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Simulation games as tools for integrative dynamic learning: The case of the management course at the University of Algarve

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Abstract

Today, in order to people or organizations survive in a changing environment it is essential to adapt. Learning provided to people is a key feature for an active response since it implies acquiring knowledge, skills and competencies to cope successfully with different circumstances. Literature has focused on how digital games support education because simulators represent dynamic models of real situations; so, their goal is to ensure that the player denotes his decisions consequences. When teaching certain skills through these games, a reflection stage is crucial to evaluate the experiences gathered during the simulation and promote knowledge appliance by participants into the real world. Due to its multiple scientific contributions, gaming can overlap a valid solution to prepare learners understanding regarding complex contexts. This research denotes an ongoing PhD research about the characteristics of a management course unit (at the University of Algarve, Portugal) that explores a business simulator- *Cesim Global Challenge*- for learning purposes, as well as the effectiveness of an integrative approach (new learning environments) on students' engagement and dynamic learning outcomes. From the earlier empirical data is understandable game-based learning advantages and disadvantages within Management and Entrepreneurship courses.

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1. Authors' argument

[9] refer that a research query acknowledges a gap between a research scope and the researcher personal knowledge. And, a research topic entails three analytical dimensions [8]: researcher motivations or background; research philosophy; and, topic debate intensity. The first co-author academic background (Bsc in Mathematics Maintenance and Masters in IT Management) and professional (Credit Manager and Appraiser) lead to a choice for serious games in Management courses which is a growing topic in literature. The option for a qualitative study endeavors to minimize the literature gap, as well as to promote personal knowledge (non-logic analysis). Since a PhD is an ongoing research process, early empirical results typically act as pre-tests in order to validate the researcher pre-assumptions.

2. Introduction

The severity of the financial crisis adds an exceptional degree of unpredictability about world's economy future. In order to promote Europe recovery it is essential to enhance human capital by upgrading skills. Although, to ensure a better match between skills supply and labor market demand is essential. The blend between skills and adaptable workforce helps economic competitiveness, benefitting employers and workers. People need to have and acquire competences in order to retort to an over-dynamic business environment. Over their lifetime, learners/workers ought to develop job-specific skills which should be kept up-to-date.

Millions of workers have been losing their jobs due to the recent economic crisis, and The Organization for Economic Cooperation and Development (OECD) predictions illustrate high unemployment rates. Although, job losses among skilled workers have been much lower comparatively to unskilled [3]. A global competitive knowledge economy enforces a skilled workforce to ensure productivity and sustainable growth. The reason to this assumption is simple: these workers are more flexible and fast learners (ability to learn new skills/competences and forms of activity quickly); since, in a post-industrial economy knowledge and creativity through the use of IS produce new business services for innovative development [3].

However, researchers and practitioners denote a considerable gap between employers' needs and what education is providing [34]. This context illustrates why several countries are developing competence-based qualification profiles, based on occupational core competences and work processes. For instance, European countries are adjusting their qualification profiles through a common European Qualification Framework [2]. Competences typically acknowledge a combination of knowledge, skills and attitudes [19], and are a prerequisite for adequate problem-solving on the job [12]. Theories about competences development emphasize that learners ought to acquire and integrate knowledge, skills and attitudes to achieve vocational competences, [16] in order to execute a task and facilitate its reliable assessment. Vocational competences require novel teaching and learning methods in order to positively retort labor market requirements; thus, there is an increasing interest on how ICT can improve education [24]. Empirical studies demonstrate that technical learning is an efficient method for professionalization and creativity stimulation [33], so educational institutions and organizations can play a more interactive role in providing contextual learning spaces (projects, internships or apprenticeships). This knowledge sharing culture provides remarkable mutual benefits, i.e., learners explore their acquired knowledge and companies explore novel ideas.

