Seeking for the Added Value of Videogames and Simulations

Sergio Vasquez Bronfman, ESCP Europe Business School, France

Abstract

Videogames and Simulations (V&S) are a hot topic in learning and education. A substantial amount of research and experiments had been done in the last ten years, which grows every month and every year. In this paper, I explore the field of V&S by focusing on its added value for learning. Building on the work of done by James Paul Gee and his colleagues at Wisconsin-Madison, by Donald Schön on reflective learning, by Fernando Flores and Martin Heidegger on learning from breakdowns, my intuition is that V&S are the best environments for reflective learning because they create breakdowns (*surprises*) very frequently, hence forcing players to reflect on and in action.

The paper describes a business simulation done at ESCP Europe Business School, in its Paris, London, Berlin and Madrid campuses, for Master in Management students. Data came from an evaluation questionnaire completed by all students that gives both quantitative and qualitative data. In addition to that, we have been able to access data by doing observation and participant observation. The results show that the added value of the simulation lies in learning by doing, competition (it's a *game*), and the discovery of ontological uncertainty in decision-making. Also, students practiced reflective learning, however encountering some limits when doing reflection-*in*-action.

Abstract in Spanish

Videojuegos y Simulaciones (V&S) son un hoy tema candente en la educación. Una cantidad importante de investigación y de experiencias se han realizado en los últimos 10 años, cantidad que crece cada mes y cada año. En este artículo exploro el dominio de los videojuegos y las simulaciones focalizando en su valor para la educación y el aprendizaje. Construyendo a partir de los trabajos realizados por James Paul Gee y sus colegas en la Universidad de Wisconsin-Madison, por Donald Schön en aprendizaje reflexivo, por Fernando Flores y Martin Heidegger en el aprendizaje a partir de *quiebres* (breakdowns), mi intuición es que los videojuegos y las simulaciones son los mejores ambientes para el

aprendizaje reflexivo porque crean quiebres (*sorpresas*) muy frecuentemente, forzando por lo tanto a los jugadores a reflexionar sobre, y en, la acción.

El artículo describe una simulación de negocios hecha en ESCP Europe Business School, en sus campus de Paris, Londres, Berlín y Madrid, para los estudiantes de su Master in Management. Los datos provienen de un cuestionario de evaluación completado por todos los estudiantes, cuestionario que entrega datos cuantitativos y cualitativos. Además, pudimos acceder a otros datos a partir de la observación directa y la observación participante. Los resultados muestran que el valor de la simulación reside en el *aprender haciendo*, la competencia entre los estudiantes (*es un juego*), y el descubrimiento de la incertidumbre ontológica propia al proceso de toma de decisiones. Los estudiantes practicaron el aprendizaje reflexivo, encontrando sin embargo algunos límites al practicar la reflexión-en-acción.

Abstract in French

Les jeux vidéo et les simulations sont un sujet abondamment discuté dans l'éducation d'aujourd'hui. Une quantité significative de recherche et d'expériences a été faite lors de ces dix dernières années, quantité qui croît tous les ans. Dans cet article j'explore le domaine des jeux vidéo et des simulations en focalisant sur leur valeur ajoutée pour l'enseignement et l'apprentissage. En partant des travaux réalisés par James Paul Gee et ses collègues à l'Université de Wisconsin-Madison, ceux de Donald Schön sur l'apprentissage réflexif, et ceux de Fernando Flores et Martin Heidegger sur l'apprentissage à partir de *surprises* (breakdowns), mon intuition est que les jeux vidéo et les simulations sont les meilleurs environnements pour l'apprentissage réflexif car ils créent des *surprises* très fréquemment, en forçant partant les joueurs à réfléchir sur, et dans, l'action.

Cet article décrit une simulation d'affaires à ESCP Europe Business School, dans ses campus de Paris, Londres, Berlin et Madrid, pour des étudiants du Master in Management. Les données viennent tout d'abord d'un questionnaire d'évaluation rempli par tous les étudiants, questionnaire qui fournit des données quantitatives et qualitatives. En outre, nous avons pu accéder à d'autres données à partir de l'observation directe et de l'observation participante. Les résultats montrent que la valeur ajoutée de la simulation réside dans l'apprendre en faisant, la compétition entre les étudiants (*c'est un jeu*), et dans la découverte de l'incertitude ontologique propre à la prise de décision. Les étudiants on

fait un apprentissage réflexif, avec toutefois des limites concernant la réflexion-en-action.

