Abstract

This article is an exploratory approach of the different strategies used in higher education institutions for implementing serious games. In the complex and often slow-moving education sector, serious games are challenging not only the learners and teachers’ practices but also the organizations’ strategies. What performance criteria can be used in this specific context to evaluate the training? What types of strategies emerge? During the past decade, different types of serious games implementation have been experimented in higher education. Through a longitudinal analysis of six case studies, this article builds a typology of six strategies to implement serious games in higher education: Recycling, Ready-to-wear, Home-made, Haute-couture, Co-branding and The Playground. This study therefore introduces a sixth level of analysis in the evaluation of training process: Innovation. It therefore supports the creation of a new strategy: the Playground strategy.

1. Introduction

Serious games can be defined as “games in which education (in its various forms) is the primary goal, rather than entertainment” [1]. These applications use the characteristics of video games to engage individual in a learning experience. They belong to the type of computer-mediated environments of human learning, combining mediated learning by machines, simulation, emotional reactions and professionalization. Serious Games as learning methods have been widely developed since the 2000s [2], [3]. Nevertheless, the optimism regarding the value of games as a means of education needs to be tempered. In 2006, researchers admitted that one of the elements that hinder the spread of games in the context of training is the lack of data making it possible to prove their effectiveness [4]. There seems to have been little evolution since then, as, in their recommendations Pivec and Pivec [5] called for researchers to intensify the rate of data collection in particular through pilot experiences.

In the complex and often slow-moving education sector, serious games are challenging not only the learners and teachers’ practices but also the organizations’ strategies. What performance criteria can be used in this specific context to evaluate the training? What types of strategies emerge? How can higher education organizations use serious games in order to create a competitive advantage? During the past decade, different types of serious games implementation have been experimented in higher education. Through a longitudinal analysis of several case studies, this article offers an exploratory approach of these different strategies in order to build a typology.

First the literature review describes how serious games have emerged as training method and identify their performance criteria. Then the methodology part details the research design and the case studies protocol. The results are presented for each case study and a general typology is detailed. Finally the conclusion discusses these results and defines the limitations and perspective of the study.

2. Literature review

The literature review first describes how serious games have emerged as training method. Then, the different performance criteria to evaluate training processes and strategies are detailed.

2.1. The development of serious games as learning tools

Serious Games have an historical and conceptual genealogy. The different evolutions reveal the way the concepts - learning, simulation, game and
professionalization – get developed and combined to elaborate the current serious game notion. We can divide this genealogy in five periods: emergence of machines as learning tools, introduction of the simulation notion, democratization through video games, professionalization of simulation games and finally the academic use in higher education.

The idea of using a computer as a learning tool emerges with informatics. In 1924, psychologist Sydney Pressey already suggested with the « Drum Tutor » one of the first machine to learn through a dozen of quizzes. In the 1980s, with informatics democratization appeared the first softwares of computer-aided learning. In this behaviorist approach computer transmits knowledge to the learner. Since the 1990s the Computer Assisted Language Learning and Teaching describes learning tools with socio-constructivism background: Learner becomes in charge of his learning process by building his knowledge in and with action. Internet use has reinforced this approach trough e-learning. In a managerial perspective, the main expected benefits are the cost reduction and the improvement of training quality.

Simulation was introduced in 1946 with the MIT Whirlwind project, which enabled military airline pilots to train in a controlled situation. Learning was then achieved by trial and error in a systematic approach. Through offering a specific environment, reducing the risks and diffusing the necessary information, this process let the learners experiment the impact of their individual decision on a global situation. The learning process also evolves: the trial and error system offer the possibility to learners to experiment new scenarios without risks. It therefore encourages creativity. Novak et al. [6] explain that simulation reinforces the flow [7]: a psychological optimal state that someone can reach when completely immerged in an action. When the challenge and the skills are perceived as high, the individual not only appreciates the moment but also increases his abilities on the long term. But this approach is efficient if the debriefing and corrections are reactive: Interactivity between learner and teacher, even virtual, is an imperative condition [8].