These issues highlight the importance of integrating ICT into Management and Entrepreneurship courses. A successful integration enables professional competences according to market requirements and a system of knowledge, skills and entrepreneurial qualities [19] which are essential to resolve economic problems and non-standard scenarios (decision-making). This paper explores the potential of an integrative and dynamic learning environment, namely the integration of a business simulator (*Cesim Global Challenge*) into the curriculum of a Management course unit at the University of Algarve (Portugal).

3. Integrative learning approach

3.1. Why is needed?

When organizations hire new workers, their expectations acknowledge human resources that can integrate and synthesize different approaches to problem solving through organizational resources (knowledge, information systems, etc) that facilitate this process. Theories on competence development emphasize learners need to acquire or integrate knowledge and skills to achieve vocational competence [16]. When debating European education, it is unrealistic to ignore the unlike nature of contemporary students. That is, knowledgeable about technology, creative and keen in searching for answers collectively [33]. That is why the use of educational technology is not the key issue; the foremost important issue is to develop critical thinking skills, so that learners can provide solutions to complex problems [27]. Hence, the blend between technology-integrated learning and social constructivism is a potential response to today's educational objectives [17]. Distinctive knowledge does not derive from mere instructions (lecturer centered environment), but is actively and socially constructed by learners through their interactions with the physical, social, and technological milieu [32].

3.2. Defining an integrative learning approach

“Integration” has become a buzzword in business environments over the past decade, since it resumes better connections among different areas in order to improve information and knowledge sharing across the organization. This requires multitask human resources with the ability to produce a multidimensional (critical thinking) and multifunctional (decision making) analysis. In an educational environment, an integrative approach facilitates sharing (learners' social and professional experiences) as well as induces learners' personal development (a free and creative self-identity). And for that, it is vital to integrate: learning objectives, content, pedagogical strategy, and learners' skills, qualities and personality traits. Summing up, an integrative approach provides a holistic perspective regarding institutions and their processes [10]. This unity implies defining another related concept- transfer - which is variously discussed as follows:

- The effect that prior acquired knowledge has on learning or in performance (new scenario- task B) [26];
- The degree to which a behavior will be repeated in a novel circumstance [7];
- How extent new learning or performance can differ from the original one when considering tasks or context involved (e.g., learning through real problems or knowledge appliance in home or work) [23].

Bearing in mind the European context, to develop a complete “mosaic” through an interdisciplinary and integrated perspective it is a concern [11]. An integrated approach to Management and Economic courses, i.e., blend of technological tools and critical thinking may resolve Computer Science lecturing issues. For instance, a task in a Computer Science textbook that does not have a real practical value promotes lack of interest among learners. Although, explore the problem through a practical and action-oriented approach enables interest and learning to students [40]. Or, instead of an inconsistent and fragmented learning to Computer Science or Management is preferable to explore their interdisciplinary knowledge, which will permit complex analyses [10]. Research studies highlight that a matching concept in each research field is defined in different ways; so, this ambiguity is a challenge to educational materials which an integrated approach also minimizes.

4. Novel learning environments

ICT plays a decisive role in our society, and its influence over education is remarkable. Therefore, numerous authors advocate that serious games fit into an array of existing pedagogical theories. It is already a well-known

fact that a technology-integrated learning environment can improve learning achievements [22], as well as change the learner attitude towards learning.

4.1. ICT versus education

A recent research conducted by [39] denotes that technology increases lecturer-learner interaction (further collaboration and trend for student-centered environments), and a change in thinking patterns. In spite of this assumption some authors question in how extent the education system has changed, since the new generations of learners expect interactive experiences in their educational environment. Educational theorists are facing novel challenges due to modern digital technologies, as for instance augmented reality. A potential retort to this scenario is to explore an integrative dynamic approach based on several technologies (observe table 1) [1].

