despite the benefits, including increased technical experience and know how and the ability to access exciting jobs and attractive salaries, many educational programs close every year because of an insufficient number of students.

The concept of *Technocity* was based on a set of five games: *Energy & Electrotechnics*, *Computer Science & Electronics*, *System Maintenance*, *Mechanical Engineering*, and *Civil Engineering*. In the first step, the real purpose, which was to inform the core target about technological educational programs, was kept secret. This strategy was based on the idea of attracting the target via the play aspects and inviting them later to discover the real message. This in turn is based on the idea that the skills which were used to win the various challenges were precisely the qualities that were sought by a specific professional domain.

Feedback

What did we observe nine months after the release of *Technocity*? Clearly, many schools were never informed about the existence of *Technocity* (Alvarez & Djaouti, 2012). As far as the target classes were concerned, only few students played the game. Some of them have reported: "it was for babies." The main reason was linked to aesthetics: the graphics avatars were developed in a too childish and colorful style. The main users of *Technocity* were in fact schoolboys of 12 and 13 years old. We noticed also that learners were mostly not supported in the use of Serious Games. In fact, neither teachers nor counselors used or required guidance when introducing *Technocity* in school. This leads us to ask ourselves how *Technocity* was presented to schools upon its release. According to a librarian, *Technocity* was received in its school without any leaflet or counsel. No information was provided. The librarians did not hide the fact that students were left to fend for themselves.

Analysis

The distribution of this Serious Game was reduced to a bare minimum: it was simply shipped by post to various institutions and schools. In the envelope containing the CD ROM, a short letter explained its purpose, but neither marketing nor information campaigns were set up, no teacher was trained, no targeting was done to introduce the product to key people. When we performed a field survey nine months after its release, we discovered that the game, which was initially intended for career guidance teachers, was instead given to librarians. The game, which has a communication function, is possibly used for occupational purposes: to entertain pupils between noon and two. Thus, *Technocity* received no support for facilitating its appropriate use within the target ecosystem. In any case, semi structured interviews confirm that *Technocity* did not reach the targeted pupils. Therefore, those who used it did not operate in the manner envisioned by the designers and do not move toward awareness about trades and industrial technology. The interviews highlight a lack of support in the 3 main families as Table 4 exposes.

Example #2: Les ECSPER

Description of the project

ECSPER (in french "Étude de Cas Scientifique Pour l'Expertise et la Recherche" i.e. Case Studies for Scientific Expertise and Research) is a set of resources for higher education in the form of case studies incorporating non linear scenario and Serious

Table 4List of missing counsels for the *Technocity* Serious Game project according the RDU Model.

Missing counsels according RDU Model for <i>TECHNOCITY</i>	Explanations
R3- Design support	<i>Technocity</i> introduced significant ruptures between the playful and the serious part. The game and videos presenting industries were clearly dissociated. Similarly the graphic style between the games and the serious parts do not were consistent. It must be said that the videos were part of a database that the sponsor could operate freely. Despite the break with the design of games, he wanted them to be implemented. Here, dedicated support would have been welcome.
D1- General Adoption	Some teachers have been at the initiative of the Technocity Serious Game project. But nothing has been done to prepare all the other teachers for the arrival of this Serious Game: To think about how to organize the activities, associated pedagogies and assessments have not been conducted.
D2- Coaching Marketing	The Serious Game would have needed an counsel in order to facilitate its introduction into the schools and hence to raise awareness among teachers, counselors and librarians.
D4- Political support	In order to convince teachers to use <i>Technocity</i> , maybe a Political support asking schools to use it in courses dedicated to discover industrial career options should have been done.
U1- Use of the Serious Game support	Both learners and faculty should have been instructed as to the use of the Serious Game, so as to know in which context to use it and thus gain the expected benefits.
U2- Reading and interpreting the Serious Game support	The testimony of the librarian who confesses that pupils are left alone with the game shows that the utility dimension is not really accessible without a suitable counsel. If the playability is efficient, then the Serious Game is more likely to complete a purely occupational function.

Game concepts. Through a storytelling approach in the form of an investigation, the student assumes the role of an expert who has to find evidence and discover the reasons why an accident occurred, or to find the optimal path to solve a challenge. Through a funny and educational scenario, the teacher can convey the keys of the methodological approach. *ECSPER* cases mix various learning activities and interactions embedded in a non linear storyline with a graphical environment via the codes of comics book.

ECSPER uses the OPA (in French: Outils pour les Pédagogies Actives/Tools for Active Learning) project outcomes that allow the creation of models for the Jaxe (MICA) and Scenari (Topaze) publishing chains, hence facilitating the creation of nonlinear case studies (Quelennec, Vermeulen, Narce, & Baillon, 2010).

The first *ECSPER* case was developed in 2011 and 2012. It is based on the principles that govern linear elastic fracture mechanics. These principles highlight the fact that the design must take into account possible defects in materials and structures. We will therefore use the key concepts developed in fracture mechanics courses. The first *ECSPER* case was tested among Mines ParisTech students in December 2012 and is now included in the curriculum of an engineering school (Mines ParisTech, level Master 2) at the end of the fracture mechanics and fatigue course.

Feedback

ECSPER stands at the confluence of case studies (widely used in higher education Dooley and Skinner (1977)) and Serious Games. The origin of this project is the need expressed by Professor Claude Robin (Mines Douai) and Anne Françoise Gourgues (Mines ParisTech) to explain to the expert the “methodology in fracture mechanics and fatigue”. The domain, which is austere and rigorous, made the design difficult; many colleagues and co authors felt that the introduction of game concepts and fun elements was inappropriate. The prototype of the first *ECSPER* case was introduced to teachers in September 2012, shortly before dissemination to students (http://lesecper.mines_douai.fr/). The feedback seemed good with respect to both the pedagogical approach and the graphic quality.

Analysis

At this stage of the project, several supports have been necessary. The pertinence of Serious Games must still be proven to teachers; there is great reluctance among some to use these games. Many works have to be done to facilitate the adoption and use of these tools, only after which these Serious Games then begin to yield positive educational outcomes. The missing supports are listed in Table 5.

Table 5List of missing counsels for the *ECSPER* Serious Game project according the RDU Model.

Missing counsels according RDU Model for <i>ECSPER</i>	Explanations
R3- Design support	When designing <i>ECSPER</i> cases, the challenge was to design a pedagogical script provided by the teaching faculty authors in parallel with a fun scenario written by, among others, comics author Gregory Charlet. This double script made the design complex but instructive, each team sharing its views in the final report.
D1- General Adoption	The Serious Game would have needed a support in order to facilitate its introduction into the school and hence to raise awareness among teachers, counselors and librarians.

