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Collaborative open training with serious games: Relations, culture, knowledge, innovation, and desire



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ABSTRACT

This article studies the convergence between MOOCs (massive open online courses) and serious games, two new types of information systems designed to improve learning. The aim of this research is to identify the areas of influence in collaborative open training serious games developed by large firms for a significant cost and made available for free to the public and to students according to the same principles as MOOCs. The methodology of this exploratory research is based on Kurt Lewin's (1945) statement "nothing is so practical as a good theory" and takes the opposite view. The deep observation of three serious games from L'Oréal, IBM, and Thales results in a theoretical model with five distinct influence domains of serious games: relations, culture, knowledge, innovation, and desire. This model is then discussed and tested on eight other serious games from major industrial companies such as General Electric, Nestlé, and Cisco.

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Formación abierta y colaborativa con juegos serios: relaciones, cultura, conocimiento, innovación y deseo

RESUMEN

En este artículo se estudia la convergencia entre los MOOC (curso en línea masivo y abierto) y los juegos serios, dos nuevos tipos de sistemas de información diseñados para mejorar el aprendizaje. El objetivo de esta investigación es identificar las áreas de influencia en la formación abierta y colaborativa y en los juegos serios desarrollados por grandes empresas por un coste significativo y puestos a disposición del público y los estudiantes de forma gratuita de acuerdo con los mismos principios que los MOOC. La metodología de esta investigación exploratoria se basa en declaración de Kurt Lewin (1945), «no hay nada tan práctico

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Conocimiento
Innovación

como una buena teoría», y defiende la opinión contraria. La profunda observación de tres juegos serios de L'Oréal, IBM y Thales se traduce en un modelo teórico con cinco dominios de influencia distintos de los juegos serios: relaciones, cultura, conocimiento, innovación y deseo. Este modelo se discutió a continuación y se probó en otros ocho juegos serios de importantes corporaciones industriales, como General Electric, Nestlé y Cisco.

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Introduction

With the development of information and communication technologies (ICT) since the early 2000s, new forms of training and knowledge transfer have emerged and are spreading. Knowledge is accessible anywhere, anytime. To access knowledge does not require being locked in a specific location at a specific time with a specific trainer. Based on this new paradigm, several universities have launched online schools in which anyone can learn about anything at any time for free. Massive online open courses (MOOCs) are much more than online courses: these interactive websites are real social networks designed to bring together people who are interested in the same subject (Cooper & Sahami, 2013). They provide a new interactive way to develop, structure, and share knowledge with each other through multimedia documents, case studies, simulations, business games, serious games, testimonies, self-assessment tools, digital intellectual contributions, wikis, and blogs, all under the supervision of eminent professors (Martin, 2012).

A serious game 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, p. 17). Gradually, MOOCs have integrated serious games to make training more exciting and immersive, to virtually confront learners with professional situations in an interactive and fun way, and to promote the best knowledge, practices, and behaviors (Allal-Chérif & Makhlouf, 2015). Companies invest millions of dollars in designing serious games to train their employees, but many of them then make these games available for free to the public, especially to students (Allal-Chérif & Makhlouf, 2016). Large industrial groups even create real professional universities including several serious games available online that anyone can play. Other businesses are partnering with virtual universities to integrate their serious games into their training programs (Wortley, 2014).

This convergence between MOOCs and serious games raises the question of the objectives associated with collaborative open training and its benefits. This article analyzes serious games from three industrial companies, L'Oréal, IBM, and Thales, using inductive theory to build a model to test on other cases. Following this introduction, ‘The synergy between serious games and MOOCs for knowledge’ section reviews the literature dedicated to collaborative open training and serious games. ‘An inductive methodology adapted to a new and polymorphic object of study’ section presents the exploratory

case study methodology. ‘Case studies’ section provides a deep observation of real-life practice associated with the serious games. ‘Results, observations, and inductive theory building’ section formalizes the impacts on relations, culture, knowledge, innovation, and desire. ‘Deductive testing, discussion, and recommendations’ section provides discussion and recommendations based on the test of the generated model on eight other collaborative open training serious games. ‘Conclusion’ section offers the conclusion.

