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ENHANCING LEARNING OUTCOME OF BUSINESS SIMULATION GAMES VIA PROCESS FEEDBACK

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Abstract
From the establishment of business simulation games in the '50s, there were several reports which concluded how many business faculties were using simulation games in at least one course. Studies made in the '60s found that in the United States of America the usage of business simulations is above 90% in business schools. In a comprehensive study, Wellington et al (2010) examined 160 studies. Those studies measured the effect of simulations on the tests' results written at the end of school-year by pupils. Based on these measurements they found that in 46.9% of the cases simulation-based lectures were more effective than traditional forms of teaching. 16.9% of the studies said that traditional ones were more effective and in 36.3% of the cases, there was no significant difference in the results perceived. In the background of the different results, there can be various effects. Based on Goosen (2002) the main factor is how the simulation is implemented in the lecture (Gold, 2015). This emphasizes the importance of giving feedbacks.
Educational business simulations are usually designed to enhance learning outcome and skill development in case of managerial and entrepreneurial skills. Skill development is usually measured with surveys; there is a lack of methods for measuring players' thinking with in-game evaluations. The aim of the study is to explore the possibilities of constructing a method to measure rationality with in-game evaluating methods to help teachers be able to give better and more useful feedbacks to enhance learning outcome of business simulation games.
KEY WORDS: management education, entrepreneurial skills, business simulation games, feedback, rationality.

Introduction

Greco et al. (2013) define business simulation games within the games, as a combination of serious games, simulation games and management games (Figure 1).

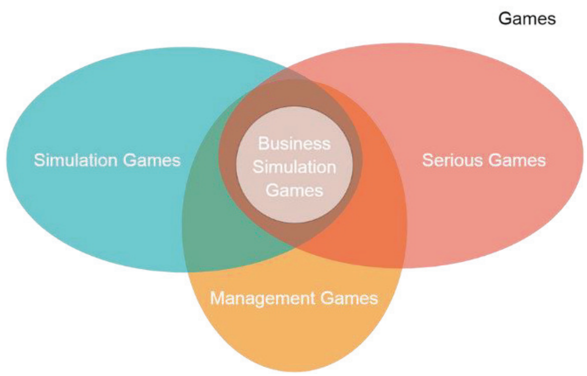

Fig. 1. The categorization of business simulation games within games Source: Greco et al (2013)

Going deeper, within business simulation games there can be further categories made. In this paper the aim is not to present a wide taxonomical spectrum of business simulation games, only to define it precisely what kind of business simulation games we want to analyze.

In business simulation games students can test themselves as managers without taking real financial risk. Business Simulation is a modeled, virtual platform, where acting as leaders of companies, players can test their strategic and analytical skills through decision-making situations. During the simulation, there are financial, human resources, marketing, inventory management, commercial, etc. decisions to be made. The players also have to adapt to changing market environments.

Characteristics of the business simulations focused by this study:

- Computer-assisted simulation;
- Multiplayer, the opponents are students, not AI;
- Turn-based, where players make decisions any time until the deadline of the given round and lack new information until results are not simulated based on the decisions;
- Strategic decisions are to be made;
- Players' companies are starting from the same, initial position;
- The simulated market environment is oligopolistic with 5-6 teams per market.

The first use of business simulations in business schools can be dated to 1957 (Watson, 1981). From the establishment of business simulation games in the '50s, there were several reports which concluded how many business faculties were using simulation games in at least one course. Studies made in the '60s found that in America the usage of business simulations is above 90% in business schools (Dale & Klasson, 1962, Graham & Gray, 1969, Day, 1968). Since the '80s almost all the AACSB (Association to Advance Collegiate Schools of Business) schools (95.1%) were using business simulations (Faria, 1987), and this number even rose to 97.5% in 1994-1995 (Faria & Nulsen, 1996). That means business simulation is a widespread method used in business education. However, there are regional differences. According to Boda (2018) in Hungary the usage of business simulation games in academia has still room to grow both in quality and in quantity: "only 45% of the institutions having a serious ratio of business education in their curricula and/or playing an important role in the business education of Hungary provide courses built on business simulations”.

