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Abstract

In a context marked by youth's shift to digital culture instead of academic culture, use of Digital Based Game Learning (DBGL) is receiving widespread attention from Business schools. Indeed, they are likely to improve student's motivation and enable them to develop knowledge within complex learning situations. Several business schools have engaged in experimenting these new learning systems, but few studies have evaluated the SGs and their potential application in Information Systems (IS) teaching. This paper presents a feedback on the use of a SG used in IS teaching: INNOV8. This game is used for teaching Business Process Management, which is a central theme in IS teaching. INNOV8's evaluation was conducted within the course: "Modeling and optimization of business processes," proposed to third year's students. The feedback from the students and teachers were quite positive. Nevertheless, the study shows a low potential of the game for novice students in this field.

Introduction

Today, Serious Games (SGs) are known as a new and promising instructional method for educational institutions (Michael et al. 2006) (Aarseth 2005). SGs are video or computer games designed for training or educational purposes (Alvarez 2007). SGs are used as a means of meeting learning objectives such as training, simulation, education, promotion, communication, etc. They are adopted in the Environments for Human Learning (EHL) by combining machine-mediated learning, simulation, use of emotions and professionalism. Thanks to their approach combining seriousness and fun, the motivation and perceived ability of individuals to process complex information or to repeat behaviors have been improved (Kebritchi et al., 2010).

In recent years, the field of SGs has grown exponentially and has been used in a wide range of application areas like management, health care, defense, industry, civil security, military training, computer science, Information system and science (Kato et al., 2008)

In the Information System (IS) field many serious games, have been developed such as INNOV8¹ and iseamethod² for Business Process Management (BPM), SharkWorld³ for Project Management and Keep an Eye4 for corporate security awareness.

² https://tel.archives-ouvertes.fr/tel-00647688
³ http://www.sharkworldgame.com/
Despite the considerable amount and variety of developed serious games, to the best of our knowledge, only a few studies have been conducted to assess the games’ degree of efficiency in achieving the implied added value in IS learning (Michel et al., 2010; Boughzala et al., 2013). The use of such SGs requires a theoretical framework to evaluate their strengths and weaknesses.

This paper tries to bridge this research gap by providing a feedback on the use of INNOV8, a SG developed by IBM BPM for Business Process Management learning. We aim to answer “partially” to the following questions of our research program:

- Is it appropriate to use SGs to teach BPM concepts?
- How to integrate SGs in the BPM learning?

This experiment was conducted in the context of the module "Modeling and optimization of business processes" taught during the third year of a business school. INNOV8 was designed to train students and employees to process modeling and more specifically to an initiation to BPMN modeling language. We wanted to enhance the course traditional learning methodologies, namely: core modeling concepts presentation, readings and case studies in order to study the potential contributions of this SG. We have selected two theoretical frameworks spanning both the education and psychology fields in order to define a grid for the evaluation of INNOV8. This grid was empirically refined by teachers involved in this experiment. Then INNOV8 was evaluated according to the grid criteria to measure its performance and impact on learning the BPM concepts and methodologies.

The remainder of the paper is organized as follows. In section 2, we present the literature review related to SGs area: definitions, related works on SGs related to the BPM domain and learning theories for SGs evaluation. In section 3, we introduce the method adopted in this research to conduct the experiments. Section 4 describes the tested INNOV8 module: Smarter customer service. In section 5, we present the research findings. In section 6, we discuss the findings and we introduce a methodology to integrate INNOV8 in the BPMN learning. The conclusion discusses contributions, limitations and future research directions.

Background and related works

What is a Serious Game?

There are several SG definitions in the literature. SGs are a kind of “computer games designed for training or educational purposes” (Kebritchi et al., 2010). SGs are games “in which education (in its various forms) is the primary goal, rather than entertainment” (Michael and Chen, 2005) to deliver engaging interactive media to support learning in its broadest sense. Alvarez (2007, p. 25) defines SGs as “computer applications having as original intention to combine both serious aspects [...] with fun aspects from video games. Such an association is achieved by providing a learning scenario corresponding, from a programming point of view, to implement a decor (sound and graphics), story and suitable rules; therefore it moves away from restricting the game to entertainment.”

The main goal is to operate the entertaining aspect of video games to facilitate the learning of serious concepts which are traditionally taught with conventional teaching or training methods.