The synergy between serious games and MOOCs for knowledge

MOOCs and serious games are two new forms of information systems whose strengths are complementary and converge to better support transfer of knowledge and stimulate innovation.

The origins of MOOCs

Sebastian Thrun, professor at Stanford University, is an internationally recognized pioneer of artificial intelligence and robotics. Former vice president of Google X, he is the lead engineer in the famous Google driverless car project. Another cause close to his heart is to make available quality training for free to the broadest audience possible. He began to realize this objective by launching in 2011 a master's level course in artificial intelligence accessible to all and free of charge (Martin, 2012).

Sebastian Thrun has created the largest virtual classroom of all time with 160,000 students who received three months of his teaching; Thrun usually has only 200 students per year at Stanford. Students also work for free on the translation of the course into 44 different languages. “Although students would not get Stanford University grades or credit, 20,000 from 190 countries finished the course successfully receiving a ‘statement of accomplishment’ from the tutors Sebastian Thrun and Peter Norvig” (Rodríguez, 2012).

The 410 best students of the course were online students. The highest rank by a Stanford student was 411th place in the final exam. Thanks to the MOOC, students from disadvantaged backgrounds living in underdeveloped countries have managed to achieve better results than the best students from one of the best universities in the world. This course helped resolve a number of difficulties linked to student identification, test validation, resource accessibility by tens of thousands of people simultaneously, and individualized educational support in a mass education context (Cooper & Sahami, 2013).

In 2012, Sebastian Thrun decided to launch the Udacity platform, a fully online and completely independent university, intended to broadcast high-level courses to the greatest number of people and at low cost. The will of the prestigious professors involved in this project not only enables all participants to improve their knowledge and skills without having to go into debt for decades but also helps revolutionize teaching by involving students using interactive tools and action-learning techniques (Rodríguez, 2012). By the end of 2012, feedback has exceeded expectations with 14 courses available, hundreds of thousands of students, and 470 local communities.

The rise of MOOCs and their influence on learning methods

The MOOC objective is to enable students of all ages, from all social levels and multiple nationalities, to connect with each other and with professors to acquire knowledge and skills not only through traditional methods but also through the interaction and collaboration among participants. In MOOCs, teaching takes different and innovative forms: courses are presented through videos, interactive quizzes, games, and challenges that students must meet to move to the next step (Martin, 2012). Most case studies, documents, and learning materials are optional and enable students to design their customized courses according to their interests and levels.

Students can answer each other's questions and the professor intervenes only if nobody can provide answers. The theoretical and formal part of the course that usually provides a lot of definitions is very limited. The course changes with technological innovations and scientific discoveries being integrated within hours into the corresponding educational content. Students can provide feedback in real time and professors adjust the next sessions to reflect demands and criticisms (North, Richardson, & North, 2014).

One of the main contributions of MOOCs is to build networks. The encounter of talents participating in the same course has sometimes generated technological innovations and business creation. MOOCs are only the beginning of a type of learning that will continue on the Internet. MOOCs are the catalysts of joint initiatives among participants who bring even more value to the course.

Limits of MOOCs and convergence with serious games

The best universities in the world have invested in MOOCs: the Massachusetts Institute of Technology (MIT) and the University of Harvard each have invested tens of millions of dollars in the www.edX.com nonprofit and open source project, which brings together 85 international partners and includes almost 700 courses. At the end of 2015, one of the major platforms, www.coursera.org, will gather more than 15 million learners in 1470 courses offered by 135 partners (e.g., Yale, Columbia, Princeton, Caltech, Georgia Tech, HEC, ESSEC, Lund, Bocconi, and Nanjing University) from 27 countries.