Keywords: videogames, simulations, learning by doing, reflective learning, reflection-in-action

Introduction

In recent years videogames and simulations (V&S) became a fast growing sector in education. During the last decade, many experiments were made with V&S in education and their number is growing from year to year.

There are essentially two types of experiences with V&S in education:

- Exploit existing products to highlight some fundamental mechanisms;
- Develop products specifically for educational purposes (sometimes called *serious games*).

For instance, in the first type, a social simulation game like *The Sims* allow gamers to understand political and economic principles and, especially, the complexity of these mechanisms. *Spore*, a simulation game in the field of Biology is a very good tool for the understanding of some aspects of natural selection. More sophisticated, scholars and management development professionals are using *World of Warcraft* for the learning of leadership skills (Denning et al., 2011; Thomas & Brown, 2009; Thomas & Brown, 2007). A first example of the second type is *Supercharged*, a simulation game whose purpose is the handling of the trajectory of a spacecraft (which is in fact a "particle") managed by manipulating electrical charges. Nowadays there are thousands and thousands of simulations and videogames especially designed for educational purposes.

In this paper we will explore the field of V&S by focusing on its added value for learning. In other words, our research question is: *What can be learnt with V&S that cannot be learnt (or poorly) with other pedagogical tools or techniques (such as case studies, role playing, problem-based learning, etc.)?* The paper starts by describing the main ideas on V&S and Learning, focusing on our intuition that V&S are a privileged tool for reflective learning. Then the paper will describe an experiment: *The 21st Century Car Challenge*, a business simulation implemented at ESCP Europe Business School.

Videogames, simulations, and learning

The recent interest on V&S for learning can be rooted to the work of Mark Prensky at the beginning of this century (Prensky, 2001). Prensky – who invented the terms *Digital Immigrant* and *Digital native* – said that there are five levels of learning with games: How, What, Why, Where, and When/Whether. First level (How) relates to game control, e.g. where to click in order to build a certain kind of buildings in a town (like in Sim City, Age of Empires, or Civilization). At the second level (What) the player incorporates the rules of the game, i.e. what can (or cannot) be done. Interestingly, in V&S the rules are incorporated while playing the game, not before, which is usually the case in board games. At the third level (Why) the player learn the strategies needed to win the game. The fourth level (Where) is related to the environment of the game, where the player is totally immersed. Finally, at the last level (When/Whether) the player must make some choices, make decisions, take action and get feedback. It is at this fifth level where the player discovers and understands the reward system of the game.

However, we think that the most interesting quest on V&S and Learning started with the investigation done by James Paul Gee at Wisconsin-Madison University. His research program starts with the finding that many people (especially young people) are willing to spend many hours doing hard, long and complex activities, i.e. playing sophisticated videogames, and they enjoy it. Why these people don't spend so many hours doing other "hard, long and complex activities" such as mathematics, physics, biology, history, literature, etc.? What is in videogames that people love so much? Are there underlying learning principles embedded in games that teachers should apply in the design of their courses? Jim Gee's investigation is aimed at answering those questions.

In his seminal book *What videogames have to teach us about Learning and Literacy* (2007), Gee found 36 learning principles embedded in "good" videogames. We will not describe here all of those principles, we're just going to select some of them that we find especially interesting for our research.

- Identity. In V&S players take a new identity, one that matters to them. Within this identity they become committed to the virtual world where they will live and act.
- Practice. Players get a lot of practice in a context where practice is not *boring*. They spend a lot of time performing tasks.

