FactOrEasy©: ART AND CRAFT OF MANAGEMENT?

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Abstract

The paper introduces newly created specific online business simulation with the artificial intelligence in the role of competitors and reveals some of its possible educational benefits. In the paper we identify the benefits resulting from the use of the unique business simulation FactOrEasy, which uses artificial intelligence to play against human opponent. The pilot study of research was conducted with 44 students. We used the simulation as the repeated experiment with the open and easy instructions for students in which we monitored their behavior due to online saves available in the simulation. To determine what students' feelings and thoughts were we used questionnaires followed up with the personal interviews.

Keywords

Artificial intelligence, business simulation, FactOrEasy, knowledge, management

Introduction

According to Mintzberg (2013) to manage it is necessary to put together art, craft, and science. Science in management lies in techniques and systematic evidence which provide the order through systematic analysis of knowledge. Art produces insights, visions, ideas, integration, and uses the intuition. Craft in management is formed by learning from experience, builds on those tangible experiences, and makes the connections. (Mintzberg, 2013)

Unfortunately, as Mintzberg (2013) also mentions the university professors teaching the management overemphasize the science in the field of management while ignoring its art and craft. There are other authors who also feel the missing parts in the management or business education especially the lack of critical thinking, creativity, innovation, and for too theoretical approach in education (Behrman and Levin, 1984; Hughes, O´Regan and Wornham, 2008) and lack of communication and teamwork (Felder et al., 2000; Alvear et al., 2006). Therefore, the disparity between the requirements of industry and the graduates´ abilities still grows (Dynn et al., 2005; Eskandari et al., 2007).

According to Mintzberg´s management point of view for training managers it is necessary to bring to the management education also art and craft. The key question is: "Where the art and craft of management can be taken from in the form suitable for the classroom?"

There are plenty of teaching methods. Huddleston and Unwin (1997) divide teaching methods to two categories: 1) teacher-centered methods and 2) learner-centered methods. The teacher-centered methods see teacher as the most active part of teaching on the opposite the learner-centered methods call for students´ activity and experience formation. Therefore, the answer for "How to transfer the art and craft of management to the classroom?" lies in the learner-centered methods. Between learner-centered methods Huddleston and Unwin (1997) rank: practicals, role play, research-based project, group work, self-directed study, trial and error activity.

Such trial and error activity within role play in management teaching might be the games or simulations. This supports Arias-Aranda (2007) by claiming the business simulations´ participants are the only responsible for their decisions, so teachers become observers or game/simulation facilitators. Many authors also agree the simulation is one of the most effective methods in active learning (Cohen and Ledford, 1994; Lainema and Makkonen, 2003).

According to Gogg and Mott (1993) the business simulations are the art and science of creating a representation of a process or system for the purpose of experimentation and evaluation. Hall (2014) adds the business simulation is a learning tool helping players to practice the fundamentals of their future profession using the imitation of human behavior in the occupation, profession, or business in a much abbreviated time with minimal risk.

Salas, Wildman and Piccolo (2009) see game-based training as ideal technique for management education programs in undergraduate and graduate management programs as it gives students practical skills, which they need when entering the business or corporate world. Also Wellington and Faria (1991) found business simulations very effective for enhancing student learning. And according to Mitchel (2004) the use of business simulations in management education can fill the gap between what market requires and what the education brings.

Present article identifies the benefits resulting from the use of the unique business simulation (FactOrEasy) with artificial intelligence in specific context of management education at Faculty of Management and Economics, CULS Prague.

Materials and methods

In the following text we present the usage and benefits of online business simulation called FactOrEasy developed and tested at Faculty of Management and Economics, CULS Prague with the financial aid of Technology Agency of the Czech Republic. In an effort to expand our knowledge we follow the findings from previous research (Švec, Pavlíček and Tichá, 2014a; Švec, Pavlíček and Tichá, 2014b; Pavlíček et al., 2014; Pavlíček, Švec and Tichá, 2015a).

The pilot run of the FactOrEasy simulation has been played in December 2015 and January 2016 with 44 students of management at Faculty of Economics and Management in the Czech University of Life Sciences Prague. Students were in the 1st year of master studies, all of them were studying the course Enterprise Management. There were 13 men and 31 females.