Despite the undeniable success of MOOCs, researchers have identified some limitations: the course completion rate is relatively low; course adaptations for beginners and advanced learners is not optimized; the quality of the

teaching initially only delivered by the best professors of the world is becoming more heterogeneous; highly technical courses are not attractive; and businesses often do not recognize course achievements (Fidalgo-Blanco, Sein-Echaluce, & García-Peñalvo, 2015). Experts question the quality of education and the valid evaluation of MOOCs: "the absence of serious pedagogy in MOOCs is rather striking, their essential feature being short, unsophisticated video chunks, interleaved with online quizzes, and accompanied by social networking" Vardi (2012).

Serious games technology is answering these concerns by implementing an adaptive and playful approach to provide more density to the knowledge transferred, to improve the proportion of students completing the courses, and to deliver more gradual and thorough evaluations (Maalej, Msaed, Pernelle, & Carron, 2014).

Training is one of the most common uses of serious games. To remain competitive in an increasingly unstable and unpredictable environment, companies encourage their employees to share their knowledge and practices with these fun video systems (Allal-Chérif & Makhlouf, 2015). Companies are also developing serious games for the general public. In these games, players can get to know the products, services, technologies, professions, methods, organization, values, the culture, and prospects of a company.

Serious games are sophisticated information systems that require a significant investment. The fact that companies develop expensive games designed to train professionals and then make them available for free to the public may seem surprising. MOOCs have begun to partner with prestigious companies to develop educational content, particularly in the form of serious games (Maalej et al., 2014).

An inductive methodology adapted to a new and polymorphic object of study

This research is based on the statement that "nothing is so practical as a good theory" (Lewin, 1945) and takes the opposite view by following a three-step methodology designed to provide an intimate understanding of practices and to develop a relevant theory to the subject of research (Van de Ven, 1989). These goals are accomplished through (1) an in-depth observation of three collaborative open training serious games from three major industrial companies, (2) the inductive building of a model based on the practices identified in the studied cases, and (3) the testing and adjusting of this theoretical model on a sample of eight other collaborative open training serious games from eight different industries.

An exploratory study for a complicated emerging phenomenon

MOOCs and serious games are recently adopted tools with diverse uses. The convergence process between MOOCs and serious games is currently taking place, so for researchers to grasp the full scope of this phenomenon may be difficult. The case study seeks to develop hypotheses for an analytic vocation by identifying some variables that can be extended in future research with more explanatory and quantitative

approaches (Woodside, 2010). Eisenhardt and Graebner (2007) highlight that “building theory from case studies is a research strategy that involves using one or more cases to create theoretical constructs, propositions and/or midrange theory from case-based, empirical evidence”.

Specifically, this research can be defined as a hybrid exploration aiming to give meaning to the subject by frequently going back and forth between the collected empirical material and current theory. Given the essentially exploratory nature of this study, two limitations arise. The study is essentially described from an inner perspective, whereas the exploratory perspective seeks to establish a convergence between MOOCs and serious games through the grid validity conditions used in industries and universities to transfer knowledge and best practices. This research has no ambition to establish a causal framework but rather to identify and characterize the key variables that can then be deductively tested (Yin, 1981).

In general, case studies are the preferred strategy when how or why questions arise, when the researcher has little control over events, and when the focus is on a contemporary phenomenon in a real-life context (Yin, 1993). An inductive approach leads to a broader view of the serious training games used in a variety of fields.

Field of study

The convergence between MOOCs and serious games is manifold, polymorphic, and spontaneous. Some MOOCs have integrated one or more professional serious games. Some firms have created their own MOOC and made the course accessible to the public. Some serious games are so elaborate that they themselves can be considered to be MOOCs. To create a general analysis that can be adapted for each case is difficult because of the diversity of strategies and behaviors (Eisenhardt & Graebner, 2007). However, observing the mechanisms in their context and deducing strong performance indicators will lead to the conception of an elaborated and flexible model.