Example #3: Flee the skip

Description of the project

Flee the Skip is a Serious Game based on a platform game involving 4 on line players. They control mobile phones which are actually defective: not being able to jump high enough, be quickly discharged, not being able to easily set up a communication ... These various anomalies prevent each player from winning individually. Thus, the players have to learn to collaborate in order to have a chance to successfully finish the game. Thus, *Flee the Skip* aims to test a player's sense of solidarity. The score of the game is very much indexed on the number of significant mutual gestures between players: exchanges of energy and data, elements facilitating the collective progress.

This Serious Game was developed within the *Orange Labs company* (Lannion, France) as a customer service. It is intended to promote both a Serious Game design contest and educate players on ways to collectively mobilize technologies against to reduce a person's social exclusion and feelings of solitude (Alvarez & Djaouti, 2012).

Feedback

Flee the Skip has been tested within a population of 140 players. The vast majority was invited to play from home via an ADSL connection. Testers should play with group of four people. It was requested to all the testers to reach level 3 and to answer a questionnaire. It especially showed that the game is appreciated globally for its playful dimension. But only some players did catch the solidarity message embedded within the game. This result are in contradiction with some recent studies on the civic aspects that could arise from the use of Multiplayer Video Games (Molyneux, Vasudevan, & de Zúniga, 2015).

Analysis

The *Flee the Skip* project was made in a PhD context. Thus, some scientific studies have been done and permit us an exhaustive list of missing counsels. There are consigned in Table 6.

Example #4: Gargas

Description of the project

This Serious Game focused on children from 5 to 10 years old. It has been developed for the Institute managing the Gargas caves (Ariège, France) in order to celebrate the 100 years of their discovery. At the same time, the Serious Game *Gargas* have been developed to make a scientific experimentation dedicated to compare three devices (Djaouti et al., 2009).

The objective of the Serious Game is to find and pick up engravings of animals on a wall of the Gargas Cave. However, there is an imposed objective to the user: the track of each animal must be carried out in a maximum of three minutes. There is no moderator to designate the animal to find and to assist the user in his research. A portrait of the animal is presented on the screen. This playfulness is combined with an utilitarian focus: to present the work done by scientists to raise traces of the different animal engravings on the Gargas Cave walls.

Table 6

List of missing counsels for the *FLEE THE SKIP* Serious Game project according the RDU Model.

Missing counsels according RDU Model for <i>FLEE THE SKIP</i>	Explanations
R7- Pedagogical support	During the tests, we have noticed that few people were able to identify the solidarity aspects in the game. Thus, we probably should have integrated a pedagogical support in our project in order to better convey the solidarity messages.
R8- R & D, technology and digital artifacts	Most of the players focus on the game mechanics. Indeed, <i>Flee the Skip</i> suffers from a lack of technology to ensure smooth synchronous operation. Players are rarely able to see identical information on their respective screens. The different avatars are located in different coordinates on the screens of each tester. In this environment it then becomes too difficult to collectively coordinate activities. A lack of support in R&D to find solutions in this area is therefore felt.
D2- Coaching Marketing	If the appreciation of <i>Flee the Skip</i> during the tests is positive, this Serious Game has not met a significant adoption by the community of gamers on the Internet. This is due to the lack of counsel during the marketing plan. If this title is used to promote the creation of Serious Games contest, nothing has been made to promote <i>Flee the Skip</i> itself.
U1- Use of the Serious Game support	It is noticed that some players do not like playing with novices. Their low skill play prevents a collective team from any hope of victory. Thus, in groups with heterogeneous skill levels rather than promoting solidarity, the games resulted in exclusion. This limits the value of the game. However some groups decided by themselves to use phones to circumvent the limits of communication via the chat function of the game and thus were able to promote cooperation and hence reduce exclusion through phone communication.
U2- Reading and interpreting the Serious Game support	The case of <i>Flee the Skip</i> could demonstrate that when players are delocalized and isolated, opportunities to receive the message of the game and to interpret it as expected is much lower than when players are grouped in the same room with a facilitator. So, the message conveyed by the game was displayed by the home page "A Serious Game to test your solidarity". But this is clearly like admitting the weakness of the game: it's not the games mechanics that can actually deliver the message. Thus a pedagogical support could help the team to resolve this aspect. This was also evidence that the whole project was insufficiently funded.

Feedback

An observer studied how the general public uses this Serious Game. He could explain how to start the game, but did not intervene once the game was launched. The users were invited to sit and play. Friends or relatives came sometimes in order to guide them. These were either sitting at their sides or standing behind them. Users were exclusively composed of children aged from 4 to 12 years old. Spectators were rare and did not long linger to watch the user performance.

As for the children who learn for themselves, they bonded often with a second party offering a new friend. The interaction with the game in total normally lasted for an average of four and a half minutes. When the animator asked the children to talk about the Serious Game, they described it only by the playful challenge it offered: "In this game, you have to trace the shape of the animal before its too late!"

Children never evoked the name of animals that they had drawn. They neither questioned nor comment on the difficulties that scientists faced identifying the original traces of animals on the real walls of the cave. The parents who counseled their children explored only rapidly these aspects.

Analysis

[Table 7](#) Indicates that *Gargas* has encountered some lack of counsels.

Example #5: Dentistry kid

Description of the project

The training of students, including in dentistry, has always required repetitive and time consuming tasks when it comes to preparing classes and correcting student work. But this is also true for the preparation students do. If training and assessment are two inseparable elements, it is nevertheless true that there is a significant break between the usual methods of teaching and the digital environment that surrounds today's students.

The case presented here is the training and evaluation of dental students in the field of pediatric dentistry (Master's degree, year 2), especially in relation to two separate exercises: The first one is an exercise aiming at developing the students' ability to identify the teeth and their positions using radiological (conventional or tomographic) and/or clinical images based on a clinical context described in the instructions. This is what we call "filling the pediatric dental scheme". It is directed education for both physiological situations and pathological situations and takes into account the notion of gradation of difficulty. The second one is an exercise in identification and placement of pathologies (from a range of simplified dental diseases: cavities and old fillings).

Initially, these exercises were performed using a computerized presentation media collection with oral or written out comes. The exercise was assessed and led to collective comments. This approach had several disadvantages. First, the time required for assessment did not make individual correction possible during the training phase. Next, this method did not allow identification of students in need during training, and made it difficult to assess when achieving the validation of this teaching module. In addition, this method made it difficult to monitor and challenge the correction of clinical cases. It is in light of these considerations that a Serious Game was designed and developed so as to reproduce in a realistic and time limited manner some of the tasks that a practitioner is required to perform. The game had to fit into the broader context of the resolution of clinical cases and provide a preparatory phase to the development of a treatment plan.