The main methods used in the paper for the identification of simulation´s benefits are experiment, interviews, and analysis. First we asked 44 students to play an online business simulation (FactOrEasy). Students were given following open instructions: 1) to earn as much "cash" as they will be able, 2) to play repeatedly to find the "best" strategy, 3) to provide us with their best simulation results. Students were given limited time period for playing the simulation (6 weeks). And after they had reached the best score, they answered questionnaire which focused on the activities they had performed in the simulation. The type of questionnaire's administration was paper-and-pencil. After experiment and questionnaire, the face-to-face interviews took place. At the end we had electronically saved results of 44 (repeated) experiments which show us each decision each student made during the simulation, 44 questionnaires about the students' simulation understanding and face-to-face interviewed the same 44 students. The face-to-face interviews were conducted to verify, extend, and understand the students' answers from questionnaires. According to the data we worked with (obtained from recorded results for each game, questionnaires, and interviews) we exclude the random answers and gaming luck (which may occur in simulations) from our reasoning.

Context of the experiment: Description of FactOrEasy simulation

FactOrEasy is the online dynamic deterministic simulation of decision making in operation or strategic management within the factory using artificial intelligence to compete against human player. According Angelidese´s (1999) point of view FactOrEasy can be also classified as the role playing game. The simulation puts players into the role of 1) executive manager, who is responsible for purchasing, manufacturing and sales, or 2) strategic manager responsible for competitive strategy.

The business simulations started after Second World War within the development of analytical and quantitative methods in economy and management. Due to usage of computers the business simulations become easier to be administrated therefore more popular. Simulations had been improved to the present days to use stochastic elements, higher level of complexity, modelling of specific firm´s or industry´s conditions. The usage of artificial intelligence within the business simulation, as in FactOrEasy, is quite unique. The FOE simulation involves the artificial intelligence which is represented by neural network with one hidden layer and had been presented by Pavlíček, Švec and Tichá (2015a). Artificial intelligence in the simulation substitute the human players in the role of competitors.

As there is the artificial intelligence presented in the role of competitors, the simulation is playable just with one human player. The FOE fulfils the conditions set for the successful tacit knowledge training (Švec, Pavlíček and Tichá, 2014): 1) specificity of trained tacit knowledge – as simulation has its own specific didactic goals, which students can achieve by training, 2) repeatability/availability of the situation in which runs – the simulation offers always the same context and is available anytime online, and 3) changeability of the training situation´s conditions – which is provided by the artificial intelligence in the competitors´ role. By adapting the methods of artificial intelligence, the solution can evolve together with the players and thus better support their professional development similar to Wawer et al (2010), or Hawtrey (2007). This way the simulation keeps its dynamic character, which is difficult to predict, and players thus must gradually work on their strategy (Švec et al, 2014b).

Process of the FactOrEasy´s gameplay

The FactOrEasy logic and gameplay had been previously described in detail by Pavlíček, Švec and Tichá (2015a). Therefore, here we describe the logic of the game briefly in summary: FOE´s gameplay is divided to three main phases: a) buying material, b) production, and c) selling the products, as shown in the Figure 1 – FactOrEasy simulation screen – in Decision Making Window. During these phases player makes three basic decisions about buying material, producing, or selling products. Other possible decisions player can make are to buy another factory (Factory Request) or ask the additional money (Loan Request).

In the FOE simulation, players´ individual decisions are interconnected in the chain of causes and effects, not only within one phase or after ongoing phases, but also in the whole game. Player´s decisions made in the specific moment during the gameplay are affected by decisions made in the past and also determine the player´s future success or failure, in future phases of the game thanks to presence of the artificial intelligence (in the role of competing players). This chain of causes and effects even with just 5 possible decisions to make during the game phase produces fairly complex situation. To ease the situation, the simulation screen uses four windows to serve players the information they might need to make decisions: Game Status window, Material Market window, Competitors window, and Costs window – see Figure 1: FactOrEasy simulation screen.