To provide the most relevant answers, a case method must be validated by triangulation of the collected information; authentication of data, testimonies, and theories; and use multiple sources (Eisenhardt & Graebner, 2007; Yin, 1981). This study analyzes three different cases to meet the requirement of having a sample that is small enough for a thorough qualitative analysis and large enough for a consistent comparative study. The number of cases depends on research objectives: if the aim is to explore new practices or discuss an original question, one or a few cases are enough (Hancock & Algozzine, 2011). Some MOOCs and serious games are backed by widespread communication campaigns that increase the availability of secondary data.

Data collection and case construction methodology

A literature review yields the first part of the data collection. The second step involves exploring the websites of the targeted serious games. Thereafter, the analysis focuses on the websites of serious games creators. The studied cases are relatively well known and serve as references. The IT service companies that design serious games list their achievements

on their websites, posting functional as well as technical sheets. The third step entails a content analysis of several specialized websites. The fourth step involves reviewing press articles on collaborative open training serious games.

The simultaneous use of multiple data-collection methods improves the reliability of information obtained from the Internet (Dochartaigh, 2002). The study performs cross-checks among several sources, particularly comparing institutional websites with specialized websites. Triangulation obtains a greater level of accuracy concerning the different uses of serious games; indeed, the declared intentions of the game editors and their customers are sometimes contradictory, ambiguous, or incomplete (Jonsen & Jehn, 2009).

Case studies

The following three case studies present the serious games used in three industrial companies: L'Oréal, IBM, and Thales. In each case, the influence of the serious game on employees and the public is described, analyzed, and categorized.

L'Oréal plays guidance counselor with Reveal

Launched in 2010, the serious game Reveal enables the numerous candidates competing to get a job at L'Oréal to discover the world of business. Recruiters of the cosmetic giant can more easily identify potential worker talents thanks to this virtual world. The main objectives of the game are to better understand the specificities of the company and to get to know the player. With more than 21,000 registrations even before its launch in January 2010, thanks to a dedicated Facebook page, Reveal has become a serious game reference, multiply rewarded by professionals, and whose attractiveness to candidates of major business schools throughout the world is undeniable, with more than 70,000 annual players.

In 2011, L'Oréal preselected some of its 3300 interns through the serious game Reveal, which resulted in 185 hires. Three human resource full-time employees and 200 managers were mobilized during a year and a half to design the game. The employer brand, already strong and consistently ranked among the best in France and around the world, became strengthened and modernized, especially among generation Y.

The company releases this information about the game: “In a Web 2.0 world, where virtual and real life are merged, each participant is asked to reveal his talent and to evaluate their adequacy with the corporate culture of L'Oréal” (www.loreal.fr). Players are directly placed in a work situation. They embody young recruits on the day of their hiring. After talking with the director of human resources, who presents the corporate culture and the integration process, the players join their teams and meet their managers.

Players evolve in six different environments called rooms to contribute to the conquest of new markets. L'Oréal wants to achieve 50% of its sales in emerging countries within five years. A team of business experts and game designers have developed scenarios worthy of the best online role-playing games. They involve multiple puzzles and enigmas as well

as interaction with 35 virtual characters. Some solutions use clues that require a very thorough investigation.

Players earn points and evolve in the world ranking by completing missions and winning challenges. They participate in the launch of new products, experience different professions, and discover the relationships among business functions: finance, production, supply chain, R&D, marketing, sales, and so on. Players travel around the world to identify opportunities, elaborate strategies, limit risks, and make the right decisions. Not only do they need to know how to collect data and analyze dashboards but also they must communicate with other players to exchange information and coordinate actions, creating a networking system.

A personalized self-assessment system enables each candidate to associate his or her skills and talents to a specific position and function. The international human resources firm Cubiks has created a specialist skills assessment and diagnosis of personality questionnaires designed to highlight personality, desire, creativity, openness, and originality. The best players have the opportunity to spend two weeks in a subsidiary of L'Oréal. Reveal has replaced several other games previously created by the group such as E-Strat, Ingenius, and Innovation Lab. Only Brandstorm, the marketing game L'Oréal created in 1992 and now in its 20th edition, continues successfully in parallel with Reveal.

