Learning Information System Consulting through the Serious Game CityOne

Completed Research

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Abstract

Smart Cities are currently a hot topic in the Information System (IS) consulting field. IS consultant should use business cases to evaluate and identify conceptual and technological solutions. However, these approaches are often difficult to understand by the learners. The use of Serious Games (SG) has emerged as an interesting strategy to promote experiential learning in several domains. Yet, few studies have evaluated game-based educational methods in the IS consulting field. This paper presents a feedback on the SG Cityone use in the IS consulting teaching for a smart city use case. This experiment was conducted within the course: "Information System consulting" proposed to Master II students. The evaluation of Cityone was carried out according to the enjoyment and learning dimensions. The main results showed that the game is a good complementary approach to be integrated in the IS consulting learning.

Keywords

Business Process Management, Serious Games, learning BPM

Introduction

Information System consulting is an essential skill for Management Information Systems (MIS) students. IS consulting teaching is crucial, but is also challenging. In fact, the theoretical concepts looks too abstract to students and practical work are complex and expensive to organize as it requires professional intervention from consulting companies. IS consulting also involves transverse knowledge covering organizational, technical and human aspects that are difficult to illustrate.

In order to support IS consulting, we are experimenting the use of Serious Games. A Serious Game (SG) is a “computer application, 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 springs from the video game” (Alvarez & Djaouti, 2011) (Prensky, 2003) identified the following situations where game-based learning is beneficial: (1) Dry, technical, boring subject matter; (2) Complex subject matter that is difficult to understand or transmit; (3) Subject matter that is difficult to articulate to an audience; (4) Assessment and certification material that is difficult to learn; (5) Analysis that involves sophisticated “What if?” inquiry and (6) Strategic planning, analysis and communication. The situations (2) and (5) are particularly relevant to the IS consulting domain.

Despite the variety of the developed SG in the IS field, 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 (Boughzala, 2014). 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 Cityone, a SG developed by IBM for IS consulting learning with an application in the smart city context. Our research question is: Is it appropriate to use SGs to teach IS consulting concepts?
This experiment was conducted in the context of the course "Information System consulting" taught in Master II of a French Business School. Cityone enables users to experiment some of the complex problems facing cities. They can implement changes and understand the results in terms of how various technology solutions can help revolutionize industries within a municipality. We aimed to enhance the conventional course learning methodology, namely: core modeling concepts presentation, readings and case studies, in order to study the potential contributions of this SG. In our experiment, we have adopted the Bloom taxonomy and the flow theory in order to assess respectively the learning and the enjoyment dimension of the SG Cityone.

The remainder of the paper is organized as follows. In section 2, we present the theoretical background. In section 3, we introduce the method adopted in this research to conduct the experiment. In section 4, we present the research findings. In section 5, we discuss the findings in order to integrate Cityone in the IS consulting learning. The conclusion discusses contributions, limitations and future research directions.

Background

Digital Game Based Learning and the IS consulting

Effective learning is described by modern learning theories as active, experiential, situated, problem-based and providing immediate feedback (Boyle et al., 2011). According to (Mickael et al., 2005) and (Korti,2006), Serious Games(SGs) are consistent with these theories as learning with SGs offers an active process where real world situations can be posed allowing novices to develop content knowledge and problem-solving skills. The success of SGs is linked also to their captivating and entertaining dimension. This practice has led to the concept of learning by the video game: Digital Game-Based Learning (DGBL) (Chen et al., 2018).

In the Information System learning, several DGBL practices were assessed in the literature. (Ribero et al., 2012) have specifically analyzed the contributions of the SG to the field of Business Process Management (BPM). They show that traditional ways of learning (courses, exercises, case studies, etc.) have several limitations. In fact, BPM environments offer simplistic simulations of business processes do not take into account possible interactions of users during these simulations and their interfaces are generally complex and abstract learners requiring training (West, 2010) . Thus SGs are seen as a promising approach to learning and simulation of business processes due to the immediate experience feedback, active participation in the game and simulation of real business situations (So et al., 2018).

In the IS consulting field, (Kim et al., 2018) stated that it is important for Management IS students to understand how to gather the necessary information from a complex situation and derive actionable intelligence, evaluate possible solutions, and then implement a decision in a certain context in order to determine its effectiveness. This kind of problem-finding and solving skill is not easy to develop with traditional learning methods. Instead, providing student with a real world-like experience in a specific context, and letting them find a workable solution by trial-and-error is more effective for this purpose.