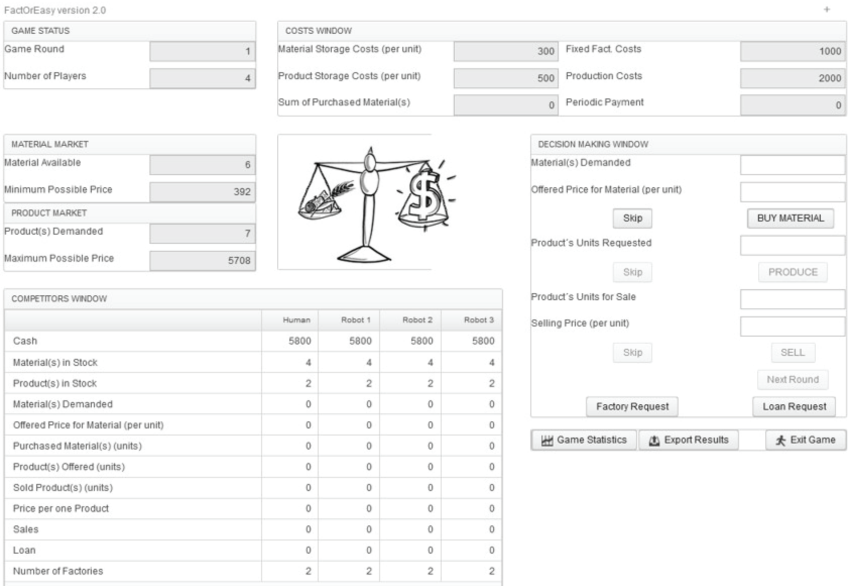

Figure 1: FactOrEasy simulation screen, 2016 (source: Pavlíček, Švec and Tichá, 2015b)

Results

The results achieved from the FOE simulation

For the students the main goal of the simulation was to earn the biggest amount of money. The overview of the students´ simulation results are shown in Figure 2: Simulation results.

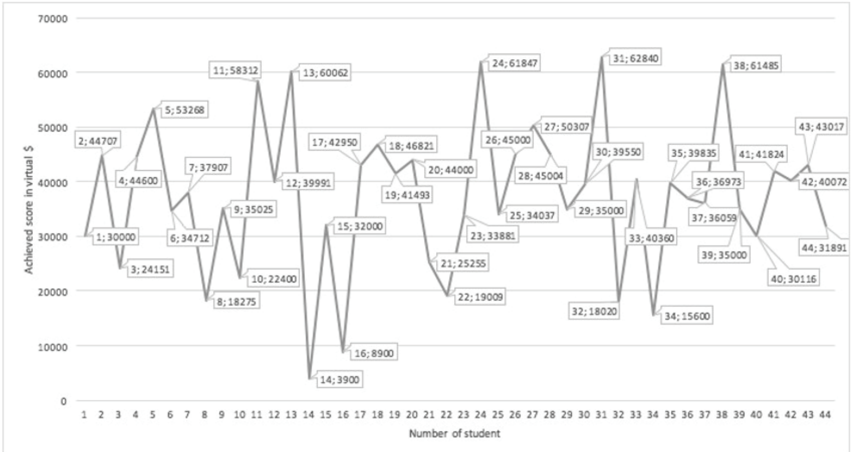

Figure 2: Simulation results, 2015-2016 (source: own calculation)

You can see all the amounts students reached in pilot run in Figure 2. The highest amount was 62840, the lowest 3900, the average 37396.73. Only two players reached the amount lower than 15000, four players did exceed the amount of 60000.

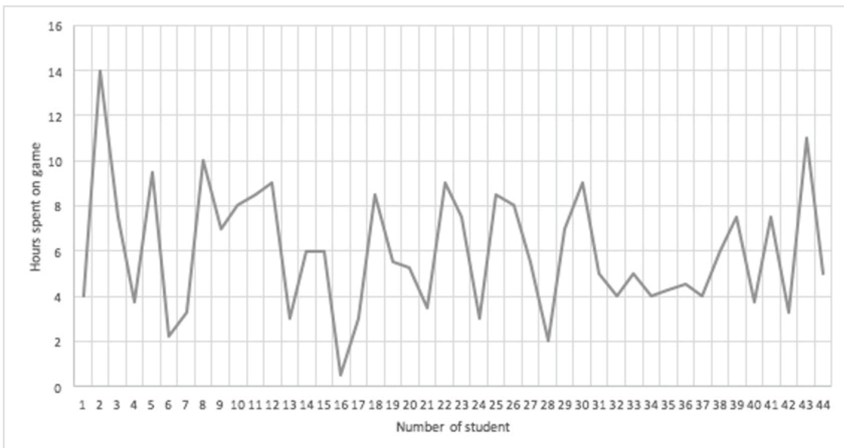

Figure 3: Time spent on simulation, 2015-2016 (source: own calculation)

We wanted students to play repeatedly to find the "best" strategy to achieve highest score. Therefore, students had to play the simulation more than once. As Figure 3 shows, students spent various time playing the simulation. Both figures (Figure 3 and Figure 4) work with the same students' numbers, therefore it is possible to compare achieved best results and time devoted to the simulation. Maximum time spent within the simulation was 14 hours, minimum time was 0.5 hour, an average time was 5.96 hours spent within the simulation.