Feedback

In the pedagogical prerequisites, some rules were established for the optimization of teaching materials. First of all, the teacher must be able to present a prefilled schema when the situation is too complex in some areas. The same strategy can

Table 7

List of missing counsels for the GARGAS Serious Game project according the RDU Model.

Missing counsels according RDU Model for GARGAS	Explanations
R2- Project Management support	By using a stronger Project Management, maybe it would have been possible to organize an iterative approach before the event in order to present a better Serious Game. The development was a one shot without any pre-test with potential users.
R5- Financial and Administrative support	The <i>Gargas</i> Serious Game was made for free. At the end, no contract was signed and then no money was paid for its development. As this game was made in a university context, the financial aspects were unclear for us.
D3- Economic support	The <i>Gargas</i> Serious Game has never been thought to become a B to C product during its conception. As it was developed only for the celebration of a scientific experimentation, nobody has imagined that it could be integrated into the museum of Gargas, which was built few months later. Indeed it could have been an approach to raise money for future Serious Game projects.
U1- Use of the Serious Game support	These observations about children's feedback highlight the need to support the use of Serious Game. Most of them need some help to understand how to play.
U2- Reading and interpreting the Serious Game support	These observations about children's feedback highlight the need to support the interpretation of its messages. For example, by offering a debriefing after the game.

Table 8List of missing counsels for the *DENTISTRY KID* Serious Game project according the RDU Model.

Missing counsels according RDU Model for <i>DENTISTRY KID</i>	Explanations
R1- Gaming culture and artistic support	The Serious Game focuses primarily on the utilitarian aspect and not enough on playful aspects. A counsel to the gaming culture seems to be missing in this project.
D2- Coaching Marketing	The Serious Game was thought to be a local product. But it could probably target other academic institutions. Hence, at an early stage of the project, it might have been appropriate to introduce a marketing support in order to help the team to consider such a strategy.
D4- Political support	The use of Dentistry Kid is unfortunately fairly confidential. It would have been opportune to set up a political support of the institution in order to invite more teachers and students to use this Serious Game.
D5- Experience feedback support	Today, there is no return on the use of this game. Hence, any assessment that could lead to some evolution of the game is also missing.
U1- Use of the Serious Game support	The teacher encountered difficulties in the generation of new clinical cases, because the tool does not yet have enough flexibility for each clinical situation, and provides a measure of uncertainty related to the quality of the iconography, its interpretation and the complexity of the clinical situation. Clinical cases must show ambiguity. This problem can be partially solved by completing the dental chart. Test phases at a local level within the teaching team, as well as at a broader level (inter-university), have been introduced. Support for students is also crucial for the success of this tool. Clear instructions should be provided and the practical work should be long enough to help them understand the tool. Sessions devoted to the creation of new games are also important for the same reason, which enables them to understand the difficulties and constraints of this task.

also be used to limit tedious and repetitive tasks in the case of situations that are too simple or unattractive from a pedagogical point of view. This obviously has to be consistent with the level of the students. Both exercises are evaluated and the final mark reflects the two tasks according to a factor defined by the teacher. It should be noted that the same exercise is used in the context of training and evaluation, which limits the risk of bias due to the discovery of the evaluation technique.

This strategy has been tested for a year with 71 students. The experiment has been evaluated by the academic structure responsible for evaluating teaching. Feedback is positive at 75% (source: the UPS educational services department) despite recurring computer network problems. The game now allows autonomous dental training for the students, who can access the various cases provided by the teacher at a rate set by him or her. Automated correction as well as authentication allows quick identification of struggling students and thus prevents stalls.

This experiment clearly showed that several educational difficulties (individual correction, identification of struggling students, etc.) encountered in a classical teaching module in dentistry involving manipulations could be conveniently circumvented through the introduction of a Serious Game. The importance of identifying the existence of a family of games is connected to two points. For an additional investment in the design and development of the game, this approach first of all allows the establishment of a true publishing chain, which returns control to the trainer, allowing him or her to implement scenarios and new case studies, and second of all, greatly reduces the cost of developing new games.

Analysis

A great lack of counsel was identified around the use of the game. [Table 8](#) gives some explanations.

Example #6: ATC

Description of the project

These games are used at the Ecole Nationale de l'Aviation Civile⁴ (ENAC) of Toulouse, and especially for the Air Traffic department that trains future air traffic controllers. The initial idea was to reproduce the environment of an air traffic controller with radar, moving aircraft and potentially hazardous situations that have to be avoided.

These games have their place among classical – and therefore perhaps less attractive – presentations using PowerPoint and practical work carried out on a very large simulation tool involving significant operating costs, linked in particular to the presence of highly qualified staff playing the role of fake pilots.

The games are accessed through a local Intranet. They are, at this stage, single player games. The game engine (which consists of a games' publishing chain that make it easy to build new cases) leads after some time to two distinct uses. The first one is dedicated to explain the basic rules of the profession, for example the need to anticipate situations given the performance of airplanes, their turning radius, etc. In this configuration, the maps are imaginary (hallways, mazes, and so on) and aircraft are simple objects moving on the screen. The second one places the player in a situation with multiple issues: several successive conflicts produced by planes intersecting at the same altitude, the presence of unauthorized flying areas, the presence of storm areas reducing the performance of the aircraft and airports, etc. The whole application is now patented and ENAC is considering its deployment abroad in similar training institutions.

⁴ National School of Civil Aviation.

Feedback

Both modes, game based discovery of the Air Traffic Control context and validation of technical skills through realistic situations, have been appreciated by a population widely used to CBT learning environments and simulators.

Analysis

After some time, these projects were finished. Nevertheless, several necessary or useful counsels were absent. There are consigned in [Table 9](#).

Example #7: Auto Junior

Description of the project

The game *Auto Junior* from the French multimedia magazine *Mobiclic* n°6 of October 1998, (Editions Milan Presse interactive) ([Alvarez & Djaouti, 2012](#)), invites the user to drive a car. The objective is to reach an open air cinema while respecting the Highway Code and being careful about speed. The game thus proposes a random series of tests (avoid an elk which crosses the road, not to cross a solid white line, stop at the halt sign ...), which insist on a rule to respect. Each mistake is given an explanation and punishes the player by drawing points away from his driving license. The faster the player will drive, the more he will be exposed to the traffic accidents. We are facing a game whose scenario is made to give an educational message: to drive prudently by paying attention to the speed and to respect the Highway Code.