In addition to these problem solving skills, Management IS professional\(^1\) stressed on specifics traits that describe IS consultants:

- Like to work with people,
- Can think strategically about technology,
- Like responsibility for developing and then implementing their ideas,
- Can bridge both technology and business,
- Can see both details and the big picture,
- Are excellent communicators,
- Can manage time and resources well.

\(^1\) https://mis.eller.arizona.edu/what-is-mis
Digital Game Based learning assessment

In our assessment of DGBL we have considered two dimensions: the learning and the enjoyment dimension.

Learning dimension: Bloom’s taxonomy (Bloom et al, 1956)

In this framework, the fundamental aspect of learning is to ensure that learners do not just expect to memorize learning, but must be able to apply them and make judgments about the subject area. The assessment of learning techniques, according to the classification of Bloom, to ensure that learning is effective, is measured through six criteria for which the learner's capabilities are enabled:

- Knowledge: The learner can recall information,
- Understanding: The learner can explain and predict,
- Application: the learner can solve problems and use information,
- Analysis: the learner can observe patterns and understand concepts,
- Synthesis: the learner can create a new structure, assemble several elements to form a whole,
- Evaluation: the student can compare and make judgments about the value of ideas or materials.

We have adopted a list of action verbs (Table 1) based on Bloom's taxonomy to assess the learning dimension of the SG.

<table>
<thead>
<tr>
<th>Action Learning</th>
</tr>
</thead>
<tbody>
<tr>
<td>Categories In Bloom Taxonomy</td>
</tr>
<tr>
<td>Remember (knowledge)</td>
</tr>
<tr>
<td>Understand</td>
</tr>
<tr>
<td>Apply</td>
</tr>
<tr>
<td>Analyze</td>
</tr>
<tr>
<td>Assess</td>
</tr>
<tr>
<td>Create</td>
</tr>
</tbody>
</table>

Table 1: Action based learning (Krathwohl, 2002)

Enjoyment dimension: The optimal experience (flow or state) (Csikszentmihalyi, 1990) Define the concept of "flow" as the subjective state of feeling good. The flow often occurs when there is a perception of a balance between personal skills and the demand for the task. This theory is increasingly present in the scientific and professional literature concerning the creation of video games, for causing flow state is exactly what designers seeking to provide players: this helps to increase both their pleasure and their persistence in the game. When there is an appropriate balance of player’s skill and challenge in the game, players may feel high levels of immersion in the game, which often leads players’ loss of time/place and intrinsically rewarding experience. Often the concepts proposed to evaluate the flow are strongly linked to the "entertainment", "fun" and "enjoyment" concepts (Buil et al., 2018).
Methodology

Sample

A total of 127 Master I students was involved in this research project, which was conducted during the last session of the course "Information System Design" in a French business school. The students were mixed up in a test in situ (see section 2.2).

The usual format of the course concern small groups of students (N = 30), which interact with teachers in solving modeling exercises and in case studies analyses.

As can be seen in Table 2, the average age of students is 21 years, there were slightly more females in the sample and 96.85% of students have used an SG as part of their curriculum.

<table>
<thead>
<tr>
<th>Variable</th>
<th>Number</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total participants</td>
<td>127</td>
</tr>
<tr>
<td>Gender:</td>
<td></td>
</tr>
<tr>
<td>Males</td>
<td>61 (48%)</td>
</tr>
<tr>
<td>Females</td>
<td>66 (52%)</td>
</tr>
<tr>
<td>Average age</td>
<td>21 years</td>
</tr>
<tr>
<td>Experience with SG</td>
<td>123 (96.85%)</td>
</tr>
</tbody>
</table>

Table 2: Sample

Serious game selection: CityOne

CityOne is an SG developed by IBM in 2010 as part of their "Academic Initiative" program. This Serious Game used by many universities worldwide, which was selected in our experiment, is a 3D game for business consulting and optimization.

The player must solve the environmental, economic and logistical problems of a modern city while contributing to its development (Petridis et al., 2015). CityOne is a training support for process management in a complex environment. The learner, by becoming a consultant for the management company of the city, will have to assume several roles to accomplish its mission by immersing itself in four major sectors: energy, water, distribution and finance. The objective of the game is to introduce the player to several sectors of the industry and to show him how all tasks are related to each other to carry out a large-scale project by taking as a support a modern city.

Players must also find the best possible balance between the three dimensions of sustainable development: people, planet, profit or how to reconcile the well-being of the inhabitants of the city and greater respect for the environment without breaking the bank?