The democratization of video games, for example in 1982 with “Flight Simulator”, made simulators available to a large audience. In the case of ELM (Elaboration Likelihood Model) [9] persuasion model games can be seen as a fun approach, making it possible to increase motivation, as well as the individual’s perceived ability to deal with information in a cognitive manner. According to Huizinga [10], play is free, is not “real” life, is distinct from “ordinary” life both as to locality and duration, creates order and finally is connected with no material interest. Games are therefore defined voluntary [11], and therefore conflicts with the notion of “serious games”. However, even if playing can be seen as a futile activity, players develop a strong immersion and concentration. Vandeventer and White [12] underline a high flow state during the game: Players are then more able to use complex information to go further in the process.

A phase of professionalization in simulation games has been taking place since the 2000s. Games are again being used in professional training, but in a broader way and not only for gaining technical skills. Serious games can therefore be presented as technologies and video game platforms which have objectives other than simple entertainment [13]. This virtual experience would aim at reengaging learners through a hyper-real experience [14]. The reintroduction of amusement has led to the appearance of the concept of edutainment [15], [16]. The commonly defended idea is that learner will be more interested in the subject thanks to the pleasure and the wealth of experience gained during the game. This increased interest and motivation leads to broader and more deep-seated learning processes. Serious games could therefore re-enchant learning [17].

Finally, the applications of serious games in the field of education are very recent and remain rather limited. Thanks to the technologies development, the price of these tools decreased and made it more accessible to the academic field and especially in higher education. However; many researchers admitted that one of the elements that hinder the spread of games in the context of training is the lack of data making it possible to prove their effectiveness [4]. There seems to have been little evolution since then, as, in their recommendations in 2009, Pivec and Pivec [5] called for researchers to intensify the rate of data collection in particular through pilot experiences.

2.2. Measuring the performance of a training process

To go further in this direction, this paper details the different models of training evaluation. We analyzed nine main models or frameworks for human resource training evaluation [18], [19], [20], [21], [22], [23], [24], [25], [26], [27], (cf. Table 1).

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<th>Table 1: Human resource training evaluation models/frameworks [18]</th>
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<td>1. Kirkpatrick (1994)</td>
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<td>2. CIPP (Galvin, 1983)</td>
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<td>3. CIRO (Warr et al.)</td>
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Each one of these models or frameworks focuses on different levels or categories. This article aims at analyzing an organizational strategy related to serious game. Therefore, it is necessary to use a model offering not only learning but also managerial criteria such as organizational benefits. We then decided to use the works of Kirkpatrick [19] who proposed to assess the contribution of a learning method according to four levels: Level 1: satisfaction (did the learners appreciate the training?). Level 2: the learning process (what did they learn?), Level 3: individual skills (were the learners able to apply their new skills in the particular situations?). Level 4: the organizational results (did the organization or the company improve its efficiency by training its employees?). We completed this model by the alternative framework of Phillips [27] who proposes a fifth level, focusing on Return on Investment (Did the training investment pay off?).

### 3. Methodology

To analyze the different strategies developed by higher education organizations when implementing serious games, we have used the case study method. This method can be defined as an empirical inquiry that investigates a contemporary phenomenon within its real-life context; when the boundaries between phenomenon and context are not clearly evident; and in which multiple sources of evidence are used [28]. This approach helps understanding a complex issue and extending experience to what is already known through literature. Through a detailed contextual analysis of a limited number of real-life situations we expect to provide the basis of a typology of serious games implementation strategies. To do this, we have followed the classical six steps suggested by the method [28], [29], [30]:

Step 1: Determine and define the research questions: to build our analysis framework, we have adapted the five criteria from Kirkpatrick [19] and Philips [27] analytics to the serious games context. To do this, we have used the literature and interview 10 experts: 5 serious games companies’ directors and 5 project managers in higher education. By analyzing the verbatim, we have identified the following adapted criteria:

- **Reaction:** in a serious games context, this dimension is considered as the learners’ satisfaction through their immersion in the game and their motivation to participate to the process. Does the strategy enhance participants’ willingness to engage in the learning process? Does it reinforce the flow? Are the students’ appreciations of the lecture higher than usual?
- **Learning:** in a serious games context, this dimension is described as the pedagogical pertinence: is the topic of the game in clear relevance with the learning objectives of the teacher? Is the level of the learners taken into consideration?
- **Behavior:** in a serious games context, this dimension corresponds to the possibility of contextualization. What can be transferred from the game to the “real” world? Does it relies on the teacher only or is the game build in order to help the transfer from virtual to real situation?
- **Organization:** in a serious games context, this dimension corresponds to the organizational benefits that an institution buying a game can expect. Does it rely on one person only (a teacher) or is there any collective support? Can the organization aim at positive effects on its internal communication, process quality or external image?
- **Return on Investment:** in a serious games context, this dimension corresponds to the financial benefits. This can be analyzed in a short-term and long-term perspective. What are the direct costs of buying the game? What are the different possibilities concerning the copyrights and business models?

Step 2: Select the cases and determine data gathering and analysis techniques: We have selected five French serious games companies, experimenting

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<th>al. 1970)</th>
<th>Outcome</th>
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<tr>
<td>5. Systems approach (Bushnell, 1983)</td>
<td>Four sets of activities: Inputs, Process, Outputs, and Outcomes</td>
</tr>
<tr>
<td>6. Kraiger, Ford and Salas (1983)</td>
<td>A classification scheme that specifies three categories of learning outcomes (cognitive, skill – based, affective) suggested by the literature and proposes evaluation measures appropriate for each category of outcomes</td>
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different implementation strategies with serious games in higher education:
- Case 1: Succubus has developed a game for the French government that is “recycled” and used by different teachers in their lecture in a Business School
- Case 2: Daesign has developed a serious games store with generic simulations that are sold to a Business School
- Case 3: Symetrix has developed a specific serious game on demand for a Business School
- Case 4: Itycom offers an authoring tool that allows teachers in a Business School to develop their own serious game for their lecture.
- Case 5: KTM Advance is working on co-conception and co-branding serious games with a Business School.
- Case 6: The Playground Project.: IRT Nanoelec (Research Programme in Nanotechnologies) funded the recruitment of a whole game designers’ team, the creation of a dedicated space (The Playground) and development of specific methods in order to imagine games to support innovations integrating technologies.

Step 3: Prepare to collect the data: We have participated (attended the different meetings, lectures and debriefing) to all the five pilot projects during 3 years. We have built an interview guide for the 5 companies’ directors and the 5 project managers in higher education according to the 5 criteria we wanted to analyze. One year after the beginning of the projects, we have made interviews to analyze the performance on each criteria.

Step 4: Collect data in the field: We have registered the interviews and gather all the data from the different meetings and analyzed the contracts between the different organizations.

Step 5: Evaluate and analyze the data: We have analyzed the content of all the verbatim. We have built a typology.

Step 6: Prepare the report: We have presented the typology to the different actors (serious games companies and project managers in higher education) for modification and validation.

4. Results

The results describe the six cases and link each one to a specific strategy: Haute couture, Recycling Ready-to-wear, Home-made, Co-branding and the Playground. Every performance criteria related to the theoretical framework is detailed and evaluated using the signs 0=no impact; + = small positive impact; ++ = medium positive impact; +++ = strong positive impact. The evaluation was made using the interviews of project managers in higher education.

4.1. Case 1: The Recycling strategy

4.1.1. Context: Succubus is a serious games company working mainly on demand with private companies or public organizations. In 2010, they have developed a game for the French government to explain the entrepreneurship abilities and the different supports from the government to the entrepreneurs. This game is available online, free and every citizen can experiment it. In a business school, a teacher decided to use it in the Entrepreneurship.