In a comprehensive study, Wellington et al (2010) examined 160 studies. Those studies measured the effect of simulations on the tests' results written at the end of school-year by pupils. Based on these measurements they found that in 46.9% of the cases simulation-based lectures were more effective than traditional forms of teaching. 16.9% of the studies said that traditional ones were more effective and in 36.3% of the cases, there was no significant difference in the results perceived.

In the background of the different results, there can be various effects. Based on Goosen (2002) the main factor is how the simulation is implemented in the lecture. (Gold, 2015)

In a simulation game, students are able to perceive the status of their company from the inside, and, in the absence of external feedback, they can get false conclusions. A good instructor should pay attention to this problem and motivate the students to develop themselves and their thinking based on the right feedbacks.

Why feedback is critical for proper learning to take place after an experience is formulated by Gentry (1990): “The student should not be allowed to conclude what was learned without receiving feedback; there is too much evidence that human beings do not do this properly.”

Tunstall and Gipps (1996) divided teacher feedback into two main kinds: evaluative feedback and descriptive feedback. Evaluative feedback - including rewards, general praise, like, punishments, general criticisms - judges student performance. Descriptive feedback has two main parts: achievement feedback and improvement feedback. Descriptive feedback focuses on what was done well and why and what to do in order to improve. (Brookhart, 2008, Schinske & Tanner, 2014) Focusing on digital game-based learning, it can be stated that if learners are given regular feedback about their performance, the entertainment instruction results in deep learning (Erhel & Jamet, 2013).

How to improve the value of feedbacks? Evaluating process instead of evaluating the outcome

In a competition or in a game reaching a good or bad position or making good or bad profit alone does not provide enough feedback about performance to improve in the future. Alone building on this information it cannot be stated what is needed to improve.

Itself the process of experiential learning, the way business simulation games are working gives a lot of feedback during the game. As Gentry & Burns (1983) point out, “most learning occurs through outcome feedback - an action is taken and we observe the outcome.” Also, he adds, that “in many cases, we judge the quality of the decision by the favorableness of the outcome.” This is problematic because “outcomes frequently depend on factors outside the control of decision makers (e.g. Emery & Tuggle, 1976), and that we should evaluate the decision process rather than the outcome. In the long run, a good decision process should result in more profit, but this may not be true in the short run.”

Although process feedback is much more valuable than outcome feedback, the outcome feedback is used more frequently, because “it is simpler to observe their game-end profit or their recommended case solution than it is to delineate the process used to bring about these outcomes. Further, far less effort is required to critique the outcomes than to critique the process.” (Gentry, 1990)

Although there are a lot of researchers who identified that analysing the profit alone is not sufficient, and now game designers use broad-based scoring systems for assessment, using 5-10 or more variables (Teach & Patel, 2007), but these performance measures are still outcome-based instead of process-oriented ones.

In a business simulation game to diagnose how a student can improve, first, we have to analyse what faults were committed by the student. Generally, amongst the decisions of the players, it is needed to find those where the player made a mistake. Superficial feedbacks do not provide a real impact on students’ improvement (e.g. Snowball & Mostert, 2013). In order to provide feedback promoting real progress of the students, teachers need plenty of time and excellent analytical skills and also to have experience with the simulation itself to know what to look for during the analysis.

If the instructor does not have the sufficient analytical skills or experience with the simulation or time to do the analysis, it can work too that the most frequently committed mistakes are presented on group level. Although the personal feedback would be more effective because it fosters the learning outcome of experiential learning. There is an improvement opportunity also, when not the teacher is who finds and draws attention to mistakes, but the students formulate their questions and they get answers to them. Here, it is important to note that formulating questions work well mainly only by those students who are aware enough with the simulation to formulate a question. Furthermore, there are a lot of students who avoid asking a question due to both individual characteristics and characteristics of the classroom (Ryan, Gheen & Midgley, 1998).

