

Field assessment of Serious Games for Entrepreneurship in Higher Education

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Abstract

The potential of Serious Games (SGs) in education is widely recognized, and their adoption is significant in particular in children instruction. However, the deployment rate of SGs in higher education (HE) and their proper insertion in meaningful curricula is still quite low. This paper intends to make a first step in the direction of a better characterization of the pedagogical effectiveness of SGs in HE, by providing a qualitative analysis based on our field experience using three games for entrepreneurship, that we have studied in the light of two well established pedagogical paradigms, such as the Revised Bloom's taxonomy and the Kolb's Learning stages. In general, we observe that SGs address several goals of the Bloom's taxonomy, in particular at the lower levels. Moreover, the cyclical nature of the business simulations can be directly mapped to the sequential steps described by Kolb. However, our analysis also shows that SGs have still to significantly evolve in order to become an effective and efficient tool that could be successfully and reliably used in HE. In the light of our experience, we also propose a schema for a proper integration of SGs by supporting different goals in different steps of a formal education process. Our study finally suggests directions for future research in the field.

Keywords: *Serious Games, Technology Enhanced Learning, Business simulations, Entrepreneurship, Game-based Learning*

1. Introduction

The potential of Serious Games (SGs) in education is widely recognized, and their adoption is significant in particular in children instruction [10] [31] [13]. However, the deployment rate of SGs in higher education (HE) and their proper insertion in meaningful curricula are still quite low. In particular, there is also a lack of papers in literature describing deployment of SGs for HE in detail, critically showing their educational benefits and providing guidelines and practices on their use, in comparison with other educational tools/techniques [8] [16].

With the present paper, we intend to make a first step in the direction of a better characterization of the pedagogical effectiveness of SGs in HE, by providing a qualitative analysis based on our field experience using managerial SGs covering various aspects such as logistics, company management and marketing. For the sake of homogeneity, this paper focuses on the assessment of three games (Hot Shot Business, SimVenture and Any Business) that address the field of entrepreneurship (motivation and company management). These SGs have been used in the context of the eSG European project at the University of Genoa for Electronic Engineering B.Sc. and, mainly, M.Sc. students. They were selected because of their quality and ability to cover the course's goals of introduction to entrepreneurship and company management [14]. The project designed a 3 European Credit Transfer and Accumulation System (ECTS) course including a series of lectures/workshops that introduce the theoretical foundations of entrepreneurship and discuss case studies. The games are played in teams as part of weekly assignments. Students are required to fill in questionnaires about each game session and the relationships with concepts presented in the lectures. The students' actual performance in the games is considered for the final course grade.

From a methodological point of view, in order to describe and analyse the educational characteristics of each game, we propose the use of models that we have straightforwardly extracted from major pedagogical paradigms [2].

Several pedagogical theories and learning models have been employed to inspire SG design and assess validity of SGs. Among the knowledge models, we highlight the Nonaka SECI model [47], which is mentioned as a theoretical basis for the use of SG-based workshops, at least in the fields of business, management and manufacturing [8], and the Kirkpatrick’s “Four Levels of Learning Evaluation”, which is a popular learning impact assessment model, involving the following levels: reaction, learning, behaviour, results [36]. A fifth level of evaluation has been added in new versions of the model by [47] and by [53], considering also return on investment and impact on clients and society, respectively.

In our work we have focused in particular on describing SGs through two models that we consider complementary, simple and particularly useful to analyse SGs: the Revised Bloom Taxonomy [Bloom], which is the most popular cognitive approach to SG evaluation [38] (Figure 1a); and the Kolb’s Experiential Learning model [37] (Figure 1b), which systemizes the work rooted on Piaget’s cognitive developmental genetic epistemology [49], on Dewey’s philosophical pragmatism [24], and on Lewin’s social psychology, putting the experience at the centre of the learning process. Good SGs and simulations should allow users to make significant experiences, thus typically supporting the experiential learning pedagogical paradigm.