4.1.2. Performance evaluation:

Reaction (+++): The game was developed by experts. Therefore, the level of immersion, the game design and the game art were very high. The learners enjoyed using this training process and but are conscious that this is not developed especially for them.

Learning (+): The game was not developed on purpose for this type of seminar. So the teacher has to spend time and expertise to explain what is important, details the concepts. The learning process therefore relies totally on the way she coordinates and uses the game.

Behavior (0): Even if the flow is high, the content is not exactly specific to the seminar. The contextualization relies only on the ability of the teacher to explain.

Organization (0): This approach is an individual one, not an organizational. This kind of teacher, often considered as a “geek”, is lonely, often without organizational support. Even if this can be considered as innovative, the business school cannot increase a specific practice or even communicate on this as a global strategy.

Return on Investment (0): The game is free. So the organization (or the teacher herself) didn’t have to negotiate any right or cost with the serious games company. But there isn’t any possibility to make financial profits using this approach.

4.2. Case 2: The Ready-to-Wear strategy

4.2.1. Context: Daesign is a serious games company working mainly on demand with private companies. In 2015, it is the editor which has developed the most important serious games store with generic simulations. These serious games are sold through license or subscription. The average price for a one year utilization of a game in academic context is between 5,000 up to 10,000 euros. This allows SMEs or academic organizations to access these training processes. In the business school a professor was
willing to experiment this training process in his seminar for sales management: With a large number of students in this class (more than 600 students split in groups of 40 students), it was almost impossible to train students face-to-face to specific soft skills. The business school subscribed a license to use a generic game.

4.2.2. Performance evaluation:

Reaction (+++): This type of games was developed by experts. Their first version was originally designed for private companies, on demand. The game design and game art are appealing.

Learning (++): The learning goal is clearly defined. The game was originally developed on a specific demand from private company. It therefore corresponds to professional needs. The learning content is “validated”.

Behavior (+): As the game was originally developed on a specific demand from private company, it therefore corresponds to professional needs. The contextualization from virtual to real life is then possible. However the teacher has a specific role to play in order to develop a critical approach of the game.

Organization (+): Buying a license involves medium costs and then implies that the organization wants to get involved in this kind of training process. The decision of the investment requires defining in which lecture, which program, for which students using this generic game.

Return on Investment (0): the level of investment is medium/low. However, the business school has no copyrights on the game and should re-invest each year. If this choice seems interesting in a short term approach, in a middle and long term perspective, business schools seek new business models.

4.3. Case 3: The Home-Made strategy

4.3.1. Context: Since 2011, different authoring tools have been developed. Ilycom is one of the first companies which have decided to offer a license to use its authoring tool: ITyStudio. These tools are user-friendly in order to be used by teachers in order to create their own games, using their expertise to develop their content. In a business school, one teacher with a strong expertise on a very specific topic: mindfulness wanted to use a serious game to explain the concepts and let the learners experiment. As there were no serious games on store or to recycle on this topic and as the price for an “haute couture” approach was too high, the teacher decided to develop the game himself, using the authoring-tool. The business school therefore subscribed a license for around 10.000 euros. And few months later the game was ready.

4.3.2. Performance evaluation:

Reaction (+++): the authoring tool helps to develop a scenario, choose avatars and context and to establish the scoring. The level of immersion is interesting but cannot compete with professional developments. However learners appreciate the “home-made” style.

Learning (++): the content of the game is developed by the teacher. In higher education the professors are also developing research and can be considered as experts in their fields. The serious game becomes a new way to present intellectual contribution. The learning relevance is therefore high.

Behavior (++): The game is built by the teacher and used later by the same teacher in his lecture. The contextualisation is considered as medium.