Results categorization

To categorize the data for the variable 'simulation results' we used categories by the thousands (of 'cash') and 2 hours' categories for the variable of 'time spent on simulation'. The categories' distribution for both variables are seen in Figure 4: Distribution of simulation results and in Figure 5: Students' distribution of time spent on simulation.

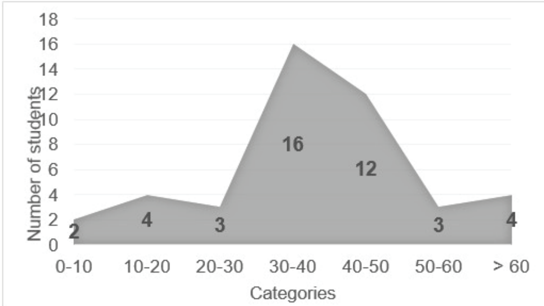

Figure 4: Distribution of simulation results (categories in thousands of virtual "cash" units), 2015-2016 (source: own calculation)

Distribution of time students spent on simulation in 2 hours´ categories is shown in Figure 5: Students' distribution of time spent on simulation.

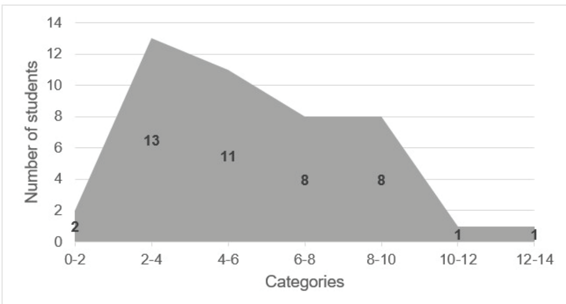

Figure 5: Students' distribution of time spent on simulation, 2015-2016 (source: own calculation)

Although the distribution of simulation results is not perfectly 'normal', it may still be 'normal' enough for use according to skewness (-0.234) and kurtosis (0.026). Also the distribution of time spent on simulation is not perfectly 'normal', but it is still 'normal' enough to be used for the purposes of our pilot study according to skewness (0.511) and kurtosis (0.107).

To find out whether the simulation results and spent time are correlated, whether they change together in a linear fashion, we used Spearman's test of linear correlation. The results are shown in Figure 6: Results of Spearman's test.

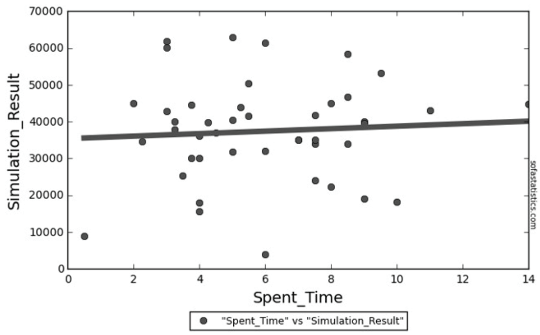

Figure 6: Results of Spearman's test, 2016 (source: own calculation)

The result for p value is 0.8119, Spearman's R statistic is 0.037 (df =42). According to results we can say there is very poor linear dependence between variables in our pilot study.

The results from interviews

We noticed two possible categories of students: 1) students motivated, prepared, willing to speak about their course of actions, and theory they discovered in the FactOrEasy simulation (40 students, 90.9 %), and 2) students less or not motivated, not involved, acting from duty (4 students, 9.1 %).

There was majority of students (90.9 %) who were really motivated by the simulation. Students, who came to interviews pleased, were well practically prepared (they spent a lot of time with the simulation), they were able to talk extensively about strategies they tried, were able to identify the possible best strategy when the conditions changed, and in almost all cases they were also well prepared in theory. The level of preparedness in theory we evaluated according to the number of areas which were students able to knowingly recognize in the simulation, study deeper, and understand the principle.

Members of this category created on their own nonpublic Facebook page to share their results and unwittingly started gamification effect between the students. Reasons why students accept the FactOrEasy simulation so positively were by their words: "the difference from usual teaching methods" or "the option first things to try", also the try "to figure out how it works, how do the AI think", and "I just liked the idea I play the game as a college homework".