Feedback

If the game was tested quickly to identify bugs and published by the editor, no any feedback was ever given after its dissemination. We never received any feedback from the general public or from schools. Thus, it was impossible to know if *Auto Junior* was able to reach its pedagogical goal or not.

Analysis

This game targeted French and Belgium School. The production was very fast, one week because all the CD Roms had to be produced in one month. [Table 10](#) lists the missing counsels for *Auto Junior*.

6. Discussion

All the fifteen categories of counsels from the RDU Model are represented if we merge all these seven Serious Game projects reviewed. [Table 11](#) includes now all these counsels.

After analyzing a collection of 150 Serious Game projects (see [appendix](#)), we have identified 3 main counsels: R for Realization, D for Dissemination, and U for Use, composing the RDU model. This one is associated with 15 items (cf. [Table 2](#)). In order to illustrate all the items, we have extracted seven examples from the collection. These examples have been designed to target educational goals.

We do not argue that this list of items is exhaustive or truly novel. Not exhaustive, if we take into account for instance the tutoring list proposed by Élise Garrot ([Garrot, 2008](#)). She proposes 16 items in order to counsel pupils during the learning process. Not new, if we look that some items from Garrot are very close from those of the U family from RDU model for

Table 9

List of missing counsels for the ATC Serious Game project according the RDU Model.

Missing counsels according RDU Model for ATC	Explanations
R1- Gaming culture and artistic support	The tests which were performed clearly highlighted the two previous approaches (<i>games for understanding the basic rules of the profession</i> and <i>games that put the player in a realistic situation</i>) and showed some clash between those who easily imagined the potential of the Serious Game among students but also for the promotion of the school, and those who demanded more realistic functionalities, incorporating features that were available on the 3D real-time simulator. In the first type of game, the air traffic control aspect is not very strong, we are close to metaphor and there is no difficulty surrounding the term "game." As for the second type, several experts refused to call it a game, as pedagogically speaking, it was difficult to imagine an association between a rather serious domain air traffic control and a game. In this case, the term <i>simulation</i> was considered more appropriate.
R4- Legal assistance	Several foreign countries ask about the game, but no contracts were signed. Sometimes, academic institutions are poorly armed as far as legal or marketing concepts are concerned.
D1- General Adoption	As several experts refused to consider ATC as a game, it is clear that a support for General Adoption was required for this project.
D2- Coaching Marketing	The project manager was not able to promote the game among other departments of the institution. A Marketing support in order to help on this aspect should have been proposed.
D3- Economic support	The customer wanted to study economic models based on B to C approaches. But the know-how in this area was not strong enough. So a dedicated support would also have been welcome.

Table 10List of missing counsels for the *AUTO JUNIOR* Serious Game project according the RDU Model.

Missing counsels according RDU Model for <i>AUTO JUNIOR</i>	Explanations
R4- Legal assistance	It was not really clear for the employees if they could be assimilated as authors or not. It was the same case for Atari at the end of the 70's when David Crane decided to leave the editor in order to create Activision. The starting point was that the creators of the Atari's game were not assimilated as authors but as programmers ... Thus, legal advice on this issue would have been important for the employees.
R6- Testing Support	An employee was designed to find bugs in the game. However, we did not have the opportunity to test the game with kids. However, they were the public target. In this context, it was impossible for us to know if the game was too simple or too difficult for them.
D5- Experience feedback support	As we had to produce very quickly each CD-Rom issue, 10 by year, we had no time to organize tests to analyze the users feedbacks. The editor didn't want to spend money for that and was concerned most on the way to optimize the production in order to produce each CD-Rom in time and to reduce their costs. Sometimes we received emails sent by children or teachers asking us to make new games on a particular subject. We didn't get any information about what could be wrong with the games in order to improve them. This is a missed opportunity to learn from feedback, thus improving future Serious Games, especially as we can observe from our Appendix that a lot of games such as <i>Auto Junior</i> are developed using this approach Appendix illustrates it (cf. Ed. Milan projects).

Table 11

List of the seven cases of Serious Games selected for Detailed Analysis.

RDU counsels/SG Projects	R1	R2	R3	R4	R5	R6	R7	R8	D1	D2	D3	D4	D5	U1	U2
<i>Technocity</i>			x						x	x		x		x	x
<i>ECSPER</i>			x							x					
<i>Flee the Skip</i>							x	x		x				x	x
<i>Gargas</i>		x			x						x			x	x
<i>Dentistry Kid</i>	x									x		x	x	x	
<i>ATC</i>	x			x					x	x	x				
<i>Auto Junior</i>				x		x								x	

instance. However, in the RDU model, we have linked the Use family with Realization and Dissemination ones. This approach seems quite new in the Serious Game scope and let us to get an overview of a Serious Game project in order to maximize its success. On the other hand, the RDU model takes into account a specific counsel dedicated to gaming culture and artistic support. We believe that this is a key item to carry out any Serious Game project, whether to realize, distribute or use such an object. Indeed, this item provides a way to assimilate the game specific grammar that is necessary to integrate such projects.

By systematically analyzing 150 projects across these 15 items, we can observe that the diversity and number of counsels set up significant organizational and strategic challenges for the successful design, dissemination and use of Serious Games in practice. For instance, we can notice in [Table 11](#) that for the seven examples, the number of items is different for each project of Serious Game. *ECSPER* proposes a lack of two counsels whereas *Technocity* presents seven items. The nature of needed counsels is also different for each project. By cross checking this with [Table 3](#), it is interesting to note that there is no correlation between project costs, the team sizes, the production contexts and the number of missing counsels in the seven projects. This observation invites us to see the principal utility of the RDU model as a tool for checking at different stages of a Serious Game project which kind of counsels would be necessary to mobilize in order to maximize its success.

By exploring [Table 11](#), we can notice that some items are more common than others. For instance, D2 (Coaching Marketing) and U1 (Use of the Serious Game support) get a score of 4 whereas R2 (Project Management support), R5 (Financial and Administrative support), R6 (Testing support) and R8 (R&D, technology and digital artifacts support) present a score of 1. What does that mean? By looking globally [Table 11](#), we can observe that the 7 items of the D and U families contain 20 missing counsels versus 11 for the 8 items in the R family. Clearly, this means that the main gaps in the success of our various Serious Games projects are linked to issues of dissemination and use. The realization part seems rather well managed. This observation makes it possible to foresee another utility of the RDU model: for structures that develop or sponsor Serious Games, what are their main weaknesses? A picture of the missing counsels in different families, made projects after projects, allows better identifying its weak points and modifying its position.