Table 1. Definitions and major terms

Major term	Definition
Serious games	Serious Games are games with the intention to train or learn through definable goals, instead of being designed for entertainment. These games are, by definition, outside the real world although recreating it in a extreme and realistic way. In fact, authenticity is the key when comparing serious games with other digital games
Simulators	Typically do not fall into just one category, but are a synthesis of more than one category. In a game context, a simulation is a digital imitation of something real that has game characteristics: competition, rules, etc.
Edutainment	The act or process of educating or being educated, while is entertained. Edutainment activities often lack game association, such as following rules or competition. Edutainment products also do not cover topics completely or in-depth when compared to older learners methodologies
Commercial	The most readily available computer games to consumers. In some circumstances these games are used for educational purposes; however, they primary aim is to entertain
Digital game-based learning	This kind of learning takes place from playing any type of digital game. Its objective is to coordinate subject matter with game play encouraging retention and application of learned material to the real world
Virtual world	A virtual world is a computer simulated environment that creates a novel world or recreates a real world. It involves a two or three dimensional representation to interact in a two/three dimensional environment

ICT development reallocates labor from a material to a informational sphere, so explore it for educational purposes is a significant “landmark” in order to achieve readiness for self-education and continuous professional development [39]. Currently, to assess managers/entrepreneurs informational success, it is vital to understand their professional and academic background which an integrated learning approach would resolute. Educational ICT enables unconventional, non-linear and creative thinking, as well as produces decision making scenarios and their analysis.

4.2. Educational games

Computer games have become highly interesting to educators and researchers due to their development over the last decade. Today, most of learners are “native speakers” in ICT language (e.g., computers, games and Internet) [32]. According to [35], it is harder for learners to be focused in a traditional learning environment (classroom) because these can simultaneously watch TV, surf personalized content over the Internet, or play games through their laptops, tablets or mobile phones. [28] suggests that a learning environment in which learners can make their own choices improves self-motivation and sense making to a future career. In the most recent National Education Technology Plan, gaming is coined as an ideal method for assess learners knowledge comprehension. The reason is that a process of self-engagement promotes responsibility, i.e., self-motivation to improve (go to the next levels) and succeed [40]. Other works acknowledge that games allow experimentation, exploration of identities, and even failure [15].

Throughout the gaming process learners construct concepts and relationships in authentic contexts, which underline “learning by doing” and “active learning” (bond with constructivist principles). Tasks completion encourages confidence, learning and achievement which also affect learners’ self-efficiency over time [18]. Besides, games provide immediate feedback to learners through for instance a score chart. This real time feedback “levels up” opportunities and immediately reinforces confidence development to perform specific tasks. Concluding, games permit to learners go beyond fun and develop their learning skills namely knowledge acquisition, critical and associative thinking [40].

4.3. Prospects for developing an integrative approach through ICT

To help determine the outlook of an integrative approach through ICT, figure 1 illustrates the most important trends in future educational environments. The snapshot retrieved from the Horizon Report 2007-2012 denotes three promising technologies depending on their temporal range (short-term, mid-term and long-term). For instance, the 2012 report identifies game-based learning as a mid-term trend (2015-2016).

Despite the assumption of a mid-term trend, the authors analyze the Horizon reports regarding game-based learning. The 2007 version already focused virtual worlds (forecasted for 2008-2009) and massive gaming (2012-2013) as potential technologies. Virtual worlds are parallel worlds in which people can now work, communicate and receive education; and, massive multiplayer games are a similar option. This report predicted the use of social networks and simulations as tools for educational environments. Simulations include online entrepreneurial games with an increasing number of players, in which each player has a specific role, and develops complex tasks and relationships. Each task entails the development of a wide variety of skills, as well as interdisciplinary knowledge in a very engaging environment [38]. Hence, massive multiplayer online games (MMOGs) should not be omitted from academic environments [18].