The theme of the city and the omnipresence of the scenarios related to logistics were not chosen by chance. By 2050, 68% of the world's population will live in cities that will need to be supplied (water, energy, food, etc.) and will need to be treated. In short, cities and related processes will focus the bulk of humanity's footprint. Taking a city as a backdrop, IBM chooses one of the themes that are among the current major concerns and represents a challenge for society in the near future. Currently, about one million people worldwide migrate to cities every week; experts predict that the urban population will double before 2050. Cities consume 75% of the world's energy, emit more than 80% of greenhouse gases and lose 20% of their water reserves due to infrastructure leaks. A finding, which leads to making decisions now, to meet the needs of people. In CityOne, the player will have the mission to set up a modern water management system taking into account energy and financial parameters.
This Serious game is for different audiences (employees, project managers, students). For companies, CityOne is a great way to involve employees or candidates in a project. By working on this simulation, they will have to manage a budget, resources, ensure productivity, optimize costs, appeal to other sectors, discover other trades, get to know them by working closely and in the field to respect constraints. It is important for a project manager to know the trades he or she is using.

Procedure

Professors concerned in this experiment informed their students about the Serious Game session. Students were asked to form groups of three players of the last course was also highlighted to legitimize the use of this SG. Each student group was provided with one copy of CityOne. A time limit of 120 min was imposed.

Teachers observed and recorded comments during the session without intervening to assist learners. At the end of session, teachers ask to learners to fulfill a survey to assess learning and enjoyment dimensions of Cityone.

A debriefing session on this experiment was carried out by teachers of each group to discuss the acquired knowledge, clarify links with the theoretical courses and practical exercises as well as to collect learner’s feedback on the SG.

Measures

All measurements were made in the same way: a list of items for which respondents were asked if they were "strongly agree" or "not at all agree" according to a Likert scale in five steps.

For the evaluation of educational benefits of the use of SG, we were mainly based on the update of Bloom's taxonomy (Krathwohl, 2002) which is among the most widely used framework for describing learning objectives.

To measure the flow, we relied on a scale of 18-item proposed by (Kiili et al., 2008). These items were derived from the GameFlow survey (Kiili et al., 2014) and the FSS-2 survey (Fournier et al., 2007).

This survey is organized in 9 dimensions: the challenge, clarity of objectives, feedback, playability, concentration, time distortion, the rewarding experience, self-loss of consciousness and the sense of control.

Results

"Flow" Assessment

Table 3 shows that the dimensions "challenge" and "feedbacks" have been well perceived by the learners. The "playability" dimension shows the lowest average, learners were not really captivated by the game design. The learners are used to video games with sophisticated design. Nonetheless, textual illustrations and user interaction were well perceived.

<table>
<thead>
<tr>
<th>Flow dimensions</th>
<th>Mean</th>
<th>SD</th>
</tr>
</thead>
<tbody>
<tr>
<td>The challenge</td>
<td>4.53</td>
<td>0.69</td>
</tr>
<tr>
<td>Clarity of objectives</td>
<td>3.72</td>
<td>0.81</td>
</tr>
<tr>
<td>The feedbacks</td>
<td>4.45</td>
<td>0.72</td>
</tr>
<tr>
<td>Concentration</td>
<td>3.75</td>
<td>0.79</td>
</tr>
<tr>
<td>Gameplay</td>
<td>3</td>
<td>1.2</td>
</tr>
<tr>
<td>The rewarding</td>
<td>3.56</td>
<td>0.94</td>
</tr>
</tbody>
</table>
Learning assessment

The learning dimension of the SG was well perceived by the students. The mission was very attractive to them as it corresponds to a hot subject in IS consulting and to a concrete situation. The design process (create) of a smart city process was particularly appreciated by learners (M = 4.78; SD = 0.36). Analyzing problems and applying a concrete solution was also well perceived by the students.

<table>
<thead>
<tr>
<th>Bloom’s taxonomy Criteria</th>
<th>Mean</th>
<th>SD</th>
</tr>
</thead>
<tbody>
<tr>
<td>Remember (knowledge)</td>
<td>3.68</td>
<td>0.63</td>
</tr>
<tr>
<td>Understand</td>
<td>3.75</td>
<td>0.69</td>
</tr>
<tr>
<td>Apply</td>
<td>4.12</td>
<td>0.67</td>
</tr>
<tr>
<td>Analyze</td>
<td>4.23</td>
<td>0.61</td>
</tr>
<tr>
<td>Create</td>
<td>4.78</td>
<td>0.36</td>
</tr>
</tbody>
</table>

Table 4: Learning assessment

Discussion

Our research study looks for whether CityOne triggered higher levels of learning and flow amongst learners compared to ‘conventional’ tutorial activity, whereby students might work on IS consulting case studies. Our results indicate that the use of SG resulted in increased levels of learning and enjoyment. These findings are discussed below.

