FactOrEasy© GAME

[1]✉Josef Pavlicek, [2]Vaclav Svec, [3]Petra Pavlickova, [4]Jana Kreckova

[1]Department of Information Engineering, Faculty of Economics and Management, Czech University of Life Sciences Prague, Kamycka 959, Prague, 165 00, Czech Republic, pavlicek@pef.czu.cz

[2]Department of Management, Faculty of Economics and Management, Czech University of Life Sciences Prague, Czech Republic

[3]Department of Systems Engineering, Faculty of Economics and Management, Czech University of Life Sciences Prague, Czech Republic

[4]Department of Systems Engineering, Faculty of Economics and Management, Czech University of Life Sciences Prague, Czech Republic

Abstract

This article describes the "FactOrEasy" management game, which was developed as a tool to help provide practical experience for students following the Strategic Management module at the Czech University of Life Sciences, Prague. The game was developed at the Czech University of Life Sciences as a collaboration between the Department of Information Engineering, and the Department of Management. The tool follows the established decision making steps, tries to support them and helps the player to gain valid and specific experience. This experience is taken as a transformation of theoretical knowledge into practical behaviour. This behaviour is partially intuitive and partially gained from their studies. Intuitive behaviour can be understand as tacit knowledge, and this tool helps highlight tacit knowledge and combine it with practical experiences. This process of transformation of knowledge (from theoretical to practical) is crucial to the educational process. This process is provided by FactOrEasy.

Keywords

Artificial intelligence, Business game, game strategy, FactOrEasy game, tacit knowledge

Introduction

This article describes the design of the "FactOrEasy" managerial game, developed for classes of Strategic Management students. We describe the students' behaviour whilst playing the game, and we show how students can be influenced by computer interaction. The results presented below are gained from our primary research, and have not been presented before.

Last year, a team of authors (Pavlicek, Svec and Ticha, 2015) presented at the ERIE conference, a paper discussing the possibilities of using managerial games for teaching strategic management. We discussed about students' ability to solve business tasks, make suitable decisions, and to be able to make strategic decisions. We said that the students' behaviour is primarily based on their tacit knowledge. This knowledge can be obtained during the course of Strategic management (Svec, Pavlicek, and Ticha, 2015). According to the Polanyi (1959), who divided knowledge into two categories: explicit knowledge (written and formalised), and tacit knowledge (the action related and unformulated), we can understand the educational process provided by managerial games as some transformation of explicit student knowledge into real (tacit) knowledge.

In comparison with Polanyi (1959), Jarosova (2005) defines two main approaches that she calls experiential and academic (based on the theoretical knowledge). Finally we can understand both these approaches as a process of transformation from "soft skills" (not practically verified, called academic by Jarosova) into practical verified "hard skills" (tacit or experimental by Jarosova).

This fact is significantly verified during the study of students play. A student who (in this work we will call him/her the "player") plays the game, has to make some strategic decisions. These decisions depend on the student's gained knowledge (gained during study at the university) and practical experiences (Pavlicek et al., 2015). This practical verified knowledge we can understand as an experience. This process was described by Kolb (1984:41) as a learning definition "the process whereby knowledge is created through the transformation of experience". To provide support to "gain" the best experiences is the goal of our team. As a direct result of the 2015 game results (Pavlicek et al. 2015, Svec, et al., 2015), we significantly improved the designed electronic managerial game powered by artificial intelligence (AI). The solved questions that were presented at the ERIE conference were: (Pavlicek et al., 2015):

1. How does a (human) player react when a relatively simple market context is presented for decision-making?
2. What does the player's approach look like, during the game strategy settings?
3. How many rounds does a player need to optimise his/her strategy?
4. In which round does the player begin to win safely over all the artificial intelligence players?

The answers to these brought significant new data, which we have used to improve the most recent version of our game. The results from our research are presented below.

The aim of this paper is to describe the changes to the FactOrEasy managerial game, based on the results of 312 students' tests, according to the 4 research questions (above) presented at the previous ERIE conference.

Materials and Methods

The managerial game has to support suitable player's operations. Because the computer powered managerial game is de facto an electronic information system, and each electronic information system needs to bring together Humans, for working procedures; Data, as a communication bridge; and Software and Hardware. Our team had to make a decision, how the system should be built. According to our research presented in the previous ERIE conference (Pavlicek et al., 2015) we designed the game as:

1. Humans: They are the de facto game players; they are students of the strategic management module, plus a few volunteers from students and researchers.
2. Working procedures: These are supported by using an internet browser (each User Interface (UI) element is used as common known element). Although the game was originally based on UI designed at the Java EE, we finally decided to move it into a pure Web based form (based on the Vaadin technology). The user no longer has to work with commands such as "java –jar FactoriesClient.jar" etc. and everything is now running from the Factoreasy.cz domain. It is now easier for the users.
3. Data: are used for communication between the user and the game (and partially between the other players who are simulated as Artificial intelligence robots). Thanks to visualized data (as the charts at the statistic section, or at the competitors' window) the player can make strategic decisions. The player can follow the strategy

of other players, primarily at the game statistic dashboard. This has been developed to graphically visualize the game situation and historical trends.