- Interaction. In V&S, nothing happens until players act and make decisions. Moreover, V&S do talk back, giving the player feedback and new problems.
- Risk Taking. V&S lower the consequences of failure. Therefore, players are encouraged to take risks, explore, and try new things.
- Well-Ordered Problems. In good V&S problems are organized in *levels*, so that the earlier ones have a lower level of difficulty and are built in a way that their solutions are the basis for solving the later, harder problems.
- Help is *Just in Time* and/or *On Demand*. Content, that one usually finds in textbooks or in teachers' talks, is usually delivered out of context, and students cannot tie it to experience; this is why it is so inefficient. In good V&S information is given when players feels a need for it (e.g. when facing a failure), can use it and are ready to use it. Knowledge is there to be applied *immediately*.
- Performance before Competence. We think this concept, emphasized by Cazden (1981) and related to assistance to learner in Vygotsky's zone of proximal development, is one of the most powerful learning principles embedded in V&S. Players can perform (i.e. act) before they become competent. Supported by the design of the simulation or the videogame, the smart tools V&S offers to the player (help tools), and by other more advanced players, beginners can learn to play *while playing*.
- System Thinking. Games encourage players to think about relationships, not isolated events or facts. It is a main feature of V&S that players need to think on how each action taken might impact on future actions, their domain of actions, and/or on other players. In our complex and global world such system thinking is crucial for everyone.

Jim Gee suggests not only to use videogames and simulations in schools and colleges, but also to make learning more *game-like* in the sense of using these principles to design and develop courses and other learning techniques (Gee, 2008; Gee, 2009).

Other scholars who have done interesting contributions to the field are Eric Klopfer and David Williamson Shaffer. Klopfer, Director of the MIT Teacher Education Program, is well known for developing games for mobile platforms using augmented reality. Maybe the best example is *Environmental Detectives*, a game developed for students of Civil and Environmental Engineering at MIT. Students play in teams, every team has a different role (identity) and a goal: to investigate a serious pollution in Boston Area. But the way students play depends on their role: environmental NGO member, communication officer at the company responsible for the pollution, a

scientist at EPA (Environmental Protection Agency), etc. To play the game, students must go out of MIT buildings and visit different places in the Boston Area seeking for data and information. In order to do this, PDAs with a GPS device are available. For instance, if one team is directed to Charles River, when they arrive to the river they have to collect a sample of contaminated water. Here comes augmented reality. When the GPS detects that the team has reached the place where they must get the sample, the augmented reality makes a virtual experience and give the team the resulting data. In fact, teams must collaborate in order to propose a good solution to the pollution problem. Because this game was designed and developed 10 years ago, it has been implemented on PDAs, but today it could be implemented in smartphones and tablets (Klopfer, 2008).

David Williamson Shaffer is interested in the ways we can use V&S to introduce children and young people to the basic conceptual frameworks that govern various professional practices (Shaffer, 2008). Building on the work done by Donald Schön (Schön, 1983; Schön, 1987), Shaffer has developed a set of *epistemic games* aimed at help players learn to *think like* engineers, urban planners, journalists, lawyers, and other innovative professionals. Interestingly, Shaffer states that V&S are powerful tools for reflective learning, statement we share and develop showing that these ideas are consistent with Martin Heidegger's ones on *learning from breakdowns* (Vasquez Bronfman, 2008). All of this lead us to the following hypothesis related to our research question: "V&S are the best environments for reflective learning because they create breakdowns (*surprises*) very frequently, hence forcing players to reflect on and in action. In this sense, V&S can be referred as breakdown creation machines".

Finally, V&S can be linked to the seminal work of Seymour Papert on educational technologies. As a matter of fact, V&S are microworlds. Papert defined a microworld as a "subset of reality or constructed reality whose structure matches that of a cognitive mechanism so as to provide an environment where the latter can operate effectively" (Papert, 1980). Andy diSessa (a Papert pupil) also wrote: "… a microworld is a type of computational document aimed at embedding important ideas in a form that students can readily explore. The best microworlds have an easy to understand set of operations that students can use to engage tasks of value to them, and in doing so they come to understand powerful underlying principles. You might come to understand ecology, for example, by building your own little creatures that compete with and are dependent on each other" (diSessa, 2000). The link with V&S is obvious.