Students less or not motivated were rare during the interviews (9.1 %). Without exception they were students who spent the least time on the simulation. According to their statements some of them found the simulation too easy - they reached above average score in the simulation but not the highest. As we found in their questionnaires, these students missed all the theory the FactOrEasy simulation provided. Their answers were significantly reckless, frivolous, with no theory background. On the other end there were also the students who were not able to reach even the average score in the FOE simulation. Therefore, we divided these students to two categories. The students from the first category did achieve really low score during the simulation. During interviews they seemed to be uninterested. According to the interviewees the reason for lack of interest was in the excessive economic focus of the course in which the simulation was used. Less motivated students from the second group did achieve quite high score in the simulation, e.g. compare students number 24 and 28 in Figure 2 and Figure 3. The reason of their disinterest in more frequent playing the simulation was the fact the students were able to achieve high score with the first attempt, with the first tested strategy in the simulation they chose. Therefore, they were not willing to try another approach to really mine the game's opportunities for their learning. In these cases, we identified too much self-comfort in students' behavior and early feeling of satisfaction, which took them away from further studying the theoretical context of situations in the FactOrEasy simulation.

Discussion

Wilson and Gerber (2008) found out the students - members of Generation Y - have shorter attention spans, desire interaction and stimulation, and they thrive in structured environments. Tanner et al. (2012) add that these students have lived their entire lives with technology allowing the expansion of computer, video, and mobile games, therefore involvement in gaming is not a characteristic of Generation Y, but the expectation of what is required to capture their attention and interest. These conclusions (Wilson and Gerber, 2008, Tanner et al., 2012) fully support our findings with the majority of students (90.1 %) really attracted by the FactOrEasy. Our findings are also consistent with conclusions of Lainema and Lainema (2007) whose research showed students' perception of business games as: engaging, useful, and as effective learning tool.

In our pilot study we obtain contradictory results within time spent on simulation and achieved game results. According to our results from Spearman's test with 44 students in pilot study we cannot say the students who spent the most time playing the simulation did achieve the highest scores. But from the results of interviews we can say the observed variables (time spent on simulation, achieved score) were too general. The specified variables are not able to explain how much each student really improved his or her own knowledge, skills, abilities, or competencies during playing/using the simulation. According to the results of our observations from interviews we can agree with Gosen and Washbush (2004), who say that the majority of studies dealing with the students´ performance in simulations assumed that the students with the best results are also learning the most.

As we found the specified variables too general for evaluating or measuring the change in the students' progress of achieving the knowledge from the FOE simulation, we propose to use the Alic's (1997) categorization of knowledge for next study: declarative knowledge (I can name it) and procedural knowledge (I can use it.). We propose to add also category of no knowledge (I do not know anything about that.)

During interviews with students we recognized significant change in their approach to their own learning. The most of the students expressed the change in an effort to educate themselves as they had the chance to "*touch the "real" situation*" as they often noted, also as "*having good times with the simulation*", or "*to enjoy the competition between comrades*". These findings correspond with the outcomes of Winberg and Hedman (2008) who studied effect of instruction format to the Attitudes of students Toward Learning (ATL) in a computer simulation. They (Winberg and Hedman, 2008) found the dependence between guiding instructions and high conceptual change in levels of "Challenge," "Enjoyment," and "Concentration" but low sense of control during simulation. The students in Winberg and Hedman (2008) experiment with the open instructions and also in our pilot study perceived lower learning score. According to results from our interviews we see this output as a result of an excessive enjoyment and too open instructions with which students were not willing to identify the areas of theory provided by the FactOrEasy simulation.

Another benefit of the FactOrEasy found during the interviews was that students can experience the situations they would fear in the real life. Within the study group the students, for example, did not want to use the external financial sources (loan). During the interviews we found out the cause lies in the student's fear coming out from personal life, where they fear bank loans. Students make no distinction between the behavior in simulation and in real life, they transfer the way how they act from real life to the simulations and vice versa.

Conclusion

As mentioned in the introduction craft in management is formed by learning from experience, builds on those tangible experiences, and makes the connections (Mintzberg, 2013). According to our results of monitored business simulation (FactOrEasy) evokes students experience, make the connections by the acquisition of implicit knowledge, through which students get a competitive advantage in the development of management skills in a different way. Pre-knowledge on declarative level - "I can name it" (Alic, 1997) of theory does not help students in the game. Students have to think first, develop possible hypothesis, find the specific solution of the problem he/she faces, and then look up the theory context to broaden his/her view of the situation. And then comes the understanding of the knowledge on the procedural level - "I can use it" (Alic, 1997). Unfortunately, the identification, support, or quantification of this benefit is possible only after further research.

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