4. Software: This has mainly been developed at the University, in the Department of Information Engineering and Department of Management. The GlassFish 4.0 application server and Vaadin 7.5 framework were mainly used for GUI (Graphical User Interface) rendering.
5. Hardware: This is located on the university servers in a dedicated server space.

All components of the game (as an information system described above) are fully covered. We will now describe, how the questions above were addressed. Please note, the results from the research are already described in the paper: "ARTIFICAL INTELLIGENCE IN EDUCATION: CAN THE AI TEACH THEM?" (Pavlicek et al.). In this presentation, we will focus only on the new results (we will not recapitulate the known facts).

Solution to issue 1:

As is known, most of the players play defensively at the start. Pavlicek et al (2015) found this continued until about the 5th round. We decided to make the game more difficult. If the market is relatively stable, the player can start to play defensively and wait for the decisions of the others. Theoretically, this improves the play strategy, however in practice this is not realistic. In the real world, the market is dynamically changing. Because of this, the players in the real market try to be dominant. This domination can be achieved via a big money buffer or via mechanism, which helps to earn the money at the end of round. We decided to cover the first need via the possibility of obtaining a loan (and thus make a big money buffer, to be able to buy all the necessary material or sell goods under the price). The second solution is the possibility of buying another factory. If the player has more factories, he/she is able to produce more goods. If, in the market, there is a bigger demand for the product offered, this player has a business advantage. The ability to fix the game strategy is harder now. Players were bankrupted 2-3 times before they fixed the strategy (Table 1).

Solution to issue 2:

If the market is stable (it is not possible to take a loan and buy more factories) the players optimize the strategy at 4-5 round (Pavlicek et al., 2015). Thus, the situation in the market became more dynamic (Table 1). Primarily, it is not easy to bankrupt the opponent player. The player can save his/her round by taking out a loan. Taking a loan helps to make the strategy more aggressive for the other players. This strategy needs money, but thanks to the loan, there is enough money in the game. An aggressive player must be careful, however; the loan interest rate is 15% and unpaid interest decreases profit. This needs to be taken into account.

Solution to issue 3:

During the first version of the game the players were able to fix their strategy between the 3rd and 4th rounds. Now it is not possible. The market is still changing. Now "the accident" plays a more significant role. If some player is bankrupted, the situation on the market changes significantly. There is still a similar demand for goods (at the interval 4-9) (Pavlicek et al., 2015), but thanks to gaining more factories, the players can cover the demanded amount (Table 1). The demanded amount is done stochastically, so here is the opportunity to improve the game to make it more realistic. It can be controlled according to the final market situation. If quantity of material demanded is decreasing (thanks to the bankruptcy of one or more players), the quantity of goods demanded can also be partially decreasing. De facto, in the market is less money amount and this situation can model economic stagnation (crisis).

Solution to issue 4:
We decided to support this issue via a statistical dashboard and the competitor's window. At the time of writing (May 2016) it is not possible to directly answer the question 4, because we would like to study the player's behaviour more deeply (using more data, which we don't currently have). The data presented in Table 1 is, say, at the 6th round. However, finding an accurate answer to this question is not the goal of this paper. What we want to do is to discover how best we can support the user so that he makes a better decision. To fix the strategy depends on the amount of qualitative "information" available to the player. To assist with this we have given to the player two panels to give him/her what probably the player needs.

Results and Discussion

The results presented in this section are based on data from two study subjects at Faculty of Economic and Management (FEM) Czech University of Life Sciences (CULS) Prague and random volunteers (Table 1).

Number of players	Subject (anonymized)	Avg. count of games to fix the business results	Avg. count of bankrupt at the game to fix the business results	Avg. count of game laps to significantly gain market superiority	Total loans count for all players / Avg. on player	Avg. number of requested factories
52	Volunteers	6	2	6	33/64%	0.5
63	Subject 1	12	3	7	42/67%	1.3
231	Subject 2	9	3	6	170/74%	0.9

Table 1: Game results for the task: "Win till 12 game lap".

Note: These results contain the human decision making only. No account has been taken of the robots' game strategies.

The results from our research can be identified as follows:

1. It is necessary to add new functionalities into the game (as a result of solving the 1st, 2nd, and part of the 3rd questions). We decided to implement this decision in view of the test results presented at the previous ERIE (Pavlicek et al., 2015):
   - Fist solution is to allow loan request (more than 60% of players used loans).
   - Second solution is to permit the purchase of more factories (more than 50% of players from volunteers set, and more than 90 % of subject students chose to do this).
2. To provide support to the decision making (cover all functions), is necessary to improve the game design by providing:
   - List of materials available.
   - List of products available.
   - Competitors window.
   - Add a statistical dashboard into the game.

This decision was implemented according to the qualitative research, done with 15 participants from the volunteers set.

1. To follow the main game better, improvements have been made to the Decision making panel.

The point number 1 is covered now by two buttons placed in the Decision making panel.