Related works on Serious Games for BPM learning

Nowadays, BPM is a mature concept which is accepted in business practice and which is supported by extensive literature worthy of being taught. Still, BPM concept offers a number of teaching challenges (Bosilj et al, 2012).

Modern BPM methods rely heavily on modeling platforms, which are used as a tool for model, simulate and analyze a process and its effects on the organizations (Tapani, 2008). But students feedbacks shows

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4 http://www.fftelecoms.org/articles/keep-eye-un-serious-game-pour-sensibiliser-la-securite-numerique-de-l-entreprise
that the user interfaces of these tools are many time complex and abstract requiring an extensive training (West, 2010). Serious-games and virtual environments are mentioned as a promising approach for teaching and simulating BPM due to their entertainment characteristics.

Towards meeting these objectives several SGs for BPM learning have been proposed in the literature.

The most important reference in this field is the INNOV8 game offered by IBM. INNOV8 offers a 3D virtual simulation environment of a business context. The player takes the role of a consultant SI who analyzes the existing business processes of an enterprise to improve its efficiency. INNOV8 also shows the modeling choices impact on the company's strategy, profitability and customer satisfaction through a complete simulation scenario. INNOV8 has been used in several universities (Lapp 2007).

(Gaibor, 2011) proposed the method ISEA for business process design to enable business stakeholders to be familiar with BPM. This method is supported by the ISEA Simulator: ISEAsy, a game developed in a virtual world. Business stakeholders embody the characters of the game in the virtual world with the purpose of simulating a business process. ISEAsy is a role-player simulation game where participants assume a role and act out a real life situation in order to get a description of their daily activities during a specific process in a participative way.

(Ribeiro et al. 2012) proposed the SG imPROVE offering 3D platform for health care BPM simulation. Improve allows players to model the process of managing a hospital emergency unit and to check the impacts on the health care choice as well as on its costs.

(Liukkonen 2009) proposed the SG VIPROSA (VIsual PROcess Simulation and Analysis) a game for business processes analysis and simulation of. VIPROSA combines games with business process simulation tools to enable better collaboration between IS consultants and business experts. To achieve this goal the game tries to include business experts in the modeling phase. In this way, the tacit knowledge on business processes could be used to define new processes.

This survey depicts that all SGs focus on the active participation opportunities for simulating business process models. Thus, we had chosen to test and evaluate INNOV8, as it is the most popular game in the field. This game is already used in many American, Chinese, Japanese, English and Australian universities in their curriculums.

**Serious games evaluation and Learning theories**

To understand the factors of effective learning and study learning specificities, several theories and models were developed. One could cite, among others, the experiential learning theory (Kolb, 1984), social cognitive theory (Bandura 1986), Self-determination theory (Deci and Ryan, 1985; Ryan and Deci 2000); flow theory (Koufaris, 2002), learning style models (e.g. Felder and Silverman, 1996), technology adoption models (Davis, 1989; Venkatesh et al., 2003), expectation-confirmation theory (Bhattacherjee, 2001), etc.

Indeed, in order for educational institutions to take advantage of the opportunity presented by Serious Games, in terms of their potential as complementary educational tools, an evaluation has to be conducted before integrating these games across the curricula. The purpose of this evaluation is to assess a games potential as an educational tool. For reaching this objective, our research method needs to cover a number of different dimensions as learning itself is multi-faceted. As such, the authors have selected two theoretical frameworks spanning both the education and psychology fields. In order to identify common criteria that could be useful to characterize and evaluate SGs, we investigated two main theories that stresses on the “learning by doing” concept. We have chosen these two frameworks because of their congruence with the learning and the motivational potential of serious games given their engaging and entertaining nature. The both frameworks which have been selected are: Keller’s Attention Relevance Confidence Satisfaction (ARCS) model and the Digital Game-Based Learning (DGBL) developed by Prensky.
• Keller's ARCS Model (Keller 2004):

"Motivation consists of the amount of effort a person is willing to exert in pursuit of a goal; hence, motivation has magnitude and direction. Consequently, motivational design is concerned with connecting instruction to the goals of learners, providing stimulation and appropriate levels of challenge, and influencing how the learners will feel following successful goal accomplishment, or even following failure" (Keller, 2006).