Besides feedback, process-oriented mindset (instead of outcome-oriented) is also needed during grading to enhance the motivation of students. Results based grading can have two forms, such as ranking based or relational grading (Biggs, 1978), both are using the practice of grade curving. Although “the practice of grade curving has had unfortunate and often unintended consequences for the culture of undergraduate science classrooms, pitting students against one another as opposed to creating a collaborative learning community (Tobias, 1990; Seymour and Hewitt, 1997). […] Moving away from curving sets the expectation that all students have the opportunity to achieve the highest possible grade.” (Schinske & Tanner, 2014) This also implies that process analysis would be needed instead of rewarding the outcome. This affects collaborative work, motivation, and thus learning outcome too; “constructing a grading system that rewards students for participation and effort has been shown to stimulate student interest in improvement” (Swinton, 2010).

Automatic measurements are required

To resolve the problems mentioned before a solution is needed where the teacher's obligation is not looking for mistakes but to teach, nor the students have to ask questions to raise a problem, but a software solution makes this automatically.

There are a lot of mistakes to find (e.g. if there is a lack of stock, the company can lose customers). Some of the mistakes are easy to identify. In many cases deciding on a value whether it was a mistake or not, depends on the applied strategy and the purpose of the player.

First, it is needed to decide that a player is acting rationally or not. This paper emphasizes the importance of measuring rationality.

Quantitative measurements are a key factor to reasoning more effectively the superiority of business simulations in business education (Scherpereel, 2005). Also, the comprehensive study of Chin et al (2009) reviewing 40 years of the journal Simulation & Gaming states that assessments primarily are focused to ensure this goal. Although there are a lot more to measure in the case of business simulations. From this point of view, not just measurements of the effectiveness of the simulations are needed but assessment of the students' performance as well.

Measuring performance with only the managed company's output (e.g. with profit) may lead to false conclusions about rational decision-making. Measuring rationality does not mean measuring efficiency. Neuert et al (2015) state that there is "no linear function between decision making efficiency and the decision making rationality". A team playing in a business simulation game can fail with rational thinking as well and can have good results in short-term without any rational strategy at all with some luck too.

The purpose of the paper is to support an aspiration of future development of an analytical system that makes it possible to measure decisions according to whether they are consciously grounded or random, heuristic and can be placed on a scale between these two endpoints in a business simulation game not specifically designed to measure rationality but to enhance learning outcome and skill development in case of managerial and entrepreneurial skills.

Rationality measurements in business simulation games: where are we now?

There are already existing methods for measuring rationality in general, such as the Afriat Efficiency Index (Afriat, 1973), the Houtman-Maks Index (Koo, 1963; Houtman & Maks, 1985), the Money Pump Index (Echenique, Lee & Shum, 2011) and Minimum Cost Index (Dean & Martin, 2016), although in case of business simulations there are much fewer attempts to measure rationality.

As Scherpereel (2014) states educational simulation games are designed to create a complex and uncertain environment. Simulation game developers expect that the players will use rational analysis as the preferred decision process. Although, "when faced with the complex decision environment of a simulation most players seem to forget the analytical tools they acquired during their education and resort instead to ad-hoc intuition or heuristic processes. […] In response to the uncertain and complex environment of a simulation game, student teams seek a straightforward yet reliable decision-making model. Because they are not confident they can correctly apply the analytical tools to make the simulation decisions, they rationally choose to ignore the methods they have learned and employ simplifying rules and heuristics." (Scherpereel, 2014). As Scherpereel argues, intuitive decisions can be rational as well, and perhaps when faced with significant uncertainty and complexity, intuition is more valuable than analysis.

This argument makes even harder to establish a methodology on how to measure rationality in business simulation games.