It is also interesting to note that in the introduction of this paper we have listed many models focused on the realization of Serious Games and much less on the diffusion and use of these objects. This distribution may imply that studying the technical aspects in the Serious Game scope may be simpler to define than human aspects. However, it is probably where research works should be conducted to increase the chances of success for Serious Game projects. Anyway, we must precise that for the 150 projects of our collection, most of them present a lack of counsels in the realization domain. And if we explore the missing points in the framework of the Realization family, we note that the missing counsels are mostly related to aspects involving human aspects R6 (testing support) or departing from purely computer or technical aspects as R4 (legal assistance). This observation confirms that bridges between social and computer sciences must be operated to optimize projects in connection with Serious Games. We can also see another hypothesis: the success of a Serious Game project may depend more on the human than on the technical aspects.

7. Conclusion

By driving all these 150 projects, we encountered several difficulties: e.g. unhappy customers or users, inability to produce the expected product aborted projects, lower sales or broadcasts than expected, targeted effects not listed, targeted population not met, investments larger than expected, product not working as desired ... By adopting a praxeological approach based on a qualitative analysis in five main steps, we have noticed that their origin was often a lack of counsels.

Thus it was important to identify different types of counsels to mobilize when we wish to increase the chances of adoption of a Serious Game and use it appropriately (as intended by its designers) in an ecosystem. In consequence the RDU model has been proposed: R for Realization, D for Dissemination, and U for Use. In order to illustrate the different items of our RDU Model, we have selected seven examples of Serious Game presenting educational goals; they regroup all the fifteen types of counsels taken into account by the model.

By analyzing both [Tables 3 and 11](#), we have noticed that the RDU model seem to be an adapted tool to identify missing counsels in a Serious Game project. More precisely, the RDU model can be used at different stages of the project in order to check problems and to manage them by adding dedicated counsels.

This analysis also revealed that the RDU model makes it possible to identify on a set of projects where the weak points of an entity related to Serious Games projects are located. For example, if counsels are lacking in the area of Diffusion family on a recurring basis, this probably means that appropriate measures should be taken for this domain. We also found that the models around the Serious Game dedicated to education are often focused on the realization of the object and less on the diffusion and use aspects. That observation invites us to further explore how to build models making bridge with social and computer sciences. This would probably help to improve Serious Game projects.

By analyzing the fact that counsels related to human aspects are more frequent than technical ones, we have concluded that the success of a Serious Game project may depend more on the human than on the technical aspects. A complementary study would allow to explore this aspect more deeply in further works. In order to experience that hypothesis, research perspectives may be the following: first, to assess the RDU model with other actors implicated in Serious Game projects, in which we were not implicated. They would maybe propose other types of counsels and suggest us to update some existing items. Second, we have to check if we get the same kind of result: a lack of human counsels superior to technical counsels. If these two points are checked, then we will be able to reinforce our hypothesis and study it more carefully.

In parallel, we have to improve the process with links problems observed in a Serious Game project and the types of counsels to be provided. For that, we need to develop other models, oriented to evaluation of Serious Gaming activities, in order to connect them to our RDU model. At the same time, that could be an approach to evaluate the gain in efficiency of an educational project. The development of such indicators would, we believe, be a complex but rewarding project for the Serious Games developer and education communities. We have now to explore these aspects in our next works.

Appendix. The collection of the 150 serious games of our study

#	Title of the Serious Game * Scholar project	Year	Sponsor	Author involved with the project	Lack of Counsels according RDU Model for Realization of Serious Games (# Item from Table 1)	Lack of Counsels according RDU Model for Dissemination of Serious Games (# Item from Table 1)	Lack of Counsels according RDU Model for Use of Serious Games (# Item from Table 1)	URL
001	Auto Junior	1998	Ed. Milan (Fr)	Alvarez	R4, R6	D5	http://bit.ly/1631r1x	
002	Les 7 Lutins	1998	Ed. Milan (Fr)	Alvarez	R4, R6	D5	http://bit.ly/1631r1x	
003	Les sons du matin	1998	Ed. Milan (Fr)	Alvarez	R4, R6	D5	http://bit.ly/1h20civ	
004	Skeet	1998	Ed. Milan (Fr)	Alvarez	R1, R2, R4, R5, R6, R7		http://bit.ly/1bJQrxK	
005	La Sonde Lunaire	1999	Ed. Milan (Fr)	Alvarez	R4, R6	D5	http://bit.ly/1a7Y7Zb	
006	Le ballon voyageur	1999	Ed. Milan (Fr)	Alvarez	R4, R6	D5	http://bit.ly/1eJVzS	
007	Le Facteur	1999	Ed. Milan (Fr)	Alvarez	R4, R6	D5	http://bit.ly/1a7XK0M	
008	Le Père Noel	1999	Ed. Milan (Fr)	Alvarez	R4, R6	D5	http://bit.ly/1bJODop	
009	Les portes musicales	1999	Ed. Milan (Fr)	Alvarez	R4, R6	D5	http://bit.ly/19pDzJF	
010	Cache-Cache	2000	Ed. Milan (Fr)	Alvarez	R4, R6	D5	http://bit.ly/1g2Ryus	
011	Exam Racing	2000	Accenture (Fr)	Alvarez	R4, R6	D5	http://bit.ly/Gla2A5	
012	Fantôme et labyrinthe	2000	Ed. Milan (Fr)	Alvarez	R4, R6	D5	http://bit.ly/18SmRBP	
013	L'Homme sur Mars ?	2000	Cité de l'Espace (Fr)	Alvarez	R1			
014	La goutte infernale	2000	Ed. Milan (Fr)	Alvarez	R4, R6	D5	http://bit.ly/19pEzNY	
015	La leçon de piano	2000	Ed. Milan (Fr)	Alvarez	R4, R6	D5	http://bit.ly/17r3gF1	

(continued)