Flow perception

In CityOne, the SG has a challenging component. Students groups can compare their game scores to their classmate’s game scores and this motivates them to want to perform better. Second, the immediate feedbacks provide self-confidence to the learners in order to incrementally help them improve their performance each time they play.

Moreover, in-class interactions within students were improved through the SG. Learners asked more questions to clarify existing information or to solicit new information from the professor. The SG is one effective means for interactive learning.

However, the video aspects, graphics and sound, have been developed in recent years, learners have been disappointed in comparison with the games they used to practice outside the classroom. Some learners were very disappointed by the graphics aspects. Even though, they prefer this mode of learning, in which they are active, compared to traditional modes in which they are generally passive.
IS consulting Learning perception

The main contribution of the SG usage was learner's engagement in the scenario of the game i.e. we have observed that learners were concentrated, analyzing smart cities issues within their group, debating to choose the right technological solution. These aspects are essential in the theoretical framework of learning (Kolb and Kolb, 2005) as well as in Bloom's taxonomy.

In terms of understanding IS consulting skills, city one offers a concrete scenario for multidimensional problem solving in a consulting mission. Each technological solution needs to fit the smart city context and to improve Key performance indicators.

The students report that the game satisfies their desire to:

- Rapidly apply and test their learning;
- Consider a real life-centric approach to learning new information and solving problems.
- Think strategically about technology,
- Be responsible about applying their ideas,
- Manage time and resources well

This evaluation (table 5) highlights that cityone offers integrated functionality allowing the learner to understand IS consulting Thus criteria: knowledge, understanding and application of taxonomy are covered.

<table>
<thead>
<tr>
<th>Criteria</th>
<th>Evaluation</th>
<th>Illustration</th>
</tr>
</thead>
<tbody>
<tr>
<td>Knowledge</td>
<td>Yes</td>
<td>Description of technical solution to solve problems related to water, electricity, distribution and finance.</td>
</tr>
<tr>
<td>Comprehension</td>
<td>Yes</td>
<td>The choices, made by the learner, lead to impacts on the management of the city that are explained.</td>
</tr>
<tr>
<td>Application</td>
<td>Yes</td>
<td>Indicators are applied, offering a tangible result of solutions for the city.</td>
</tr>
<tr>
<td>Analysis</td>
<td>Yes</td>
<td>Presenting a realistic problem and finding a solution to optimize the city's resources.</td>
</tr>
<tr>
<td>Synthesis</td>
<td>Yes</td>
<td>In the final score, the learner has a summary of the results.</td>
</tr>
<tr>
<td>Evaluation</td>
<td>Yes</td>
<td>At the end of the game, a feedback is proposed.</td>
</tr>
</tbody>
</table>

Table 5: Comparison of research results to Bloom's taxonomy (Bloom et al, 1956)
CityOne was appreciated in the context of applying the theoretical concepts of IS consulting concepts. However, the game did not provide theoretical knowledge. Thus, we have imagined a new course design method in order to integrate this SG within the IS consulting course. We have therefore proposed the following agenda (see figure 1).

The SG will be used in two distinct periods of training. First, after the introduction of Consulting theoretical concepts. This first experience of the SG will be the opportunity for the learner to discover, through this virtual environment, the various concepts and models studied during the first stage of the course. This will initiate the IS consulting and business optimization through its first virtual junior consultant experience. After this introduction to IS consulting, exercise sessions and case studies will be conducted in small groups to deepen some aspects of the audit, reconfiguration and optimization process. This group work, will allow participants to be active in their learning and learning by doing. In the final stage of training, when the learner has acquired extensive knowledge on Business optimization, the Serious Game is used again. This second experience of SG allows for virtually live the learner a mission organization consultancy entrusted to him and to better understand that during the initiation phase, the activities performed to optimize the city's resources (in the case of CityOne).

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**Figure 1: Proposal of an educational process that integrates the use of CITYONE.**

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**Conclusion**

Today’s business environment is very complex and dynamic so the traditional linear type learning methods (e.g., reading materials, listening to lectures, and taking notes) are not enough to prepare students for the modern, global business environment. 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.
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 survey.

The analyzed research frameworks, especially on the flow framework could be transferred in a model which contains hypotheses between the different variables (such as motivation, skills, instructional content, game characteristics etc.). The relationships between the variables will represent the hypotheses which refer to the influence between the variables.

REFERENCES