Various measurement techniques have been developed to diagnose the personal style of information processing, i.e intuitive, quick, unconscious and affect-based of first cognitive system, or logical, conscious, slow and reason-based, "rational" of second cognitive system in Dual-Process Theories (e.g. Epstein, 1994, Stanovich & West, 2000, Kahneman, 2003); two classes of these measurements can be distinguished: self-reported inventories and task solving tests (Sleboda & Sokolowska, 2017).

Lukosch et al (2018) state we can represent rational choices and model behavior in simulation games. Business simulations can provide a sufficient environment to measure rationality if they are expressly developed with this aim, but if so, it is more like a task solving test (Sleboda & Sokolowska, 2017). But what if the primary motivation behind simulation development serves other educational purposes (such as enhancing entrepreneurial skills or help to understand the business acumen) and measuring skill development or measuring rationality is only a secondary goal? It seems to be a more complex question.

The other measurement technique mentioned before is the self-reported measurement. Usually learning benefits of business simulations are measured with self-reported surveys (e.g. Dhatsuwan & Precharattana, 2016, Wellington, Hutchinson & Faria, 2017) which may lack the objective perspective. Also, students are usually asked to reflect on their own decision-making abilities e.g., were they rational or intuitive decision makers (e.g. Costin et al, 2018) which is still a very subjective methodology. As Reeder (2013) states, actors compared to observers are more likely to explain their own behavior rational by citing good reasons for their actions, due to they are motivated to portray themselves as rational; which strengthens there is a need for objective solutions. Also, as Mayer (2018) formulates, the "use of questionnaires also contradicts the key principle of gaming, namely that the game play itself should be the assessment". Although he adds that today "a triangulation of data based upon self-reporting, personal observation, and digital observation is highly necessary for various practical, theoretical and ethical reasons" (Mayer, 2018).

Assessing with digital simulation games have the fundamental advantage of data can be gathered unobtrusively (Mayer, 2018, Mayer et al, 2014), although there is a little evidence that these data would be used to evaluate the rationality of players' decisions.

The primary focus of participant assessments in business simulation games is how players' skills were developed (e.g. Teach & Patel, 2007). There are a very few studies deal with the decision process itself. For example, Rashid et al (1988) proposed an expert system model for making "first-period" pricing decisions.

Musshoff et al (2011) analyzed boundedly rational behavior (Simon, 1956) in business simulation games. The study provided a results-based analysis instead of a decision-process based solution (i.e. authors compared achieved results with achievable results if uncertainty in case of price forecasts would be eliminated).

Kuperman's (2009) findings suggest that in business simulations, searching for strategies that satisfy normative standards would be justifiable: As students were able to learn from experience and improve their policies, it was expected that they should eventually discover an appropriate policy that maximizes their payoffs. However, in the research, the majority of the subjects failed to reach optimal strategies. "It appears that there is a preferred bias toward choosing particular types of strategies that satisfy normative standards, even though these strategies produce lower payoffs."

The "degree of rationality and the degree of decision-making efficiency depend on the situational and structural context of the decision making […], indicating that professional decisions are generally conducted more along rational reasoning than private decisions (Neuert et al, 2015)." This statement also indicates that decisions made in a business simulation environment should be assumed more rational than the private ones. Although Wolfe (2016) notes that rational decisions in business simulations are affected by the level of engagement.

Wolfe (2016) states that "Those who were completely engaged in the experience obtained superior economic results and created strategies and implementations that were rational, goal-oriented and correct for the simulation's modeled competitive environment." Which implies that one key element of rationality is engagement, and based on this, rationality measurements could lead to active participation/engagement assessments too.

In case of evaluating the simulation performance in a classroom environment, in order to maintain motivation, instead of achieved results (such as profit) rational decision-making as an indicator seems to be a better element to evaluate because it values more the efforts taken.

How to measure rationality in business simulation games?

Students can receive useful feedbacks and do not draw false conclusions solely based on the results. The aim of the rationality measurement supplemented by giving detailed feedback is supporting students in identifying where their thinking has gone wrong and promote learning.