#	Title of the Serious Game * Scholar project	Year	Sponsor	Author involved with the project	Lack of Counsels according RDU Model for Realization of Serious Games (# Item from Table 1)	Lack of Counsels according RDU Model for Dissemination of Serious Games (# Item from Table 1)	Lack of Counsels according RDU Model for Use of Serious Games (# Item from Table 1)	URL
016	La sculpture	2000	Ed. Milan (Fr)	Alvarez	R4, R6	D5	http://bit.ly/GNBnBs	
017	L'écureuil fait ses provisions	2000	Ed. Milan (Fr)	Alvarez	R4, R6	D5	http://bit.ly/191LhTe	
018	Le carré magique	2000	Ed. Milan (Fr)	Alvarez	R4, R6	D5	http://bit.ly/15Xo8t8	
019	Le jeu du pain	2000	Ed. Milan (Fr)	Alvarez	R4, R6	D5	http://bit.ly/15qXzKu	
020	Le Sampler	2000	Ed. Milan (Fr)	Alvarez	R4, R6	D5	http://bit.ly/1hFohBn	
021	Lorenzaccio de Musset	2000	Ed. Milan (Fr)	Alvarez	R1, R4, R6	D5	http://bit.ly/17r2Vlq	
022	Morpion hanté	2000	Ed. Milan (Fr)	Alvarez	R4, R6	D5	http://bit.ly/1acZRLt	
023	Tycoon	2000	Accenture (Fr)	Alvarez	R4, R6	D5	http://bit.ly/17hTh5L	
024	Billy the cat: le cache-cache de Billy	2001	Ed. Dupuis (Be)		R4, R6	D5	http://bit.ly/191MTW0	
025	DJ Otzi	2001	Emi Music France (Fr)	Alvarez	R4, R6	D5	http://bit.ly/15XoD6A	
026	L'Atelier de Samsam	2001	Ed. Bayard (Fr)	Alvarez	R6	D3, D5	http://bit.ly/19CXN4o	
027	Le jeu des percussions	2001	Ed. Milan (Fr)	Alvarez	R4, R6	D5	http://bit.ly/17hUmum	
028	Le nombre mystère	2001	Ed. Milan (Fr)	Alvarez	R4, R6	D5	http://bit.ly/1GRqzSc	
029	Le petit train	2001	Ed. Milan (Fr)	Alvarez	R4, R6	D5	http://bit.ly/18SpEe4	
030	Le Petit Spirou: ne jette pas de cailloux	2001	Ed. Dupuis (Be)	Alvarez	R4, R6	D5	http://bit.ly/1c4Sj7x	
031	Prends garde à toi !	2001	Ed. Dupuis (Be)	Alvarez	R4, R6	D5	http://bit.ly/16TIHhN	
032	Rattrape les crêpes en plein vol	2001	Ed. Milan (Fr)	Alvarez	R4, R6	D5	http://bit.ly/19Ct69Q	
033	Sauve la galette !	2001	Ed. Milan (Fr)	Alvarez	R4, R6	D5	http://bit.ly/1hFq5KQ	
034	Samsam, le jeu des 7 erreurs	2001	Ed. Bayard (Fr)	Alvarez	R6	D3,D5	http://bit.ly/1GRemB	
035	SOS Hélico	2001	Ed. Milan (Fr)	Alvarez	R4, R6	D5	http://bit.ly/1aqkaXh	
036	Toboclic: le jeu des cadeaux	2001	Ed. Milan (Fr)	Alvarez	R4, R6	D5	http://bit.ly/18SqfFX	
037	Billy the Cat: Hot dog Billy	2002	Ed. Dupuis (Be)	Alvarez	R4, R6	D5	http://bit.ly/163dCvg	
038	Carnage Total	2002	Ed. Dupuis (Be)	Alvarez	R4, R6	D5	http://bit.ly/18SBPri	
039	Flip Mobile	2002	TF1 (Fr)	Alvarez	R4, R6	D2, D5	http://bit.ly/1gtPDg6	
040	La chasse aux caries	2002	Laboratoires Fabre (Fr)	Alvarez	R6	D5	http://bit.ly/1GPKJF	
041	La poubelle écologique	2002	Ed. Milan (Fr)	Alvarez	R4, R6	D5	http://bit.ly/1GRAPKd	
042	Les monstres du placard	2002	Ed. Bayard (Fr)	Alvarez	R6	D3, D5	http://bit.ly/16zMkjP	
043	Mélusine: la nuit des citrouilles volantes	2002	Ed. Dupuis (Be)	Alvarez	R4, R6	D5	http://bit.ly/163dKL9	
044	Mélusine: les dalles infernales	2002	Ed. Dupuis (Be)	Alvarez	R4, R6	D5	http://bit.ly/1aqvjY9	
045	Memory	2002	Ed. Bayard (Fr)	Alvarez	R6	D3,D5	http://bit.ly/1fmC7vS	
046	Monster Attack	2002	Ed. Dupuis (Be)	Alvarez	R4	D5	http://bit.ly/15qZIGb	
047	Où est passée sa majesté Carnaval ?	2002	Ed. Milan (Fr)	Alvarez	R4, R6	D5	http://bit.ly/1hFzO3B	
048	Parker & Badger: Pipo Pizza	2002	Ed. Dupuis (Be)	Alvarez	R4, R6	D5	http://bit.ly/1fmAChb	
049	Petites histoires de dents: une journée avec Zoé	2002	Laboratoires Fabre (Fr)	Alvarez	R6	D5	http://bit.ly/19m1qrl	
050	Remue-toi les méninges	2002	Ed. Dupuis (Be)	Alvarez	R4, R6	D5	http://bit.ly/1bjYAT5	
051	Viande a la sauce Ratiche	2002	Ed. Dupuis (Be)	Alvarez	R4, R6	D5	http://bit.ly/163bDXN	
052	Volley Bork	2002	Ed. Dupuis (Be)	Alvarez	R4, R6	D5	http://bit.ly/1hFA1nC	
053	Canyon Monster	2003	Ed. Dupuis (Be)	Alvarez	R4, R6	D5	http://bit.ly/1fUuFIF	
054	Cédric: Mais quelle mouche l'a piquée ?	2003	Ed. Dupuis (Be)	Alvarez	R4, R6	D5	http://bit.ly/1bV50L9	
055	Cédric: Pagaille chez les scouts	2003	Ed. Dupuis (Be)	Alvarez	R4, R6	D5	http://bit.ly/1fmES06	