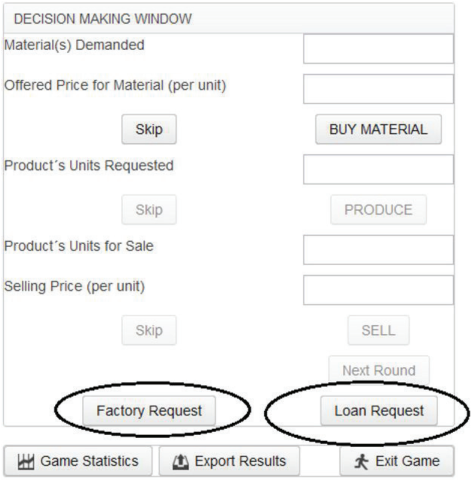

Figure 1: Factory and Loan request. Image was recorded at Factoreasy.cz (Pavlicek et al. 2016)

This functionality is placed into the bottom of the Decision making window for two important reasons:

1. These functionalities are important for the game strategy
2. These functionalities are important during the game round, if the player knows final cash in the account (he/she can save or increase the business via a Loan or buying a new factory)

If we follow the game step flow, we can construct the "Decision making" panel in a logical sequence (Figure 1). The steps follow:

1. Buy material (if you need it) or skip this phase
2. Produce product (if you decide to) or skip this phase
3. Sell product or skip this phase
4. Play next round

Alternative flow (Figure 1):

1. Make Loan or Factory request
2. Visit game statistic (player account trend etc.)

To support the Decision making we decided to design a "Competitors window".

In Figure 2 it can be seen that, the main information about the players is presented. Please note, this is not realistic. In the market we do not usually know the costs in the account of our opponent. Material or product in stock is hidden. We can predict it statistically or by artificial intelligence – this technology is implement in this game for robots according to the players' decision making. The same applies to Loan amount. What is known is the number of factories, i.e.: production capacity during game round. This window was provided, however, to help the students make better decisions – to help them to gain tacit knowledge.

COMPETITORS WINDOW	Human	Robot 1	Robot 2	Robot 3
Cash	5800	5800	5800	5800
Material(s) in Stock	4	4	4	4
Product(s) in Stock	2	2	2	2
Material(s) Demanded	0	0	0	0
Offered Price for Material (per unit)	0	0	0	0
Purchased Material(s) (units)	0	0	0	0
Product(s) Offered (units)	0	0	0	0
Sold Product(s) (units)	0	0	0	0
Price per one Product	0	0	0	0
Sales	0	0	0	0
Loan	0	0	0	0
Number of Factories	2	2	2	2

Figure 2: Competitors window. Image was recorded at Factoreasy.cz (Pavlicek et al. 2016)

Discussion

According to Becker (2011), who describes the impact of business games as a tool of experiential learning, we can follow his conclusion and use the tool for experimental learning. If we need, we can dynamically update the teaching tool. Thanks to the game architecture (Pavlicek et al. 2015, Svec, et al., 2015, Pavlicek et al., 2014) which is based on artificial intelligence, we can update the opposite player behaviour (Robots 1-3) in Figure 2, very quickly. As we suggested in the publication (Svec et al., 2015): "By adapting the methods of artificial intelligence, the solution can evolve together with the players and thus better support their professional development". A similar conclusion can be seen in Wawer et al (2010), and Wolfe (2000). The dynamic character of Factoreasy game, makes it difficult to predict on the one hand, but the decision making is as easy as is possible (for example Figure 2). On the other hand it helps the students to gain the experiential (or practical) knowledge as was suggested for example at Jarosova (2005).

Conclusions

Our team has tried to describe, how we can improve the mechanisms of gaining experiential knowledge by the students. The study presented above, describes the software Factoreasy etc. and is based on 3 years of research work. The theoretic base is gained primarily from sources such as Jarosova (2005), Kolb (1984), Wawer et al (2010), Wolfe (2000) and our results (Pavlicek et al. 2015, Svec, et al., 2015, Pavlicek et al., 2014). This business game is based on artificial intelligence and has proved to be very useful for the education of students of the strategic management courses. But not only for them. Thanks to the support of the study of the subject "Human computer interaction" lead by Pavlicek at the Czech University of Life Sciences, department of Software Engineering, we can practically test this game from the point of view of the usability. How usability does influences the managerial skills, you may be asked? Because the following game steps, which simulate activities in a real business (material buy decision, produce good, sell good, build factory, take loan, study game result of opponents etc.) deeply influence the players' decision (Pavlicek et al. 2015, Svec, et al., 2015). As discussed above, the game design can help (or hide) the mandatory information needs for making the decision. Our software tries to follow common steps and tries to be as helpful as possible for the students. But we can change it. We can develop new decision making issues as Wolfe (2000). These decisions can be (as educational plugin – "add-on" plugged into the game) offered as a played service. For example the game statistic is now for free, but in real business you have to pay for that etc. the game will be improved and the results will be presented.

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