TEACHING TACIT KNOWLEDGE: CAN ARTIFICIAL INTELIGENCE HELP?

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Highlights

- *To find out the level of knowledge students are able to use in the simulated situation*
- *To propose teaching tool for specific tacit knowledge training*
- *To specify basic conditions under which proposed tool can be functional*

Abstract

In the paper we first examine students´ ability to use tacit knowledge. We conducted the experiment to test whether the students are able to transfer and use tacit knowledge they obtained in the basic course of Strategic management. As tacit knowledge is difficult to transfer to another person we used course design with several experiential techniques to increase the students´ abilities in the field of Strategic management. For the evaluation experiment we chose to play a board game "Power Grid", where we tested whether the students were able to use knowledge they had been taught in the basic course. As the result we found out low students´ ability to use tacit knowledge. Despite the fact that in the basic course where they obtained the knowledge we used experiential techniques. Used techniques force students to acquire a skill and therefore, they also acquire corresponding understanding that defies articulation i.e. tacit knowledge. According to the result of the experiment, we propose the business game with the artificial intelligence as a teaching tool which can be further discussed as a tool for teaching specific tacit knowledge in the paper.

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Introduction

Approaches to managers´ education

According to Jarosova (2005) there are different approaches to educate future managers which can be divided into two main streams: an academic and an experiential approach. Academic approaches to learning understand learning as a process of learning highly formalized objective scientific knowledge and capability development process of critical review and skills to explain knowledge in practice view (Jarosova, 2005). Experiential approach is represented by the experiential learning. Experiential learning according to Kolb (1984) is learning process whereby knowledge is created through the transformation of experience. Kolb´s learning cycle (Kolb, 1984) consists of four stages of learners' progress (active experimentation, concrete experience, observation and reflection, generalisation and abstract conceptualisation). Among adult learning theorists is a general consensus that the experiences which adults have gained during their lives are important part of any learning activity they will join (Huddleston and Unwin, 1997). Hawtrey (2007: 144) sees the experiential learning as 'the incorporation of active, participatory learning opportunities in the course' which is sometimes also called situational learning.

To the discussion about management teaching Mintzberg (2004) adds that university professors overemphasize the science of management while ignoring its art. He contends that even graduated students have inflated views of their competence and ability to be successful. Mintzberg (2004) argues that many essential managerial skills can be learned only from personal experience and suggests a major change in management education which will allow students to gain more experience.

Experience is the knowledge of a subject or event gained through involvement in or exposure to it (Oxford English Dictionary, 1989). Linkage between experience and knowledge supports Kolb (1984:41) with his definition of learning as 'the process whereby knowledge is created through the transformation of experience'. When we speak about knowledge, we understand the personal level of knowledge. Then we see knowledge as what person knows as well as his/her skill and ability that would determine or help him/her make decisions and take action (Gao, Li, and Nakamori, 2003). Drucker (1989: 242) defines the knowledge as information that 'changes something or somebody either by becoming grounds for action, or by making an individual or an institution capable of different and more effective action'.

Polanyi (1959) divided human knowledge into two categories: explicit knowledge (written and formalized) and tacit knowledge (the action related and unformulated). Gao, Li and Nakamori (2003: 9) expand and explain the characteristics of knowledge in Polanyi´s point of view that 'there are two different dimensions in knowledge: one relates to the scientific, logical or objective dimension; another to the subjective dimension'. In the objective dimension the knowledge is like a "thing' or 'object' that can be articulated, captured and stored. The subjective dimension of the knowledge, however, can be fully understood only by person with enough capacities. (Gao, Li, and Nakamori, 2003) This view of tacit knowledge (as subjective dimension of the knowledge) uses Mintzberg (2004) in his statement that university professors overemphasize the science of management while ignoring its art. And Jarosova (2005) adds that for students to know is fundamental but more difficult is to be able to apply knowledge in real managerial situations.

The aim of the paper is to find out the level of explicit and tacit knowledge (taught in the previous course of Strategic Management) which the students are able to use during the model situation (board game playing) and propose the teaching tool which can ensure the transfer of specific tacit knowledge for the usage in the course of Strategic management. The paper extends and elaborates the findings of Svec, Pavlicek and Ticha (2014) and Pavlicek, Svec and Ticha (2014).