Organization (++): This strategy requires a strong support from the organization in order to invest in terms of finance, but also in terms of expertise and training. When the organization is willing to buy a license to develop its own serious game, it invest around 10.000 euros, but also 30 days from a teacher and time spent to train him how to use the authoring tool. This strategy is therefore interesting when the organization expected to promote in a different and innovative way its expertise. In the case of the professor teaching mindfulness, the serious game is a way to promote the development of a Chair.

Return on Investment (+): Investing in an authoring tool license represents almost the same cost than investing in a generic store through a store. But the copyrights of the home-made games belong to the business schools. So this strategy is interesting when foreseeing a middle or long term perspective. In this case, the game « The Mindful Manager » is now expected to become a generic game, in a store, to be sold as license to other academic organizations.

4.4. Case 4: The Haute couture strategy

4.4.1. Context: Symetrix is a serious games company working mainly on demand with private customers. They developed solutions for long life learning is French major companies. They were not used to work with academic organizations but in 2012, for their first time they have developed a serious game on demand for a Business School. This school had a strong
specialty on Innovation Management and wanted to have its own serious game related to this topic. They expected to develop their image towards their future learners, but also towards companies with whom they are developing different activities (consulting, long life learning, executive education). For the Business school, investing in an “Haute Couture” serious game strategy was a huge challenge.

4.4.2. Performance evaluation:

**Reaction (+++):** The game was developed by experts. Therefore, the level of immersion, the game design and the game art were very high. The learners enjoyed using this training process and were really motivated and proud to participate to something unique.

**Learning (+++):** The game was developed to reach a specific pedagogical need. The level of the learners and the context in completely integrated in the definition of the game’s content.

**Behavior (++):** As the flow is high and the content is relevant, the learning-doing gap can be reduced.

**Organization (+++):** The game was a new and important challenge for the school’s team. The project manager has to build a core team. The internal communication was strong. The commitment to the project from the different internal stakeholders was high. The game had a positive impact on the image of the school related to the Innovation Management topic.

**Return on Investment (+):** We cannot communicate the exact price of this game. However to develop this kind of serious game, the minimum cost is around 50,000 euros and the average price is around 150,000 euros. This represented a strong investment for the business school. But they gain a return on investment on two dimensions: using the copyrights that belong now to them, the school is selling the game to other programs. Then, this innovative process had a positive impact on their image and they have gained several private contracts on long life and executive education thanks to this process.

4.5. Case 5: The Co-Branding strategy

4.5.1. Context: KTM Advance is one of the leaders of the serious games companies in France. They developed mainly on demand game for private companies. To differentiate themselves, they are willing to experiment the development of serious games collection on specific managerial and business topics. To do so, the challenge is to collaborate with academic institution which can provide specific and high quality content. Higher education organizations such as universities or accredited business schools represent therefore key stakeholders. On the other side, a business school with a strong expertise and image on the topic of innovation management is willing to gather its intellectual contributions through an innovative tool. As this is not just related to knowledge management but also to image promotion, they prefer to work with experts rather than using authoring tool to develop their serious games.

4.5.2. Performance evaluation:

**Reaction (+++):** The game was developed by experts. Therefore, the level of immersion, the game design and the game art were very high. The learners enjoyed using this training process and were really motivated and proud to participate to something unique.

**Learning (+++):** The content of the game is developed by the teacher. In higher education the professors are also developing research and can be considered as experts in their fields. The serious game becomes a new way to present intellectual contribution. The learning relevance is therefore high.

**Behavior (++):** As the flow is high and the content is relevant, the learning-doing gap can be reduced. The games are co-developed by teachers who are going to use them. So the contextualization is high.

**Organization (+++):** The partnership help both stakeholders improving their level of expertise. Both gain benefits from this learning curve. This innovative process is expected to have a high lever effect on the image of both organizations.

**Return on Investment (++):** Working in a consortium, through a partnership help reduce the cost of production, promotion and distribution of the game. Moreover, the two stakeholders manage a part of the diffusion process: the serious games company can use a store to promote the serious game while the business school can uses the academic networks. The degree of investment is lower than “Haute couture” strategy but the visibility is higher, as the expected return on investment.