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#	Title of the Serious Game * Scholar project	Year	Sponsor	Author involved with the project	Lack of Counsels according RDU Model for Realization of Serious Games (# Item from Table 1)	Lack of Counsels according RDU Model for Dissemination of Serious Games (# Item from Table 1)	Lack of Counsels according RDU Model for Use of Serious Games (# Item from Table 1)	URL
056	Depustulator	2003	Ed. Dupuis (Be)	Alvarez	R4, R6	D5		http://bit.ly/16zNH1U
057	La chute infernale	2003	Ed. Dupuis (Be)	Alvarez	R4, R6	D5		http://bit.ly/1a6p3bR
058	Le grand Zap!	2003	Ed. Dupuis (Be)	Alvarez	R4, R6	D5		http://bit.ly/1icTagM
059	Les Potes au Feu	2003	Ed. Dupuis (Be)	Alvarez	R4, R6	D5		http://bit.ly/1h7h0wS
060	Les Zappeurs: Dynamo zap	2003	Ed. Dupuis (Be)	Alvarez	R4, R6	D5		http://bit.ly/1bdxrD0
061	Mélusine: le bal des dragons	2003	Ed. Dupuis (Be)	Alvarez	R4, R6	D5		http://bit.ly/19DaOei
062	Mélusine: le grand sortilege	2003	Ed. Dupuis (Be)	Alvarez	R4, R6	D5		http://bit.ly/19tttEW
063	N'oublie pas ton maillot	2003	Ed. Dupuis (Be)	Alvarez	R4, R6	D5		http://bit.ly/16zNoEh
064	Parker & Badger: A fond la caisse !	2003	Ed. Dupuis (Be)	Alvarez	R4, R6	D5		http://bit.ly/1bdyeUu
065	Parker & Badger: chaud devant !	2003	Ed. Dupuis (Be)	Alvarez	R4, R6	D5		http://bit.ly/19m4KD7
066	Petit Spirou: Tu vas te faire mal !	2003	Ed. Dupuis (Be)	Alvarez	R4, R6	D5		http://bit.ly/1eldOpi
067	Ponkey Bong	2003	Ed. Dupuis (Be)	Alvarez	R4, R6	D5		http://bit.ly/1bK02EP
068	Tuniques Bleues	2003	Ed. Dupuis (Be)	Alvarez	R4, R6	D5		http://bit.ly/1aFkpwD
069	Boule & Bill: quel cirque !	2004	Ed. Dupuis (Be)	Alvarez	R4, R6	D5		http://bit.ly/1a6su2i
070	BlorK Quest	2004	Ed. Dupuis (Be)	Alvarez	R4, R6	D5		http://bit.ly/1icTZGv
071	Chips Attack	2004	Ed. Dupuis (Be)	Alvarez	R4, R6	D5		http://bit.ly/18JeusX
072	Culino Casse-Tête	2004	Ed. Dupuis (Be)	Alvarez	R4, R6	D5		http://bit.ly/1fUxwRM
073	Cranniman	2004	Ed. Dupuis (Be)	Alvarez	R4, R6	D5		http://bit.ly/19tN3CS
074	Horror Pic-Nic	2004	Ed. Dupuis (Be)	Alvarez	R4, R6	D5		http://bit.ly/HegGit
075	Les 7 énigmes de K'stèt	2004	Ed. Génération 5 (Fr)	Alvarez	R3, R4, R8	D5		http://bit.ly/H9Qhlz
076	Les Tuniques bleues: des bleus explosifs	2004	Ed. Dupuis (Be)	Alvarez	R4, R6	D5		http://bit.ly/1fUubIF
077	Musique Extreme	2004	e-TF1 (Fr)	Alvarez	R4, R6	D5		http://bit.ly/1aFkErw
078	Nebulozitor	2004	Ed. Dupuis (Be)	Alvarez	R4, R6	D5		http://bit.ly/1icTHzs
079	Spirou & Fantasio: l'attaque des robots amphibies	2004	Ed. Dupuis (Be)	Alvarez	R4, R6	D5		http://bit.ly/Hegj7u
080	Tamagoblork	2004	Ed. Dupuis (Be)	Alvarez	R4, R6	D5		http://bit.ly/Heg9x6
081	L'énigme Vermeer: le jeu des pentaminos	2005	e-TF1 (Fr)	Alvarez	R4, R6	D5		http://bit.ly/16uuyeo
082	Poster 3500	2005	Ed. Dupuis (Be)	Alvarez	R4, R6	D5		http://bit.ly/17HWdsl
083	Chaud devant !	2006	Ed. Dupuis (Be)	Alvarez	R4, R6	D5		http://bit.ly/1gDYf6t
084	Gargas	2006	IRIT (Fr)	Alvarez	R2, R5	D3	U1, U2	http://bit.ly/1cVs0f
085	Les Poissons de la Chance	2006	IRIT (Fr)	Alvarez	R4, R7			http://bit.ly/3Fflirw
086	Technocity	2006	Rectorat de Toulouse (Fr)	Alvarez	R3	D1, D2, D4	U1, U2	http://bit.ly/HgTSHA
087	Doubleur*	2007	CISPM (Fr)	Alvarez	R4	D1		http://bit.ly/1asc70b
088	Ebeniste*	2007	CISPM (Fr)	Alvarez	R4	D1		http://bit.ly/16rsHde
089	Fat Mario*	2007	ESAV (Fr)	Alvarez	R4	D1		http://bit.ly/17wQTxU
090	Fee Design*	2007	CISPM (Fr)	Alvarez	R4	D1		http://bit.ly/1aYAFbW
091	Ingénieur*	2007	INSA Toulouse (Fr)	Alvarez	R4	D1		http://bit.ly/1aYAFbW
092	Ingénioland*	2007	INSA Toulouse (Fr)	Alvarez	R4	D1		http://bit.ly/1dX36xE
093	IngEscape*	2007	INSA Toulouse (Fr)	Alvarez	R4	D1		http://bit.ly/1dx17xp
094	InsAdventure*	2007	INSA Toulouse (Fr)	Alvarez	R4	D1		http://bit.ly/16Rd3KF
095	Make'Em Chat*	2007	INSA Toulouse (Fr)	Alvarez	R4	D1		http://bit.ly/1ggzT1r
096	Projet ONISEP*	2007	CISPM (Fr)	Alvarez	R4	D1		http://bit.ly/18XgIh
097	Sérigraphe*	2007	CISPM (Fr)	Alvarez	R4	D1		http://bit.ly/1hyWrJM
098	Urbaniz*	2007	CISPM (Fr)	Alvarez	R4	D1		http://bit.ly/16S1XQn
099	Big Mac Sonic*	2008	ACT Formation (Fr)	Alvarez	R4	D1		http://bit.ly/1blzUW5
100	Campto	2008	Publicis (Fr)	Alvarez		D5		http://bit.ly/17angQB
101	Chrono Diet*	2008	INSA Toulouse (Fr)	Alvarez	R4	D1		http://bit.ly/1h5hnui
102	Dance Dance Food*	2008	INSA Toulouse (Fr)	Alvarez	R4	D1		http://bit.ly/16rrJOf
103	Dora - Sasa la salade*	2008	INSA Toulouse (Fr)	Alvarez	R4	D1		http://bit.ly/1dX0VKI