In the case of rationality, it is assumed that there should be consciousness as well. To be able to measure consciousness on database level, first, understanding the decision-making process of the players is critical.

Generally it can be stated that decision-making methodology can vary from one decision maker to other but the essence of the decision-making process is similar. The following phases can be separated (Fig. 2):

- analysis at the beginning of the round, where it is analysed how results met previous plans;
- defining strategic directions and goals, adjusting to the actual and expected situation;
- operational support of implementing the strategy;
- make the actual decisions.

Fig. 2. The usual phases of decision making in BSGs

Also, generally, it can be stated that players usually determine an important decision point in their decision-making process and then adjust the other decisions of the company to this first decision point, as it is presented in Fig. 3.

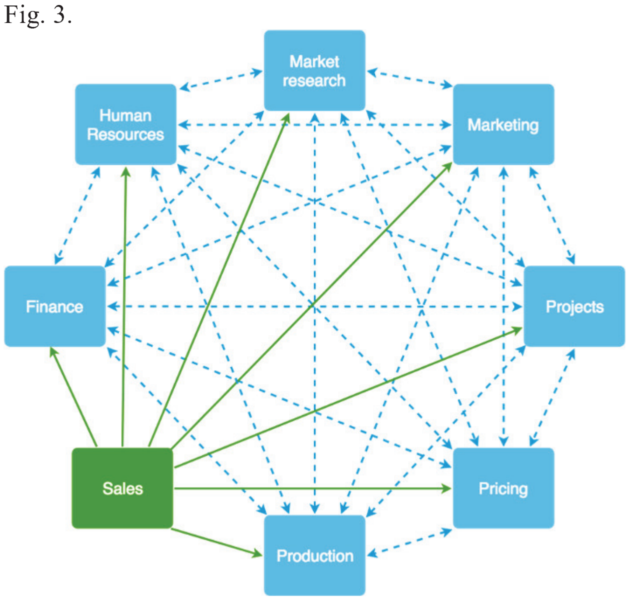

Fig. 3. Players first choose a factor to decide on, other decision points are adjusted to this first decision.

To define what measurements are appropriate for assessing consciousness or rationality, exploratory interviews are needed to be made with good business simulation players, who have deep insight as a user how decision-making in a business simulation works.

Based on the interviews a survey can be made to quantify what aspects are important to different players in different situations when they make decisions. Using the responses of the survey it is planned to build a model where virtual agents are formed and these agents make decisions instead of real players.

The decisions made by the agents can be inserted as an input into a business simulation game and the results can be generated. This way after running thousands of simulations we get patterns that help to identify that in specific situations how should different players act.

Later, comparing these patterns with real players' decisions we should find out what decision motivation was in the head of the decision maker. Statistical analysis methods are needed to investigate whether any strategy was clearly applied by players. Data is available on each round of the game on database level. It can be also traced how the players in each round had information about their own team and their competitors, and it is also known what they had decided in these situations.

Conclusions

Players in business simulation games usually create a strategy based on analysis. Players are assumed to be more rational in business simulation games. Rational decision-makers in business simulations build their decisions on analytical considerations - where it is possible. Teams mostly analyse their own company and their market as well. How they adapt to the market situation and to what extent they tend to be rational varies a lot. There is not a single good choice for strategy creation, several strategies can work as well. In terms of rationality, the decision-maker can apply a variety of rationality models. There is a need for a program that is able to find successfully what kind of decision models were used in a specific situation.

Based on the exact decision models were used by the players, more specific feedback can be generated by the teacher which improves the learning outcome.

With the automatic rationality analysis, not only the learning outcomes can improve based on process feedback instead of outcome feedback, but the students' motivation is also increasing by overshadowing curving in grading. Thus, teamwork can be strengthened during the learning process. In addition, the grades would have a more valid meaning because the results are far less depending on the level of opponents.

Although it is assumed that patterns of rationality can be identified, further quantitative study is needed to prove whether it can be determined on database level analyses or not if any pattern of rationality correlates with the actual decisions of a player.

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