4.6. Case 6: The Playground Strategy

4.6.1. Context : IRT Nanoelec (Research Programme in Nanotechnologies) funded the recruitment of a whole game designers’ team, the creation of a dedicated space (The Playground) and development of specific methods in order to imagine games to support innovations integrating technologies. This strategy corresponds to a a trend in serious games which reverses the classical top-down learning process. The
key point of this approach is to use serious games to facilitate innovation. For example, the 57,000 players of the virtual puzzle “Foldit” are contributing to scientific research on different diseases through protein folding, as well as learning about molecular biology. IRT Research Project is willing to develop games and process to support innovation. The game Nanorider aims at understanding the innovation process through creating new products and services using nanotechnologies. The 42 technologies used in the game are real ones, detected in the most advanced research labs and validated by the research center. All the ideas emerging from the games can therefore support real business development.

4.6.2. Context:
Reaction (+++): The game was developed by experts recruited directly in the organization. Therefore, the level of immersion, the game design and the game art were very high. The learners enjoyed using this training process and were really motivate and proud to participate to something unique, created inside the organization. The game is played by 1,000 students each year in a business school. The seminars integrating the game improve the student’s satisfaction by 20%.

Learning (+++): The content of the game is developed by the teacher and experts from research center. The serious game becomes a new way to present intellectual contribution. The learning relevance is therefore very high. 42 technologies from the research center were presented and used by learners, increasing their knowledge.

Behavior (+++): Players were more willing to deal with complex information after the session. After playing the game 5% of them were willing to visit a technological showroom, integrate and incubator and start their business ideas.

Organization (+++): The partnership between technological research centers made the game a unique link between complex technologies and markets. The projects won several international awards for innovation. The Playground was visited by more than 400 companies in one year.

Return on Investment (++): Using the game, several projects were launched and contracts signed with the research centers. The game is sold by case studies center. A certificate for trainers was created. Financial incomes were made.

Innovation (+): Using the game Nanorider and participating to session in the Playground, several companies launched new products and services. Patents were created. This criterion is completely new for a training process. Serious games can introduce therefore a new type of outputs.

5. Discussion and conclusion

This article is an exploratory approach of the different strategies used in higher education institutions for implementing serious games. Through a longitudinal analysis of six case studies, this article builds a typology of six strategies to implement serious games in higher education: The recycling strategy relates how a university uses free-to-use serious games. The ready-to-wear strategy explains how a university is using a serious games store with generic games. The home-made strategy describes how a business school experiments a serious games authoring tool. The haute couture strategy details how a business school ordered a specific serious game to reach its own specific needs. The co-branding strategy details how a business school is developing cooperation with a serious games company in order to co-develop and co-brand a collection of serious games. We can summarize and compare the six strategies in a typology (Table 2 in Appendix).

This study has academic implication: First we introduced innovation as a new level to evaluate the performance of a training process. Second we define a typology of six strategies to support serious games implementation. This study has managerial outcomes: The results might help the higher education organization in their decision of serious games’ implementation.

This study suffers some limitations: this exploratory approach relies on qualitative data and can be therefore submitted to interpretation. To reduce this effect the validation of the typology is made with the interviewees. To go further, a quantitative analysis to test the different strategies and their criteria performance should be made on a larger sample of higher education organizations.

10. References

Table 2: The six Serious Games implementation strategies in higher education

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<thead>
<tr>
<th>Strategies /Performance Criteria</th>
<th>Reaction</th>
<th>Learning</th>
<th>Behavior</th>
<th>Organization</th>
<th>ROI</th>
<th>Innovation</th>
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<tbody>
<tr>
<td>Recycling</td>
<td>+++</td>
<td>+</td>
<td>0</td>
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<tr>
<td>Ready-to-wear</td>
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