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104	Evolution*	2008	ESAV (Fr)	Alvarez	R4	D1		http://bit.ly/17wQv2s
105	Hutnet Island	2008	Orange Labs (Fr)	Alvarez	R1	D1, D2, D4	U1, U2	http://bit.ly/162C7Ma
106	La bouffe pour les nuls*	2008	IRIT (Fr)	Alvarez	R4	D1		http://bit.ly/Hyfw0C
107	Le déjeuner de Puppy*	2008	ESAV (Fr)	Alvarez	R4	D1		http://bit.ly/Hyfw0C
108	Les Simpsons: Homer se met au vert !*	2008	INSA Toulouse (Fr)	Alvarez	R4	D1		http://bit.ly/18IVRBu
109	MindUp	2008	Orange Labs (Fr)	Alvarez	R1	D1, D2, D4	U1, U2	http://bit.ly/18JgUru
110	Multaq	2008	Publicis (Fr)	Alvarez	R4	D5		http://bit.ly/1fUyOMC
111	Pakumon*	2008	IRIT (Fr)	Alvarez	R4	D1		http://bit.ly/16S10HM
112	Acnophobie	2009	Ed. Dupuis (Be)	Alvarez	R4, R6	D5		http://bit.ly/18aknuX
113	Ange ou démon ?*	2009	INSA Toulouse (Fr)	Alvarez	R4	D1		http://bit.ly/1aNtmW5
114	Des gars, des filles	2009	INSA Toulouse (Fr)	Alvarez	R4	D1		http://bit.ly/1f8rYjl
115	En soirée, n'oublie pas ta sécurité !	2009	INSA Toulouse (Fr)	Alvarez	R4	D1		http://bit.ly/1aNtNQ9
116	Flee the Skip	2009	Orange Labs (Fr)	Alvarez	R7, R8	D2	U1, U2	http://bit.ly/H1r8Jn
117	InnovNation	2009	Paraschool	Alvarez	R2, R4, R5, R7			
118	JohnJohn Racing	2009	Ed. Dupuis (Be)	Alvarez	R4, R6	D5		http://bit.ly/Hel699
119	Oh ! Style !	2009	Ed. Dupuis (Be)	Alvarez	R4, R6	D5		http://bit.ly/17HZNSU
120	Quatre amis*	2009	INSA Toulouse (Fr)	Alvarez	R4	D1		http://bit.ly/1ai01k8
121	The true story of Pedro*	2009	INSA Toulouse (Fr)	Alvarez	R4	D1		http://bit.ly/1cuURVF
122	ATC games	2010	ENAC National School for Civil Aviation	Alvarez, Plantec	R1, R4	D1, D2, D3		
123	Dentistry Kid	2010	Ecole dentaire de Toulouse	Plantec	R1	D2, D4, D5	U1	http://jsd.univ-tlse3.fr
124	Entretien en terre de Fangh*	2010	IRIT (Fr)	Alvarez	R4	D1		http://bit.ly/16rtH13
125	Escape from Port-au-Prince*	2010	INSA Toulouse (Fr)	Alvarez	R4	D1		http://bit.ly/1h5gxhf
126	First Job*	2010	IRIT (Fr)	Alvarez	R4	D1		http://bit.ly/16rtH13
127	Flucorp Inc.*	2010	INSA Toulouse (Fr)	Alvarez	R4	D1		http://bit.ly/1ctmzSA
128	Lusitania*	2010	IRIT (Fr)	Alvarez	R4	D1		http://bit.ly/1ctUteb
129	Open*	2010	INSA Toulouse (Fr)	Alvarez	R4	D1		http://bit.ly/1ctSDd2
130	SG du Vivant	2010	Université Toulouse 3 (Fr)	Plantec	R1	D1, D4		
131	SG en Automatique	2010	Université Toulouse 3 (Fr)	Plantec	R1	D1, D4		
132	Superflu*	2010	INSA Toulouse (Fr)	Alvarez	R4	D1		http://bit.ly/180Mmhx
133	Welcome to Sarkoland*	2010	INSA Toulouse (Fr)	Alvarez	R4	D1		http://bit.ly/1blzRtt
134	Ze Recruiter*	2010	IRIT (Fr)	Alvarez	R4	D1		http://bit.ly/17Bjccv
135	La course d'endurance*	2011	INSA Toulouse (Fr)	Alvarez	R4	D1		http://bit.ly/1ctmzSA
136	Med's Lab*	2011	INSA Toulouse (Fr)	Alvarez	R4	D1		http://bit.ly/180MihL
137	MOJOS	2011	Hôpital de Montpellier (Fr)	Alvarez	R3, R7	D1, D2		http://bit.ly/HyM8az
138	SG Utilité	2011	Université Toulouse 1 (Fr)	Plantec	R1	D1, D4		
139	The Wikileaks*	2011	INSA Toulouse (Fr)	Alvarez	R4	D1		http://bit.ly/17BhhEO
140	Tunisian*	2011	INSA Toulouse (Fr)	Alvarez	R4	D1		http://bit.ly/16rr9A6
141	Wardopi*	2011	INSA Toulouse (Fr)	Alvarez	R4	D1		http://bit.ly/HilcHp
142	Les ECSPER	2012	Ecole des Mines de Douai (Fr)	Vermeulen	R3	D1		http://bit.ly/1ayJSgb
143	SG Rex	2012	ENIT	Alvarez	R2, R3, R5, R6	D1, D2		
144	Generic SG	2013	Lavoisier	Alvarez, Plantec	R1	D1, D4		http://bit.ly/U3tjW
145	Les ECSPER 2	2013	Ecole des Mines de Douai (Fr)	Vermeulen	R2, R6	D1, D2, D4, D5		

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#	Title of the Serious Game * Scholar project	Year	Sponsor	Author involved with the project	Lack of Counsels according RDU Model for Realization of Serious Games (# Item from Table 1)	Lack of Counsels according RDU Model for Dissemination of Serious Games (# Item from Table 1)	Lack of Counsels according RDU Model for Use of Serious Games (# Item from Table 1)	URL
146	Dalada: game in ontology	2013	Université Bordeaux 3 (Fr)	Plantec	R1	D1, D4		http://bit.ly/HsXEER
147	Protocole Odonto	2013	Université Toulouse 3 (Fr)	Plantec	R1	D1, D4		http://bit.ly/1bjpXrD
148	Protocole Gériatrie	2013	Université Toulouse 3 (Fr)	Plantec	R1	D1, D4		http://bit.ly/1gh4BHT
149	SG Logistique	2013	Thiel (Fr)	Plantec	R1	D1,D4		http://bit.ly/16SJC5H
150	SG Sécurité	2013	Université Toulouse 3 (Fr)	Alvarez, Plantec		D1, D4,	U1, U2	http://bit.ly/1aN4eyQ

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