IBM INNOV8 CityOne: the SimCity for professionals

INNOV8 CityOne is an urban planning serious game designed by IBM. This professional version of the famous SimCity is available on the corporate website of the US company, a leader in information technology and consulting. INNOV8 CityOne is an evolution of INNOV8 BPM Simulator 1.0 and 2.0. In the first version from 2007, players have to interview virtual employees and suggest a diagnosis of the business processes to improve them. In the second version from 2009, the game features three different areas: call center administration, supply chain management, and traffic optimization.

The third version of the game launched in 2010, INNOV8 CityOne, is divided into two parts: (1) water and energy management and (2) banking and retail management. "CityOne offers players the opportunity to optimize banking, retail, energy and water solutions via an online, sim-style game in which the player is tasked with guiding industries within a city through a series of missions. Players will make decisions to improve the city by attaining revenue and profit goals, increasing customers' and citizens' satisfaction, and making the environment greener with a limited budget" (www-01.ibm.com).

CityOne is conceived to inspire players to have a prospective and sustainable vision of the management of a city and to identify the technologies that can be mobilized and developed for that purpose. They identify inefficiencies and malfunctions and implement changes to correct them. The problems to solve are complex and have financial, environmental, and societal impacts. The main objective is to demonstrate the performance of green IT. Optimization of the sustainable supply chain, construction of efficient water and electricity grids, and reduction of car traffic via intelligent tolls are among the more than 100 tests available.

To address such challenges, players have to combine IBM technologies and solutions and balance people, planet, and profit dimensions. Players have to reconcile welfare of inhabitants, respect the environment, and show rational expenditure management. The theme of the city and the preponderance of scenarios related to logistics are not chosen randomly: by 2050 two-thirds of the world population will live in cities that will need to be supplied with water, food, and energy. Waste processing will become more and more crucial.

Thales Moonshield: saving the planet while planning a career

The Thales Group, although relatively familiar to young people, suffers from a lack of visibility and attractiveness. Indeed, despite the strong reputation of the company, the Thales Group does not provide a clear vision of professional opportunities available to graduates of schools and universities. Thales products are designed for popular industrial sectors such as aerospace, telecommunications, energy, and defense. Thales is an extremely innovative company that devotes 20% of its profits to R&D resulting in about 300 inventions a year. More than 22,000 researchers and senior engineers are developing the current portfolio of 11,000 patents in collaboration with the research laboratories of the most prestigious universities in the world. However, the company faces a shortage of young talent and must recruit massively to deal with retirements and growth of the business. The number of applications is not sufficient enough to be as selective as other large multinationals in appropriately staffing.

The serious game Moonshield, free and accessible to all, launched in 2008 to attract the best graduates by presenting Thales careers and technologies. The game promotes the company with a staging of its products in a playful highly immersive context. The player evolves in a futuristic world, in 2029, when the planet Mars just exploded after a collision with the killer asteroid 201P WILD. A meteor shower is threatening the earth. The player is the commander of the lunar base Moonshield and his mission is to create a protective shield using Thales technologies. The game is designed in several levels with growing and dynamic difficulty. The game becomes more complex according to the progress of the player.

To prevent the asteroid fall, the player has to implement a managerial strategy that involves the construction of a scientific complex and a military center equipped with radars, sonars, lasers, sensors, armaments of destruction, and transportation of troops and cargo infrastructures. Gradually, as the player develops skills, the game becomes more complex and enables progress at higher levels. Experts appear in video recordings to guide and educate players about the different functions of Thales. Even gamers who are used to these kinds of games are attracted by the graphic design and playability of Moonshield, which makes them discover the company's development, manufacture, marketing, selling, and maintenance of highly sophisticated military equipment.