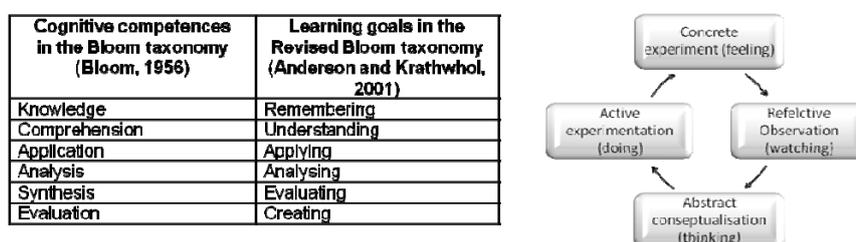


Figure 1. The Bloom taxonomy and the Kolb’s learning stages

Beside this, we are also interested in analyzing the games’ support to soft skills such as strategic thinking, communication, collaboration, etc., that are considered of growing importance for the current educational targets.

2. Related work

Most of the games used for entrepreneurship cover business-related knowledge and skills and their use in education dates from a long time (e.g., [25] [28] [39] [12]). [29] highlights some advantages of business simulations and that skills employed there are not the same as those being assessed in conventional academic evaluation. [35] reports of a project about evaluation of business simulation software for mechanical engineering students, analyzing various open source and Components-Off-The-Shelf (COTS) tools. A certain number of high-level business games and simulations, with different features and targets, are being used in business schools (e.g., [5] [35] [29] [34] [50]). Here is a list of games that we have considered in our preliminary analysis for the selection: Marketplace Venture Strategy, SimVenture, Virtual Trader, Intopia, Beer Game, Zapitalism, Virtual U, Industry Giant II, Innov8, EagleRacing, The Enterprise Game, The Finance Game, MetaVals. Small Business.

Other SGs have been developed for research. For instance, [1] presents a SG modeling an entrepreneurial environment through simple software agent behaviors in order to combine realism and pedagogy, in particular caring about feedback. ENTRExplorer is a multiplayer SG intends promoting development of entrepreneurial skills based on curriculum units (e.g., market and ideas, product strategy, price, distribution, etc.) along the eight levels. A critical voice, [52], stresses the current unavailability of specific evaluation tools and methods for SGs, also considering the complexity of the field. Broadening the overview to other application domains beyond entrepreneurship, we see that several SGs and tools have been designed for various topics in Universities and high schools (e.g., [33] [27] [32] [3] [23] [43] [51] [21] [26] [7] [45]). Strategies for integration in secondary school [20] and a model for describing the acceptance and predicting the uptake of commercial games by secondary school teachers have been proposed [19].

Reviewing the results of experimental studies designed to examine the effectiveness of VGs and SGs on players' learning and engagement, [30] highlight a lack of empirical studies investigating the effectiveness of SGs in learning, also in comparison with other tools. Our work stems from these considerations, and intends to investigate the basis of the effectiveness of serious games considering two well established pedagogical paradigms, such as the revised Bloom's taxonomy and the Kolb's learning stages.

3. Case studies

This section describes three case studies, that the authors have deployed in higher education contexts. We start from a simple Flash game, namely Hot Shot Business, that provides a cartoon-style introduction to the basic principles of entrepreneurship. Then, SimVenture is a very detailed business simulation addressing a variety of aspects of company management. We conclude with Any Business, a multi-player business simulation with modules and market typologies that can be configured by teachers in order to meet specific educational goals.