Materials and Methods

In the paper we first examine students´ ability to use tacit knowledge. We conducted the experiment to test whether the students are able to transfer and use tacit knowledge they obtained in the basic course of Strategic management they completed in the last semester. As tacit knowledge is difficult to transfer to another person we used course design with several experiential techniques to increase the students´ abilities in the field of Strategic management. Therefore students are taught within the experiential learning approach with usage of case studies, team work, experiential exercises, active students' presentations and role playing, and active discussions to level up the experience between students.

In engineering and technological fields it is usual to conduct experiments for students so they have opportunity to test and employ the theories and concepts they have learned (Sun, 1998). However, in management areas as in the field of social science such experiments are if not impossible thus difficult to carry out. Keeping this fact in minds we chose for the evaluation experiment to play a board game "Power Grid", which met the criteria of complex situation in managing the company on strategic level. With this tool we tested whether the students were able to use knowledge they had been taught in the basic course.

The game was played with 25 students, 17 women and 8 men, who studied the course Applied Strategic Management in their final year in masters´ study. This course follows the course of Strategic Management, where students learn strategic management principles, rules, and techniques with help of real life case studies. Therefore all students playing the game were supposed to have skills coming from the previous course of Strategic Management. Students passed the examination in Strategic Management course with different results. The structure of results is: (i) excellent 4 % of students, (ii) very good 48 % of students, (iii) good 36 %, and (iv) 12 % of students did fail to pass exam. We can see the official study results as structure of knowledge level within the observed group of students. We also measure students´ managerial competencies during the course of Strategic Management in six competency sets (Švec, Tichá and Kadeřábková, 2011): (i) Planning and organising (competencies of planning, organizational skills, and delegation), (ii) Impart information (competencies of transfer of information, presentation of opinions, written communication), (iii) In-person competencies (learning by doing, creativity, perspective, self-knowledge), (iv) Decision making (problem solving, quality decision making, early decision, cope with uncertainties, critical thinking), (v) professional competencies (business issues knowledge, specific field competencies), (vi) Team building competencies (co-creation of an effective team, building relationships with colleagues, dispute settlement, focus on results, issue instructions). Competencies affected in Strategic Management courses taught at FEM CULS Prague were identified and elaborated on basis of competency models of Lombardo and Eichinger (2009), and Stevens and Campion (1994). The structure of competencies of students involved in the experiment is seen in the Fig. 1.

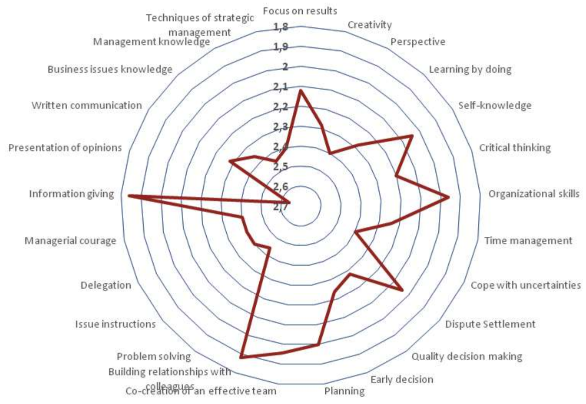


Fig. 1: Competencies structure of students involved in the course of Strategic Management

Game-play

Students were given rules of the game in advance for a week to precisely identify the driving forces, principles, barriers of the game, and to set up goals and their plan. With game rules came the task to study it, so students were not explicitly instructed to work more with the principles of the game as they were tested whether they will prepare themselves more or not and whether they exploit the experience and knowledge gained in previous course of Strategic Management.

In the workshop where experiment took place, before the game playing itself started, the students were given task to write down their main goal and strategy for the game. During the game playing, students were making the notes about their decision making process and its results. After the game playing, they were asked to make an evaluation of each decision they had made. Students were also observed during the game playing.

The Power Grid Game´s Phases

The Power Grid game is played over several rounds. Each round of the game has five phases (Fig. 2).