The HRs 2008, 2009, and 2010 do not debate any technologies directly related to educational games, while the 2011 version identifies games greatest potential: foster collaboration; and, engage students more deeply into the learning process (forecasted for 2013-2014). The 2012 report main focus is tablet-computing and game-based learning in spite of their initial stage of development according to experts. Although, some keen arguments against educational games are: high cost of development; non-specialists difficulties in changing games features; and, finally, the creativity bonded with game creation [29]. However, with the development of an integrative approach, games will play important role in future educational systems.

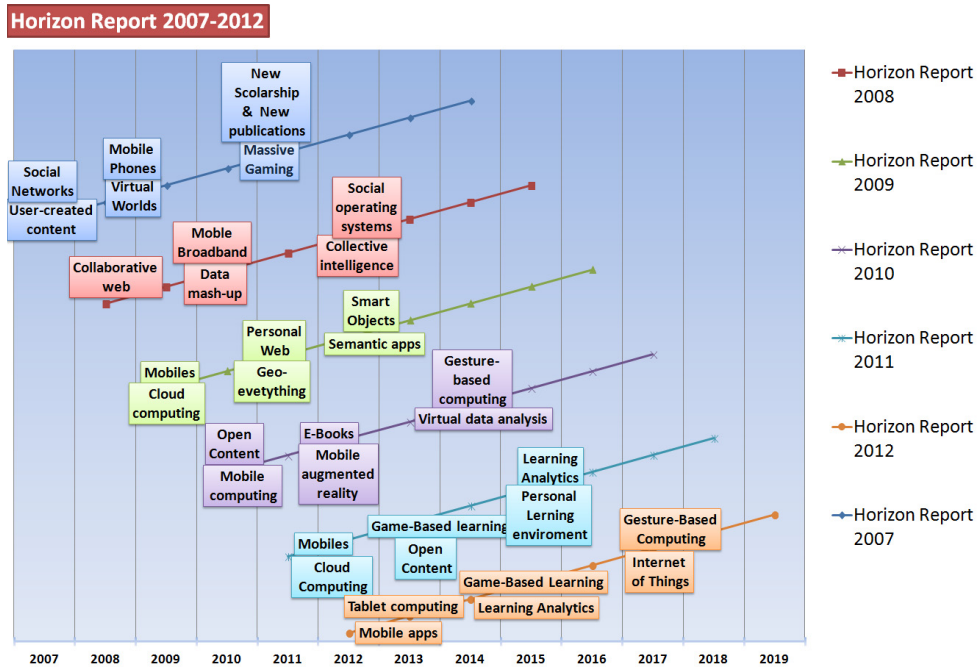


Fig. 1. Technology's trends according to the Horizon Report 2007-2012

5. Research

The link between aims/objectives and a research query must be coherent in order to understand researcher future requirements which are influenced by the context.

5.1. Context

The University of Algarve (UAlg) is a young (thirty years old) higher education public institution located in the southern region of Portugal. Currently, has around 750 permanent lecturers and 450 researchers with a growing commitment towards R&D and innovation. Research and undergraduate and postgraduate courses vary from Earth/Marine Sciences and Health to Engineering and Technology, Tourism and Social Sciences/Humanities. Given the above information, the university campuses are a key piece within the region since they interact as centers of cultural, scientific and technological development as a result of strong regional, national and international ties. The University also comprises a knowledge transfer office (CRIA) and a unit for industrial property promotion (GAPI).

In this case, the authors acknowledge the unit “Entrepreneurial Games” (Management course- 3rd year, 2nd semester) which explores a business simulator- *Cesim Global Challenge*- for learning purposes. The course unit had 29 students enrolled in academic year 2012/2013 working on 35 computer stations pre-loaded with the business simulator.

5.2. Aims and objectives

Understand the unique characteristic of a unit that explores game-based learning is a *sine qua non* condition to investigate the effectiveness of an integrative approach to learning in Management and Entrepreneurial courses. Likewise, the authors introduce the following objectives:

- Get a clear idea of an integrative learning approach using educational ICT in higher education (Management/Entrepreneurship courses);
- Investigate its effectiveness on learners' thinking, interpretative and associative skills;
- Advantages versus disadvantages in game-based learning.