3.1. Hot Shot Business: an introductory game for entrepreneurship

Hot Shot Business (HSB, <http://disney.go.com/hotshot/hsb2>), by Disney, is a Flash game that has been designed for children, but that we have successfully employed for introducing students with the basic principles of the entrepreneurship. The student has to open and run his own business, taking the best decisions to make it successful. Five business settings can be selected at the benning: landscape (gardening) service, pet shop, custom skate, comic shop, candy factory. The game-play in the five scenarios follows an identical schema, consisting of six stages, each one presenting different situations with different educational objectives. Before starting the business, players have to choose the financing mode (get a bank loan or use own money), then they can rent tools and material needed to carry out the activities and decide how to advertise their business (different channels, different costs, different population reached). During the game, pop-ups appear, containing "news" related to competitors' choices and/or specific events that the player should consider for taking decisions. Players have also access to a real time report on the situation of their investments, profits. The situation of the local market may vary, so that on-the spot decisions need to be taken. A full financial report for each week is presented, so to enable further tuning of decisions and activities.

3.1.1. Support for Bloom's cognitive learning goals

Table 1. Bloom's cognitive learning goals covered by Hot Shot Business

Learning goal	Modality/mechanics
Remembering	Memorizing previous actions and game feedback is necessary for players to improve their business and advance in the game levels. In particular, it is important to recognize (different types of customers have a different look) and remember (for a prompt response) the customers' needs to be satisfied.
Understanding	It is important to understand the customers' typologies of the business and how to satisfy them, in a very short time. The kind of possible decisions are very simple, such as the choice of the kind of machineries to be purchased (which is in a 1-1 correspondence with the type of client), the marketing campaign type, the finance mode to found the enterprise. The strict time-frame (timing is a significant player assessment parameter) draws the player to develop simple decision mechanics that can be taken "automatically", for instance by associating different decisions with different colours/shapes of the various customers' typologies.
Applying	The most important rule to be applied is the demand/offer market rule, which is fundamental for achieving the goal of the game, which is to reach a certain income level.
Analysing	Simple analysis of elements and documents such as balance sheet and sales results is necessary in order to perform well in the game. Upcoming events (e.g., notice of skate competitions that could increase the sales or of a comics' festival that may influence the shop's customer typology) should be analysed as well.
Evaluating	In order to proceed in the game it is important to correctly evaluate the outcomes of previous actions and listen to the suggestions given at the end of each stage. Effects of random events that occur during the game should be considered as well.
Creating	The game environment is closed and stimulation of real creativity is not a target of the game.

3.1.2. Support for Kolb’s learning stages

The Kolb’s cycle is not directly supported by the game. However, all the learning stages are addressed in the overall game experience.

Table 2. Kolb’s learning cycle Hot Shot Business

Learning stage	Modality/mechanics
Concrete experience (feeling)	Players are involved in the experience of creating and managing a business, within some simple market dynamics. The environment is compelling and demanding in particular because of the need for the player to promptly react to events.
Reflective observation (watching)	Players need to analyse the documents (e.g., sale results, balance sheet, etc.) in order to check their performance and think of how to improve their performance. Players are required to observe the reality of the market, whose conditions may be changed also by random events. The player’s assistants give performance feedback at the end of each stage, which has to be taken into account to enhance their results and strengthen their strategies. Finally, players need to look at their competitors’ performance, even if they cannot interact with them. The speed of the game does not let the players think carefully about their decisions. However, reflection could be made off-the-game.
Abstract conceptualization (thinking)	The speed of the game does not allow much time to reflect on decisions to be taken, and, anyway, the decisions are relatively simple.
Active experimentation (doing)	The simulation is simple, but the business is inserted in a market where players are asked to quickly satisfy the potential customers’ needs. Given the relative simplicity of the game, the experimentation margins are quite limited. The educational value of the game clearly relies on the “learn by doing” principle.

3.1.3 Support for soft skills

The game supports mainly strategic thinking, but at very low level, since the pace of the game is very tight and the type of decisions that can be taken are simple and immediate. For example, players have to rapidly choose what machinery to install in order to satisfy their customers’ typologies.

3.2. SimVenture: a game on entrepreneurship and managerial skills

SimVenture (www.simventure.com) is a single-player business game, which aims to teach the basis of company management. The player’s managerial/entrepreneurial skills are solicited in a high detailed and flexible (with huge number of parameters) simulation. The game exposes the player to a number of factors in four functional areas of sales and marketing, organization, operational (design and production) and finance. Product development is well addressed, differently from the other two featured games.