The results proved the attraction of the collaborative open training serious game. Since its launch date, Moonshield was played more than 450,000 times. It has been downloaded on iPod, iPad, and iPhone more than 20,000 times. 50,000 visitors from the game's website have demonstrated their

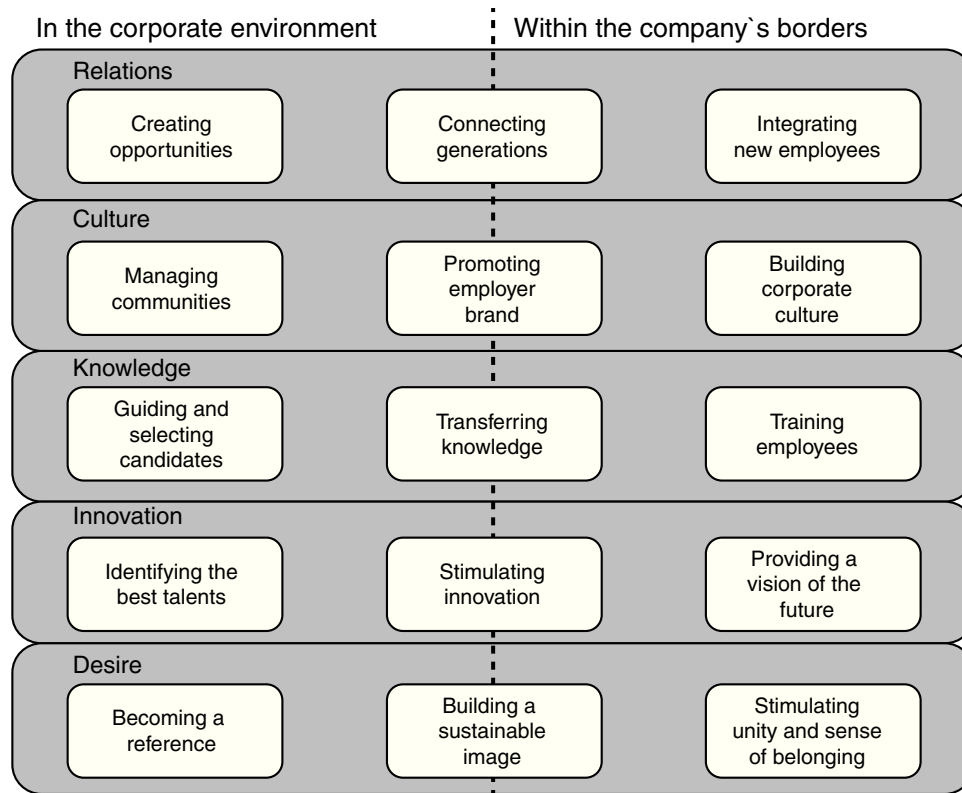


Fig. 1 – The five dimensions of collaborative open training serious games.

interest in Thales careers and decided to visit the page: www.thalesgroup.com/en/homepage/careers.

Results, observations, and inductive theory building

L'Oreal Reveal, IBM INNOV8 CityOne, and Thales Moonshield are serious games used inside firms to recruit and train employees and outside, especially in universities and business schools, to teach students and the public. Observation of these three games has identified five areas of internal and external influence.

- (1) Relations. The influence of collaborative open training serious games on relations is diverse. When played by the public, the games enable passionate people to meet and share ideas. Inside a firm, the games accelerate the integration of new employees and help them connect with each other and with senior employees involved as coaches or referents. All three studied games bring together young students and experienced professionals. Inside the virtual world, the game play encourages learners to work as a team and collaborate to address challenges.
- (2) Culture. Through serious games, corporate culture and values consolidated in-house are also promoted externally. The games contribute to endorsing the identity and specificities of the firm and to creating strong international learning communities that will be sensitized to the employer brand.

- (3) Knowledge. The main objective of serious games remains training and knowledge transfer. The game supports learners, internally or externally, in their progression. The brightest students will become eligible for job interviews. The top performers within the firm will advance in the hierarchy.
- (4) Innovation. The combination of the talents of people who may be in very distant countries and who would not have met otherwise promotes innovation and entrepreneurship projects. Serious games can identify external talents before they go to work for competitors and advance internal talents in a stimulating virtual environment.
- (5) Desire. The three companies are using serious games to convince players of the excellence of their products and practices. The firms that appear sustainable and can be viewed as references in the topics integrated into the serious games. The sense of belonging developed by games is stronger but may not last, like with other types of games (Fig. 1).