5.3. Research design

The proposed research frames a qualitative interpretative longitudinal case study. "Qualitative researchers aim not to limit a phenomenon- make it neat, tidy, and comfortable- but to break it (...) so that a description of the phenomenon, in all of its contradictions, messiness, and depth, is (re)presented" [15, p. 11].

Interpretative research promotes subjective thoughts and researcher ideas as valid constructions, contrarily to a positive argument (only phenomena that a researcher can know through his senses can really produce knowledge) [11]. Thus, theory becomes a set of meanings which provide insights and understands people behavior [5]. Interpretative epistemology is a more flexible research approach and particularly relevant for longitudinal exploratory studies in which the research focus is not predefined [13], as well as depends on the circumstances and emerging analytical patterns. A potential criticism to interpretative studies is generalization, i.e., it encourages the study of a small number of cases whose results may be not applied to the whole population [13]. However, other authors refer the level of detail and effort of interpretative inquiry as sufficient for researchers gain valuable insights regarding particular events, or a range of perspectives that may not have came to light without this scrutiny [20]. This will be useful to authors understand for instance learners thinking, interpretative and associative skills or the lecturer perception about integrative learning.

This research entails a case study methodology, since the authors develop explanations for an integrative learning approach through a qualitative case study analysis [41]. That is, to understand the characteristics of an Management course unit that applies a business simulator. The unit is "Entrepreneurial Game", a 3rd year discipline within University of Algarve (Faculty of Economics) that explores learners acquired knowledge during the initial two years (case study).

5.4. Data collection and analysis

Data collection procedures resume a blend of personal interviews and questionnaires. Interviews are an oral exchange in which an interviewer strives to extract information, values or opinions from an individual [4]; and, questionnaires despite their multiple forms (e.g., web questionnaire) act as opinion collectors [4]. Therefore, interviews serve for understanding the course unit characteristics while questionnaires reflect upon learners' engagement; so, these methods are considered appropriate for probe respondents' opinions and observe behaviors [36].

Qualitative content analysis, in spite of its non-homogenous recognition, has a long tradition in text analysis [37] which validates the authors' choice for interviews; and, questionnaires analysis enables a simple numerical analysis [6].

6. Diagnosis

Throughout this section the authors highlight the empirical procedures, i.e., surveys design, empirical results and research limitations.

6.1. Surveys design

The following step is to relate each aim with the survey design for data collection. The authors options' are listed below:

- Research Aim #1: get a clear idea of integrative learning through the business simulator *Cesim Global Challenge*;
- Research Aim #2: *Cesim Global Challenge* impact on student's engagement.

To address aim #1, the first interview had two sections: lecturer profile (professional and academic background/experience); and, game-based learning knowledge (why *Cesim Global Challenge*, how to integrate a simulator in lecturing, potential course units and lecturer role). Its design was achieved through a pre-test (queries through e-mail), as well as a pilot study (personal interview). In addition, the lecturer responded a questionnaire with a qualitative scale in two different milestones (beginning and end of the semester) as regards to game advantages/disadvantages for the lecturing process.

To obtain a conclusive retort to aim #2, a questionnaire was performed by students comparing their engagement through *Cesim Global Challenge* and a traditional learning environment (case studies, examples, tutorials, quizzes, etc). The available queries ranged from practices to usability, skills development and appliance into other course units. Again, a qualitative scale was designed (from strongly disagree to strongly agree) to permit a feasible comparison with the lecturer answers.

6.2. Findings

In research aim #1, from the lecturer questionnaire is possible to outline positive outcomes from *Cesim* simulator on self-activity, as well as development of commitment and responsibility. In fact, the lecturer also denoted a similar result for self-evaluation and benefits of combined study strategies (important features). The most common difficulties are complexity of assessment criteria, since learners' resistance was considered a minor problem. Other minor issues, like self-evaluation techniques, were slightly rated.