The game runs as a month by month simulation. At every month cycle the player has all the time to observe the current status and the achieved results, to take the decisions and then launches the next month simulation. A game session usually has a fixed duration (e.g., 1 simulated year) but is over in the case of bankruptcy. The game provides a good text-based tutorial that includes descriptions of the real world situations while explaining the games mechanics. For every functionality and parameter to be manipulated, the game offers detailed texts, tips and real-world examples that are quite useful for a player to understand well the concept and think of real-case applications. All the interactions are done without time limits. After doing his choices, the player can make the simulator “run a month”. At the end of each month, it is possible to see not only the effects on these parameters, but even a detailed report of the activity the company did during the whole month. Pre-set scenarios on different topics and of different difficulty levels are provided.

The game is single player. No comparison with other players is performed, but an Excel sheet can be exported, providing a very wide detail of the performance of the player under several parameters (e.g., company value, cash-flow, profit and loss) in all the months covered by the simulation. A lot of performance indicators are provided (Bank Balance, cash-flow, Company Value, Gross Profit...), that

are useful for self-assessment, but it is difficult for the player to understand the impact of his choices (e.g. about marketing, personnel, etc.) on those figures.

3.2.1. Support for Bloom’s cognitive learning goals

Table 3. Bloom’s cognitive learning goals covered by SimVenture

Learning goal	Modality/mechanics
Remembering	The game provides a lot of documentation that the player can exploit in order to make meaningful choices during the game. However, that support for remembering is not a real game mechanics, but a kind of online documentation, so the player has no real need to remember. Running several (virtual) month simulations, the game involves several repetitive tasks, which is useful to help the user in fixing concepts and notions
Understanding	The game requires the player to understand many concepts related to sales and marketing, organization, design, production and finance, which are necessary during the game play. These concepts may be learnt (also with tips and real-world examples) also through a detailed and contextualized online documentation. The simulation algorithms are entirely opaque and the outcomes of the simulation are not easy to understand by the players, who have difficulty in learning from their own experience and mistakes. The several diagrams about the company’s performance are not easy to understand and interpret, particularly in relationship with the player’s game choices, even if “highlight” feedback is provided at the end of each month simulation.
Applying	The complexity of the simulation allows the user to put in practice a number and variety of concepts in fields such as marketing, administration, sale management, finance, product development, legal issues, etc. The game clearly targets development of entrepreneurial skills, in particular concerning company management.
Analysing	The company’s status is shown to the player through a number of tables, temporal diagrams (profit and loss, cash-flow, production, employee satisfaction, etc.) and reports (e.g., market analysis documents), so that he can control the whole situation and take conscious business decisions. Diagrams are not easy to relate to the player choices.
Evaluating	The game shows the trends of all the relevant business dimensions to allow the student’s evaluation and decision making tasks. However, some users tended to over-fit the game mechanics (once they have discovered them) and developed some misconceptions. In order to properly achieve this learning goal, the presence of the teacher as qualified expert is required.
Creating	The game support for creativity is very limited, the gameplay is bounded by the simulation rules and it is not possible to go beyond that.

3.2.2. Support for Kolb’s learning stages

In SimVenture, as we will see in Any Business as well, the cyclical nature of the game play can be directly mapped to the sequential steps described by Kolb, as we show in the following table.