An experiment with V&S: The 21st Century Car Challenge

This is a simulation developed by Megalearning, a Brussels-based company There are of course other business simulations products, such as the *Global Management Challenge* from Simuladores e Modelos des Gestao (SDG) in Lisbon (www.sdg.pt), CESIM (www.cesim.com), a Finland based company, and Industry Player (www.industryplayer.com). Students are split in *universes* of five teams, of 3 to 5 students each. The role of the students is to be the general management team of a car manufacturer multinational company and their goal is to win the competition against the other teams of their universe. There are four different product lines: Low Cost cars, Family cars, Eco-friendly cars, and Image cars. At the beginning of the simulation, all teams are in the same situation: 20% of the total market, etc. Teams are evaluated on six criteria that have the same weight: Revenues, EBIT (Earning Before Taxes and Insurance), ROCE (Return On Capital Employed), ARE (Accumulated Retained Earnings), Share Price, and Employee Morale. The simulation calculates all of these indicators.

The first task is to fill a table about customer sensitivities on different purchasing criteria such as design, robustness, technology, size, performance, consumption, advertising, etc. Then students download an Excel sheet where they must make decisions on these criteria for all lines of products. In addition to that they have also to make decisions on price, production capacity, investments in facilities and in Human Resources & Quality, etc. While preparing their decisions the systems give them feedback, so students can see the foreseeable consequences of their decisions (see Figure 1). When the decision is ready, students upload it to the server.

Once every team has uploaded its decision, the professor in charge for the universe runs the simulation. The system gives then the results of the first round of the simulation.