In the research aim #2, students' responses have been summarized collectively due to their number. On the first two queries, about the engagement topic, learners explored the business simulator several times per day and enjoyed its usage rather than using traditional learning tools (pencil and paper). Comparing to other educational tools, utilized once or several times per week, the leading conclusion is a high level of engagement regarding the educational game. Questions three to five, usability topic, the learners strongly agree that a business simulator is extremely valuable to improve their skills; however, traditional lessons and examples were not disregarded. As a result, learners are opened to explore a business simulation in future learning environment as a complement to examples, cases, lessons, and tutorials.

This contribution retorts both research aims through a different set of methods, and despite a collective summary regarding questionnaires results these were individually analyzed. Early conclusions will help authors to redefine the research focus, namely the implementation process of user-centered game-based learning in higher education. According to the analysis, the business simulator *Cesim Global Challenge* contains an abundance of information that is applicable to Management and Entrepreneurship courses within University of Algarve. Students have several opportunities within the simulator for learning, although as well as this learning tool promotes a successful compliance regarding the course unit's curriculum (objectives). It is the authors' opinion, that with future guidance from supervisors and incorporation of examples, lessons, tutorials and

discussions, the simulator *Cesim Global Challenge* can be an effective educational tool for management and entrepreneurial areas. However, without using those resources (tutorials, lessons, examples, discussions, etc.), learners will still gain knowledge but less structured and insufficiently acquired. These understand that playing without knowledge does not really make sense, since they will be “lost” in the game. Thus, with previous help of traditional classes these can achieve more and win the game.

6.3. Limitations

The perils of conducting surveys are well documented in research methods literature. For instance, [41] argues that perform a diagnosis to a questionnaire is vital (pilot procedure); or, the contextual environment, participant/interviewer personal characteristics, and type of interview may constraint empirical results quality [22]. To avoid these weaknesses, the authors followed the work of [41] and explored documents and direct observation beyond the traditional pre-tests.

A trustworthy qualitative research arises from an effort to realise meaning or validity about data collection through four standards [14]: (i) credibility, results’ accuracy through member checking; (ii) transferability, “thick description”; (iii) dependability, record the research process and documentation; (iv) conformability, data audit. Hence, the authors’ systemic approach that interpretative flexibility recognizes, as well as empirical results insights ought to minimize potential limitations.

Finally, some criticism may arise due to number of interviews (one) and questionnaires (2 in 29) which the authors’ retort through their initial argument (section 1).

7. Discussion and conclusion

Both research aims serve a dual purpose, i.e., provide some insights concerning first co-author pre-assumptions (PhD ongoing process) and gather data for this study.

As regards to this research several remarks are latent: (i) it is a worthwhile subject; (ii) the researcher pre-assumptions are important; (iii) and, the research design seems to positively retort aims/objectives, although data collection procedures reveal some weaknesses. The interaction from literature and research aims/objectives is possible to conclude the richness and importance of the topic; however, preliminary empirical results do not provide yet solid evidences or a complete explanation.

For instance, for research aim #2, the number of questionnaires is a major setback which clearly indicates that in future data collection procedures a more profound collaboration with learners it is crucial to avoid similar results. Beyond this engagement, the questionnaires need improvement as well as secondary sources of data should include a more extensive observation and focus groups interviews.

Finally, this contribution may encourage researchers to analyze and develop future work on business simulators as well as to decide the focus of future educational environments. Even so, the quandaries are numerous due to multiple reasons: maturity of games development; users (lecturers and learners) acceptance or experience; usability, etc. Thus, through future work, a more detailed analysis ought to explore each analytical dimension, including the mandatory workplace element of vocational education and training to serve the holistic competence development of individuals (able to deal with fast changing work environments and occupational/social mobility).

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