Motivational design in the context of learning refers to “strategies, principles, processes and tactics for stimulating and sustaining the goal-oriented behavior of learners” (Keller, 2010). The ARCS model was initiated by John Keller in 1988, based on an extensive review of motivational literature, and then refined through application and research over time. A group of motivational concepts based on their shared attributes yielded four main categories: Attention, Relevance, Confidence, and Satisfaction.

Keller's ARCS Model, details four steps through which learner motivation can be achieved and fostered.

- **Attention**: Gaining and sustaining the learner’s attention. Capturing the learner’s interest. Stimulating curiosity to learn.
- **Relevance**: Building relevance. Meeting the learner’s needs and goals, affecting a positive outcome.
- **Confidence**: Creating learner confidence. Helping the learner build the belief that he/she will succeed, and giving the learner control over his/her success.
- **Satisfaction**: Providing satisfaction. Reinforcing the learner’s accomplishments with rewards.

Each precipitates specific strategies for stimulating motivation. Successful application requires a keen understanding of targeted audience, the involved content and the application of that content on the job.

• The Digital Game-Based Learning Model (DGBL) (Prensky 2001):

Prensky (2007) defines digital game-based learning (DGBL) as “…any marriage of educational content and computer games” and further refines it to be “…any learning game on a computer or online”. This definition assumes then that learning achieved through DGBL means can be equally, if not more, effective than traditional learning methods. The reason why DGBL learning is effective can be attributed to three primary reasons (Prensky, 2007):

These three main factors have been identified to assess SGs, namely:

- Added engagement thanks to real setting simulation exercise: the learner experiment and develop skills in contexts that are difficult to reproduce in the professional life for reasons of cost, time and security (Corti 2006).
- An interactive learning process: Thanks to their interactive and fun aspects (such as competition, reward ...) SGs encourage Y generation learners to learn theoretical concepts.
- Immediate feedbacks: each decision is assessed and explained in real time to the learner.

The next section explains the use of these two models for evaluating INNOV8.

**Research method**

We have adopted an experimental approach to study the impact of INNOV8 on the BPM learning. The evaluation protocol involved six main steps, namely: self-evaluation, lab study (surveys) and facilitative participatory observation. The figure 1 summarizes the main steps of the evaluation protocol.

Drawing on the ARCS and DGBL models, three IS associate professors have refined the criteria identified in the previous subsection “Serious games evaluation and Learning theories”.

Three relevant criteria for BPM learning were selected:

- **Playability dimension**: Gaining and sustaining the learner’s attention
- **Learning dimension**: learners can acquire new theoretical knowledge
- **Added engagement dimension** : the knowledge and the scenarios described in the game are common working situations
In a second step, the 3 associate professors have played the game in order to define a questionnaire.

The questionnaire is organized in three groups of items corresponding to the dimensions of Playability learning and added engagement. A team of three students was then selected to assist student volunteers to test INNOV8, and complete the pre-prepared questionnaire.

We targeted students from a business school and from an engineering school, in order verify the relevance of integrating INNOV8 in a common curriculum for both schools. The participatory observation team has organized seven test sessions of the INNOV8 game. The team has opted for testing sessions in small groups for this experiment.

The questionnaire began with some general information about the participant in order to perform and analyze statistics on populations with relevant criteria. Then the questionnaire addresses the three dimensions depicted in phase 1. Finally, as one of the objectives of our study was to evaluate the relevance of SG implementation in our curriculum, the final part of the questionnaire gathers opinions of all participants about the SG integration in their courses.

For the questionnaire format, we have chosen to include 15 closed questions in order to get the most reliable answers. Closed questions provide us a more objective feedback from the participants.

The students responded anonymously. The questions were based on binary scales or Likert scales from 1 to 10 (not important at all - somewhat important - very important). Some questions were negatively formulated to vary the types of responses (Gall, Borg and Gall, 2003). The questionnaire was verified by two faculty members to ensure the soundness of the results.

32 students have participated in these tests, in a non-academic setting. At the end of the test, each student completed the questionnaire. The participatory observation team observed the students and has assisted them in case of difficulties. This phase of testing was conducted between April and May 2014. The target population had an average age of 22.37 years. The participants are familiar with information technologies (PC, Internet, video games, etc.).