Deductive testing, discussion, and recommendations

To test the induced model deductively, eight other collaborative open training serious games have been used (Table 1).

Although the five dimensions are systematically presented internally and externally, the test of the theoretical model on eight other serious games demonstrates one or two dominant dimensions and that the games have an identifiable

Table 1 – Test sample of eight collaborative open training serious games.

Game name	Company (sector)	Aim of the game
Genius	Total (oil and gas)	Designed in an original format, this game offers an interactive and funny way to raise awareness about energy-related issues and how to face them. This game can be played by Total employees as well as high school students to explore the energy mix and complete the education they receive.
Born to be alive	General electric (health care)	This 3D and real-time game is a realistic simulation available on the Internet and created to familiarize pregnant women with the process of giving birth and complete the training of health professionals. This tool can accompany other childbirth-preparation materials and can be a great help for midwives.
World Without Oil (WWO)	General motors (automotive)	This game invites players to think about solutions to face in a worldwide shortage of oil. Players have to collaborate to imagine a future with alternative energies. Thirty-two weeks of a global oil crisis helps people realize the extent of people's oil dependence and understand energy security issues.
Allianz experience	Allianz (insurance)	This game's goal is to satisfy a wide range of customers and test the players' listening and comprehension skills, the major assets of a wealth management advisor. Players have to understand the customers' needs and projects and make a financial diagnosis. Players can see their national rank and the best ones can get a job interview.
Mais Divertido	Nestlé (food)	This serious game, focused on health and nutrition, encourages players to eat in a more balanced way and to be physically active. Several different levels are centered on different sports and the world of cooking.
Power matrix	Siemens (power generation)	This game aims to raise awareness on energy issues and to teach people how to save energy. The goal is to manage an entire city and provide sustainable power to citizens through a balanced energy mix. Players develop an energy business and network and create an R&D department.
Helopolys	Orange (telecom)	Helopolys invites the player to become a telecom operator and develop a landline and mobile network in a city. Customer satisfaction, coverage of the territory, and the number of people connected are the key performance indicators. Players also have to optimize resources and manage unexpected events.
You're the Boss	CISCO (networking)	This game aims to entice players to become entrepreneurs and helps them learn how to manage their business. They discover aspects of finance and business control, human resource management, social and environmental responsibility, and the need to innovate to win market shares.

direction: inside-out or outside-in. Interactions between the inside and the outside of the company are crucial: broadcasting message to the public and specific targets and collecting data and feedback from the audience.

Several games are designed as competitions or challenges intended for crowdsourcing and open innovation. Other games are rather intended to establish standards and to position the company's products and services as indispensable. The model can be used to categorize or design serious games according to the dominant dimensions and orientation.

Other serious games used by firms from different sectors and sizes could be studied to increase the diversity of the sample and to refine the model. A specific study on each specific dimension would enable professionals to adjust approaches and projects to their specific needs.

Conclusion

This research demonstrates the convergence between MOOCs and serious games and generates a theoretical model from the deep observation of practices associated with three serious games: L'Oréal Reveal, IBM INNOV8 CityOne, and Thales Moonshield. This model shows the internal and external influences of collaborative open training serious games on five dimensions: relations, culture, knowledge, innovation, and desire.

The test of the theoretical model on eight other serious games designed by companies from different sectors confirms and elaborates the results.

Some of the studied serious games are embedded in training programs and recruitment processes. The analysis of a larger sample of serious games would refine the findings and enable a better measure of the performance on each of the five dimensions. Future research could build a typology based on the generated model and make recommendations on how managers could use this model to define a strategy and specific goals associated to the development of MOOCs and integrated serious games.

Authors' contribution

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