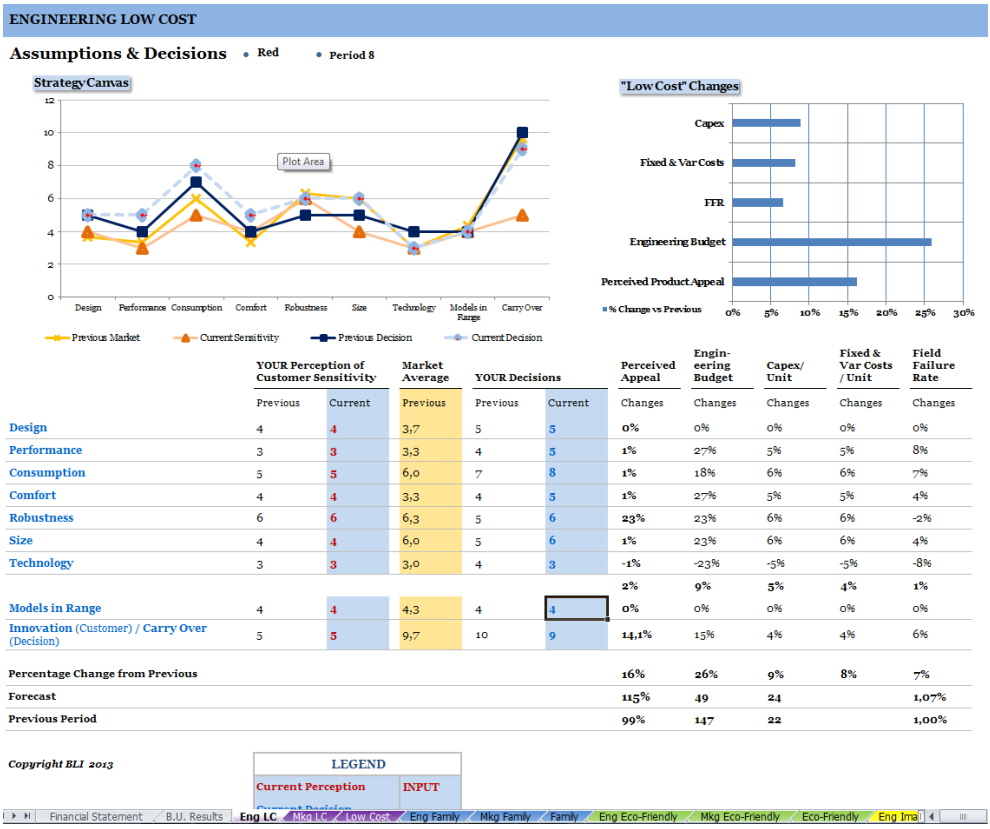

Figure 1. A screenshot of the Excel sheet

At ESCP Europe Business School we have been running this simulation since January 2010, especially for students in our MiM (Master in Management) Program. Every year we have almost 400 students in our Paris campus that we divide in two streams, and in every stream we have 7 or 8 universes. This simulation has also been running in our London, Berlin, and Madrid campuses. Evaluation surveys in these campuses are consistent with our findings at Paris campus. Every universe has a professor who acts as a coach for this universe teams. The simulation lasts for 3 days, where students have to make 7 decision rounds. Professors coach the teams helping them to analyse the results of their decisions and giving them documentation with data on their results and on their competition, which allow teams to build scorecards and analyse their competitors' strategy. As the simulation progress, it becomes more complex. For instance in Day 2 there is a merger with a manufacturer of an emerging country (China, India, Brazil, etc.). Therefore, decisions should be taken for two different markets with different characteristics, production can be outsourced to the emerging country (but this have a negative impact on employee morale), etc.

Based on our main research question (What is the added value of V&S for learning?) we have done an exploratory study using *The 21st Century Car Challenge* as fieldwork for this research. We started this inquiry with the following questions in mind:

- What did students like?
- What did students learn?
- What did students learn better than with other techniques (e.g. case studies, etc.)?
- Did students practice reflection?

At the end of the simulation, all of the students must complete an evaluation questionnaire that gives both quantitative and qualitative data. In addition to that, we have been able to access data by doing observation and participant observation. The author of this paper is also a professor who coaches simulation teams. On the other hand we have hired a researcher and some students doing their MiM Thesis in order to have an external point of view. This protocol has been implemented during three years.

Clearly, students love to play this simulation/game. What they like most is that "it is close to reality", the experience of doing teamwork, and the competition (they don't play against the machine, they play against other teams). Students learnt to apply general knowledge to particular situations, especially strategy and competitive advantage analysis, financial statements analysis, marketing mix, operations management, and KPIs (Key Performance Indicators).

What students learnt better than with other techniques? First, the *systemic nature* of companies: there are relationships between financial ratios; there are relationships between functions (the decisions you make when designing a car have an impact on production costs, hence in price, etc.); in other words there are always a multitude of factors to take into account. Second, students experienced the fact that the decision-making process is always done in *uncertainty* ("You can't know what other teams will do", "The situation is changing all the time", etc.). Finally, we observed that students practiced *bricolage*, informed improvisation, trial and error.

Did students practice reflective learning? Our intuition is that V&S allow the practice of reflection, in particular *reflection-in-action*, because during the videogame and the simulation, one is always facing surprises, breakdowns, unexpected results… and must take action, often immediate action. Our findings show that almost all students practiced reflection-*on*-action when discussing the results after a simulation round

and when discussing their views during the decision process (because of the system's feedback), but only some students sometimes practiced reflection-*in*-action when preparing their decisions because of the system's feedback, the trial and error process, etc.

Conclusions

The experiment of *The 21st Century Car Challenge* confirms that V&S have at least some of James Paul Gee's learning principles. As a matter of fact, students took an identity (the general management of a car manufacturer company), had a lot of practice making decisions, interacted almost all the time with the simulation, and they have taken risks. Also, students faced well-ordered problems of increasing complexity and got *just in time* help (delivered mainly by the professors), and learnt system thinking. Finally, performance before competence was the rule.

However, it is important to state the limits of management learning within this simulation. In his book *Managing* (2009), the well known management thinker Henry Mintzberg says that there are three levels of management: at a first level people take action; at a second level, managers motivate and organize people to take action; and finally, at a third level, managers take decisions based on data and information. In *The 21st Century Car Challenge* students manage only at this third level. This is a key learning point that professors should emphasize: in this simulation, there is no change management.

Finally, concerning our research question, we believe that the added value of V&S for learning can be hypothesized as follows:

- V&S are *breakdown creators*, hence forcing players to reflect in and on action;
- In V&S players experiment that decision-making is always at risk, because decision it's done in uncertainty;
- In V&S players experiment the systemic nature of organizations, hence allowing for system thinking.

Last but not least, in all of this learning players have fun (in particular "hard fun").

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