**INNOV8 description:**

INNOV8 was developed by IBM in 2007 as part of their "Academic Initiative" program. The SG was designed to train students and employees to process modeling and to introduce the modeling language BPMN (Business Process Modeling Notation).
INNOV8 is a single-user system, where the player assumes the role of a consultant who has to reconfigure the process of a call center to allow the company to be more efficient. The player is a consultant named "Logan" in a fictitious company "After Inc". He needs to move in the company and gather information from colleagues and then make decisions that will affect both business performance and the final score of the player. Throughout the scenario, the player has to:

- Choose the right strategy to meet specific needs,
- Choose the budget to be allocated to different units of the company,
- Change a process to achieve specific goals,
- ask the company's employees for complementary information.

Advises are given to the learner throughout the scenario such as: finding documents or interviewing other virtual employees. In most cases, these dialogues provide important information to the user, and are followed by a decision. The information in the interviews is often the keys to find the optimal solution to the problem. Indeed, it is often necessary to find a compromise between quantity and quality. The solution provided by the player will rarely the best, but it can approach by being attentive to the information given in interviews.

![Figure 2: INNOV8 user interface sample](image)

The decision includes the finding of optimal compromise between the number of employees to be assigned to certain tasks and the level of their skills. This is to be achieved under a budget constraint. For such decisions, the user has the right to three simulations before submitting his response. This helps to take into account the impact of each parameter on the objectives. When a non-optimal solution is passed, this induced impact on the entire process chain.

Throughout the scenario, INNOV8 creates an immersive environment: the graphics and music are consistent with common situations. Giving a score at the end of the game allows a self-assessment, but also gives the opportunity to the player to challenge themselves, and this aspect of "self-competitiveness' is very often found in conventional video games.

**Findings:**

Firstly we have analyzed the "playability" dimension of INNOV8, in order to analyze satisfaction, interest of the participants. We note that 78% of the population easily navigated through the virtual enterprise Inc. After. We noticed that almost 75% of the students surveyed rated the game as friendly.
56% of the players do not like the background and 69% did not appreciate the graphics of the game. These aspects are less valued by students, usually accustomed to video games.

In figure 3, we depict the evaluation results for the immersion factor of the game. We observe that the students enjoyed getting involved in the mission of their "Logan" avatar. This shows that the game is exciting and captivating.

![Immersion in the game](Imagenes/Immersion.png)

**Figure 3: evaluation of the immersion criteria**

We have then studied the marks given by students on understanding the concepts explained throughout the game to evaluation the "learning" dimension. That essential criterion shows whether the educational aspects, distilled through the game scenario, are properly highlighted.

In view of the scores, we can consider that the teachings of the theme, namely the management and optimization of processes, are clearly presented in the SG (figure 4).

![Understanding of the Business Process improvement concepts](Imagenes/Understanding.png)

**Figure 4: evaluation of the learning dimension**
We have examined the "added engagement" to check whether the SG scenario corresponds to a real business problem that the student may face in their professional career (Figure 5);

84% of students consider the entrepreneurial situation described as realistic, and believes the mission entrusted as a professional situation.

![Realism of the mission](image)

**Figure 5: evaluation of the mission realism**

Finally, we have compared the characteristics "Game play" (navigation, music, graphic design, usability, fluidity and immersion in the game world) to the overall assessment of the student.

As an average for the "Game play" dimension, we have obtained a score of 6.15 / 10, which takes into account only the SG features as a video game and not as an educational device.

This mark is below the average rating that students have assigned to INNOV8: average mark is 7.34 / 10. This means that the educational dimension of INNOV8 has been well evaluated, approximately to 8.53 / 10, considering that the educational qualities and playful qualities are equally important in assessing the SG.

Nearly 95% of students would be motivated by sessions in which they use the SG to test their knowledge. The targeted population was very open to this type of support.

**Discussion**

In light of the questionnaire responses, the game is exciting and entertaining. Outstanding tasks, graphics and animations, and the challenge of the mission induce concentration, involvement of the learner.

The participants stated that they have enjoyed playing, which induces a sustained attention. The objectives of the mission are clearly explained at the beginning and the learner knows the actions that will be carried out to complete the game. The game advises the learner with the information they need and guide for them. The set of single character role allows the learner to actively participate in the training process. The game includes a progress bar indicating the learner where he stands in relation to the purpose of his mission.

The final stage of the game in which the learner varied some indicators to improve call center performance tests knowledge of the learner, stating the success or failure of his mission. Participants emphasized the realism of the game scenario and highlight the quality to promote this tool in the teaching
Feedback on the Integration of a Serious Game

curriculum. Pragmatism, the reality of the proposed mission, allows the learner to generalize the knowledge and skills acquired.