Table 4. Kolb’s learning cycle SimVenture

Learning stage	Modality/mechanics
Concrete experience (feeling)	SimVenture allows the player to feel a company’s management experience through the complexity of the simulation and of the controllable variables. The user interface is not always straightforward (in spite of the validity of the contextualized more-in-depth information possibility) and implementation of decisions typically requires several steps. The game provides pre-defined scenarios with different levels of complexity and difficulty (e.g. start-up, business growth management, cash-flow crisis). This is a key feature to provide the user with different problematic and concrete situations, which he has to address in different ways.
Reflective observation (watching)	The player can observe detailed time series and graphs of several key business factors (balance, incomings, orders, etc.), that help him to reflect on his performance. However, the link between the player’s decisions and the monthly simulations’ outcomes is frequently difficult to interpret (possibly also because of simulated market delay effects). This can lead to misconceptions caused by the complexity of the simulation without a teacher supervision.
Abstract conceptualization	The player can think of business strategies and see their effects in the simulation. As mentioned above, lack of direct feedback makes it difficult to learn from experience. Again, the supervision

(thinking)	of an expert is necessary to identify and stress lessons learned and avoid misconceptions..
Active experimentation (doing)	The player has to manipulate a huge number of parameters and monitor the impact of his decisions. From this point of view, SimVenture allows an extremely active experimentation of business dynamics.

3.2.3 Support for soft skills

Strategic thinking and decision-making abilities are important for the game. Moreover, the complexity of the simulation allows for the division of responsibility within a single company team (e.g. director of marketing, director of purchases, financial director, etc.). This is not a feature supported by design of the game itself, but can be interesting to support specialization in different roles within the same team (company) and development of professional interpersonal relationships.

3.3. Any Business: a highly configurable online multiplayer business simulation

GoVenture Any Business (<http://goventureanybusiness.com>) is an instructor-customizable business simulation platform that can be used to simulate virtually any type of business, within any industry and any market. It is playable both individually and in teams. The game objective is to successfully manage a business while competing with other companies, managed by other players or by the computer. The Simulation Manager (usually an instructor) has a lot of freedom to configure the simulation, creating scenarios that can range from very simple to very complex/difficult, The Simulation Manager is also able to model specific events or situations to target specific learning goals.

The gameplay consists of making business decisions, which means setting several parameters – price, product features, marketing, human resources, business ethics, among others – before the deadline of each period of the simulation. After the deadline, the simulation advances to the next period and the game presents the results of the previous decisions in terms of sales and profits. A performance score is provided as a weighted sum of different dimensions, and the instructor receives a detailed report with all the activities performed by the students. Every simulation is different (e.g., economic and market conditions), which makes performance not perfectly comparable, but allows for more engaging challenges. Teams compete against each other in the same settings, as in a strategy game, and computer-driven competitors are also generated, creating a good model of the market.

3.3.1. Support for Bloom’s cognitive learning goals

Any Business shows a good capability for covering all the levels of the Bloom’s taxonomy (Tab. 5).

Table 5. Bloom’s cognitive learning goals covered by Any Business

Learning goal	Modality/mechanics
Remembering	The game does not place special emphasis in remembering, as there is contextual help available in the simulation at any time, where the player can revise the main concepts whenever needed. However, practice helps remembering.
Understanding	The game requires the player to understand business concepts, which are important when reading the reports (e.g., company performance reports, market surveys, etc.) available inside the game to make their own decisions for the next period
Applying	Closely related to understanding the business concepts, the player is required to apply the concepts when making decisions inside the simulation.
Analysing	The concepts of entrepreneurship are used to support the analysis of the results and the data (reports), so that the player is able to make informed decisions in the business, taking into account also the competitors’ behaviour.
Evaluating	The evaluating learning goal is fundamental, since the player, once analysed the market reports and company status documents, has to think of and evaluate possible alternatives to better advance in the simulation. The player can also write a decision journal, explaining his business decisions and making also medium-long-term planning (business plan, that can be checked and updated at any simulation period).
Creating	The game does not support the creation of new content, as all the decisions must be made within the parameters specified by the simulation manager. However, the possibility of giving students (beside instructors) the possibility of setting up their own simulations (defining markets, product types, etc.) exists, in which case the learning goal of creating original content could be targeted as well.

3.3.2. Support for Kolb’s learning stages

As seen for SimVenture, also in AnyBusiness the cyclical nature of the game play can be directly mapped to the sequential steps described by Kolb.