Given the interactive aspect of Innov8, the criteria of involvement and learner assessment are naturally integrated into the game. The immediate feedback at the end of the game brings satisfaction to the learner.

<table>
<thead>
<tr>
<th>Criteria</th>
<th>Evaluation</th>
<th>Illustration</th>
</tr>
</thead>
<tbody>
<tr>
<td>Gain and maintain the attention of the learner (Attention)</td>
<td>yes</td>
<td>Participants state that they enjoyed playing, which induces a sustained attention. The objectives of the mission are clearly explained at the beginning and the learner knows the actions that will be carried out to complete the game. Due to the actual appearance of activities within INNOV8, the learner finds the prospect of his future profession. The game suggests the learner with the information they need and guide for them.</td>
</tr>
<tr>
<td>Stir interest (Relevance)</td>
<td>yes</td>
<td>For immediate feedback at the end of the game, it brings satisfaction to the student who knows how he has progressed.</td>
</tr>
<tr>
<td>Develop confidence of the learner (Confidence)</td>
<td>yes</td>
<td></td>
</tr>
<tr>
<td>Give satisfaction (Satisfaction)</td>
<td>yes</td>
<td></td>
</tr>
</tbody>
</table>

Table 1: Comparison of research results ARCS model (Keller 2004)

This evaluation shows that the features of INNOV8 cover all the criteria of the ARCS model because the SG is designed primarily to engage and give satisfaction to the learners. The results of the experiment show that maintaining game learners’ attention and stirs their interest because the entrepreneurial situation described is realistic. Learners confirm that the task entrusted is a professional situation that they could live in their future careers. We also observe that learners had pleasure to be involved in the mission of their avatar. The game is challenging and captivating thanks to immediate feedback functions on progress in the mission.

<table>
<thead>
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<th>Illustration</th>
</tr>
</thead>
<tbody>
<tr>
<td>Scenario</td>
<td>yes</td>
<td>The tasks, graphics and animations, and the challenge of the mission induce concentration, involvement of the learner. Due to the actual appearance of activities within INNOV8, the learner finds the prospect of his future profession.</td>
</tr>
<tr>
<td>Interactivity</td>
<td>yes</td>
<td>The last step of the game in which the learner varied some indicators to improve the performance of the call center, allowing the player to interact with the SG.</td>
</tr>
<tr>
<td>Immediate feedback</td>
<td>yes</td>
<td>Immediate feedback at the end of the game, it brings satisfaction to the student who knows how he has progressed.</td>
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Table 2: Comparison of search results DGBL (Prensky 2001)
INNOV8’s functionalities cover entirely the criteria set by the DGBL. The learner is immersive in a real mission. It interacts with the game with the ability to vary his choice (employees, their skill levels, etc.) and immediately see the impact of its choices (the Budget gauge fills in as and becomes red if exceeded). This comparison allows us to conclude that INNOV8 completed the majority of requirements introduced by the theoretical frameworks that we have analyzed.

However, the associate professors find that it does not provide sufficient theoretical knowledge. The survey participant was familiar to BPMN modeling language and thus found the learning dimension efficient. This induces a necessary additional training to deepen the topic. Innov8 cannot be used alone as a self-training tool. Based on our research findings, we have sketched a methodology (Figure 6), for integrating INNOV8 in our Business Process Management course.

![Figure 6: A pedagogical scenario proposal for integrating INNOV8 in BPM courses](image)

**Conclusion**

Companies are looking for professionalism and business knowledge for young graduates, in order to be operational more quickly. Furthermore the learners appreciate learning sessions that are close to professional situations.

The results of our experiments confirmed that it is useful to use SGs as a complementary learning material to theoretical. SGs allow learners to be active in their learning and to develop other skills through role playing close to their future carrier. However, in order to have a more relevant feedback and make new assumptions, we need assess SGs on a larger scale.

These observations could not be generalized to all communities of learners. Cultural characteristics, for example, probably have an impact on the key success factors of these devices. Scientific assessments we have today are in experimental stage. They are often made within a class or a small group of learners. As a future research direction, we plan to assess the SGs for educational purposes on a larger scale, in a regional or national level.
REFERENCES


validated process”, Journal of Educational Media, (29:3).