Table 6. Kolb’s learning cycle Any Business

Learning stage	Modality/mechanics
Concrete experience (feeling)	Especially in the first period of a simulation, the player needs to set a number of parameters based mostly in his “feeling” of how the decisions will affect the simulation. Even if he does know the business concepts, there is the need to experiment with the many settings in the simulation, which gives a “concrete” experience in the game.
Reflective observation (watching)	As the simulation advances, the player observes the status of the company (determined by his decisions) and is able to compare his own performance with that of the other companies.
Abstract conceptualization (thinking)	By analysing the several reports provided by the simulation, the player may formulate a mental model of the market, company management and how his decisions affected the results. However, as mentioned for SimVenture, the link between the player’s decisions and the monthly simulations’ outcomes is frequently difficult to interpret (possibly also because of simulated market delay effects). This can lead to misconceptions caused by the complexity of the simulation without a teacher supervision.
Active experimentation (doing)	Finally, using the concepts that were generated by the observation of the results, the player is able to apply the concepts in setting his company’s parameters for the next period of the simulation.

3.3.3 Support for soft skills

The game supports mainly strategic thinking and decision making. In cases where the game is played in teams of more than one person each (we observed that two people would be the most suited choice), it also supports interpersonal relations, as the decisions could be negotiated among all team members, who may also specialize and consider different aspects of company management (e.g., human resources, finance, etc.).

4. Discussion and synthesis

Based on our experience in the mentioned games, and also others deployed in various courses (e.g., on logistics), we propose the following summary table about the pedagogical value of current SGs and how they could be enhanced.

Table 7. Bloom’s cognitive learning goals summary

Learning goal	Modality/mechanics
Remembering	Games are very good for helping people to remember things through images, animations and compelling situations. The repetitive nature of several games also contributes to support remembering.
Understanding	Games look not very efficient in this, especially if compared with other educational tools/situations based on reading and listening. In several cases it happens that the player, without proper supervision, get lost in a game’s information space. Some games feature very interesting contextualized helps and provide in-depth textual information. However, in general, usable and entertaining games should usually limit the quantity of text information.
Applying	Games look particularly suited in putting in practice acquired knowledge (“learn by doing”).
Analysing	Games, and the managerial/simulation-based ones in particular, can provide a variety of analytics and documentation about the player performance, which is a real-time feedback particularly useful to assess and improve performance.
Evaluating	It is not easy to understand the effects of the player choices, observing the simulation results. Supervision by a teacher is necessary and current games should improve in helping the player’s assessment and improvement through appropriate indications and suggestions.
Creating	Support for creativity is very limited at the moment, also because of the scripted nature of the games/simulations, where everything is coded by the programmer. We believe that even more

	complex simulations could allow the players to freely experiment new solutions (not foreseen by the game designer) that could be evaluated by teachers, peers and through advanced automatic techniques (e.g., machine-learning-based classifiers) as well.
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Table 7. Kolb's learning cycle summary

Learning stage	Modality/mechanics
Concrete experience (feeling)	Managerial SGs have the ability to involve players in meaningful "real-world" activities, offering several choice opportunities and data to check. The user interaction modalities can be significantly increased in order to enhance the user experience. Also, current business simulations are weak as games and their entertainment aspect should be greatly improved.
Reflective observation (watching)	Current SGs provide a variety of graphics and time-series that have to be observed and investigated by the player. New generation tools should improve in the presentation aspect (also considering the recent widespread diffusion of analytics) and better supporting interpretation of the results.
Abstract conceptualization (thinking)	The abstraction process is generally difficult in games, where the player is also drawn by the competition in winning making the most of the current data (in some cases also quickly, as time is an assessment parameter), without directly stimulating abstraction. The presence of a teacher is important in this regard and more theoretical tools (e.g., books) look more suited to this goal.
Active experimentation (doing)	Games surely support active experimentation and learn by doing. Of course, this may lead the user also to some drawbacks, such as lack of theoretical foundations, lack of abstraction capabilities, practical mentality oriented towards immediate goals. For this reason, we think that the use of SGs should be inserted in a significant educational schema, as we suggest later in this final section of the paper.

Managerial games typically solicit strategic thinking and decision making. Cooperation and collaboration is limited and up to the players' initiative. New mechanics and even types of games could be developed in the future, in order to directly support collaboration.

Analysing the features of the different games employed, we propose the following outlook of strengths and weaknesses.

Table 8. Outlook of the games

Serious Game	Strengths	Weaknesses
Hot Shot Business	Freely available Immediate to play Effective in conveying the very basic concepts of entrepreneurship	Very simple decision Very limited market simulation Very quickly paced Very short playability
SimVenture	Very detailed business simulation (several functions and parameters controllable; several diagrams shown and recorded) Pre-defined scenarios playable Contextualized more information and real-world examples No time pressure Product design addressed Long playability	Low usability Limited game aspects No multiplayer No competitor simulation Difficulty in relating simulation outcomes to player choices Not considering key aspects of entrepreneurship (e.g., innovation) Focus on a small business
Any Business	Detailed business simulation Highly customizable, in particular by teachers Multiplayer allows competition in the same market context Enjoyable graphics Long playability	Difficulty in setting the parameters and understanding their effect Difficulty in learning from experience Limited realism with respect to the complexity of the simulated market Lack of difficulty levels Limited game aspects Presence of bugs (early versions of the software)

In the light of our experience, we propose a schema for a proper integration of games in entrepreneurship education, supporting different goals in different steps of a formal education process, as shown in Tab. 9.

Table 9. Fitness of games to the different steps of an educational process

Educational process' step	Fitness of games
Initial motivation.	Games look very useful for raising awareness and interest of a student about a new topic
Theory	Here the role of the teacher and of tools like book look quite effective and efficient, especially to support abstraction
Practice	Games look very useful for practicing learned contents. Games should be of various levels, allowing different degrees of freedom according to the student expertise. Supervision of the teacher is highly recommended in order to avoid misconceptions and loss of coordinates that could easily arise in a complex simulation environment
Verification	Games could be useful to verify some aspects of knowledge/skill acquisition, but attention should be paid by the teacher in order to avoid over-fitting. In general, use of digital games is particularly suited for tracking the user and understanding his performance, through learning analytics

While developed mostly through experience with business games, we believe that this schema could be applied to other educational subjects as well.

5. Conclusions and directions for future research

This paper has made a first step in the direction of a better characterization of the pedagogical effectiveness of SGs in HE, by providing a qualitative analysis of three SGs in the light of the Revised Bloom's taxonomy and the Kolb's Learning stages. In general, we observe that SGs address several goals of the Bloom's taxonomy, in particular at the lower levels. Moreover, the cyclical nature of the business simulations can be directly mapped to the sequential steps described by Kolb. However, our analysis also shows that SGs have still to significantly evolve in order to become an effective and efficient tool that could be reliably used in HE. Significant weak points still remain particularly in combining entertainment and pedagogy in game design, providing effective formative and summative feedback, supporting student assessment (e.g., [16]), user monitoring in particular for personalization (e.g., [17], [46], [13]), advanced Human-Computer Interaction for increased realism and inclusion (e.g., [22], [42]), cooperation and collaboration. We argue that these topics should be carefully addressed by future research. In particular, we believe it will be important to collect significant experimental information in order to design methods and tools on a more solid basis than today. In our opinion, definition of proper SG formats, based on effective SG mechanics, will be key in order to have a new generation of educational tools that can be promptly used by teachers and educators, also allowing them to add specific contents and rules/goals as well [14] [11] [40] [41] [44] [6].

In the light of our experience, we have proposed also a schema for a proper integration of SGs by supporting different goals in different steps of a formal education process. While developed in the entrepreneurship domain, we believe that this schema could be applied to other educational subjects, which will be a next step of our research.

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