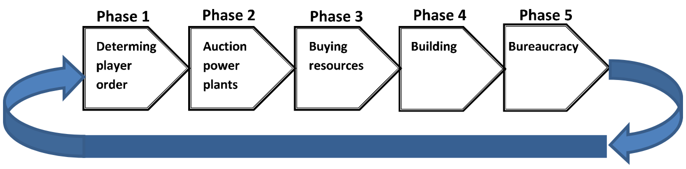


Fig. 2: Power Grid Game´s Phases

During the phase 1 players´ order is set up. Starting player is always the player with the most cities in his network. Determination of the order of remaining players follows the same rule. Strategic point with the players´ order is that if you are the first one, you can pick a power plant from auction, but you buy the resources for your plants as the last one (and vice versa). In the phase 2 each player has the opportunity to buy at most one power plant according to his/her needs, which means to have plants with enough capacity to power all the cities in his/her network and to decide what kind of resource will the player use (the same as desired power plant needs). In the auction the player can do just two decisions: to pass or to choose the power plant for auction. In the phase 3 players buy resources for their power plants from the resource market. The strategic point here is reverse: player with the smallest number of cities in the net starts. The phase 4 is building and as in the previous phase the last player starts to add cities to his/her network on the map which is essential to win the game. The phase 5 is called bureaucracy and players in this phase – according to detailed rules - earn money, re-supply the resource market, remove and replace power plants from the auction. This phase brings some strategic points for players: (i) Payment – according to number of cities connected to their network players earn amounts of cash known in advance (seen as table in rules). (ii) Re-supplying the resource market – players re-supply the resources used in their power plants and give them back to the game in the amounts according to the game rules, the amounts are also known in advance. (iii) Updating the power plant auction, where each player can see the new offer of power plants before the next run starts. After phase 5 new round of the game begins with the phase 1 again. The whole game ends immediately after phase 4 when at least one player has at least 17 cities connected and fully supplied in his/her network.

The winner is the player who can supply electricity to the most cities in his network with the power plants and resources he/she has. Only if there is a tie, the player with the most remaining money wins.

Used approaches

To find out what lessons from playing board games can be brought back to teaching of Strategic Management course we used combination of above mentioned competencies approach (Lombardo and Eichinger, 2009) and general views on strategy (Mintzberg, 1987).

Strategy and competency of planning

According to Mintzberg (1987) the word strategy has been used implicitly in different ways even if it has traditionally been defined in only one. Explicit recognition of multiple definitions helps people to manoeuvre through this difficult field. Mintzberg (1987) provides five definitions of strategy: Plan, Ploy, Pattern, Position, and Perspective. Strategy as a plan is some sort of consciously intended course of action, a guideline (or set of guidelines) to deal with a situation. By this definition strategies have two essential characteristics: they are made in advance of the actions to which they apply, and they are developed consciously and purposefully. Strategy as a Ploy is a specific manoeuvre intended to outwit an opponent or competitor. Pattern is seen as stream of actions. As strategy is consistency in behaviour, whether or not intended. The definitions of strategy as plan and pattern can be quite independent of one another: plan may go unrealised, while patterns may appear without preconception. Plans are intended strategy, whereas patterns are realised strategy. From this we can distinguish deliberate strategies, where intentions that existed previously were realised, and emergent strategies where patterns developer in the absence of intentions, or despite them. Strategy as Position represents locating an organisation in an environment. Strategy is the mediating force between organisation and context (between internal and external environment). Perspective strategy is not just a chosen position, but the perspective shared by members of an organisation, common thinking or behaviour of employees in specific organisation.

Research questions

In this article we want to find out the level of knowledge which students learned and are able to demonstrate in a "real" situation. We take advantage of continuing teaching the same group of students in two consecutive semesters. The main research question is whether the students are able to use knowledge taught in the previous course of Strategic Management in current course during the model situation substituting the real situation.

Partial research questions follow:

1. Are students able to propose for the "real" managerial situation the goals in SMART format?
2. Are students able to propose goals which are relevant to the context of the managerial situation they face?
3. Are students able to propose the strategy corresponding with the set goals in the managerial situation they face?
4. What kind of strategy are students able to propose and follow in the "real" situation?
5. Are students able to identify strategic failures correctly?
6. Are there any conditions under which we can assure the transfer of previous characteristics of the tacit knowledge on students during Strategic management course?
7. Can we propose any tool we can use for such intention?

For presenting teaching tool proposals we use the flow chart technique, where we represent solution model to a given situation using usual symbols.

Results and Discussion

Experiment´s results

Based on proposed researched questions we followed six basic criterions: students´ knowledge of rules, the ability to invoke the principle of SMART goals setting, the ability to propose goals corresponding to the context of the situation students face, the ability to derive strategy from the goals, type of strategy students used in game, and type of any poor decision they did in the game.

The level of rules knowledge can be deduced from the number of rounds played in the game. As students had the same time slot for the game (90 minutes) and they had to arrange the game in the beginning, the number of rounds played is showing who mastered the game rules and who did not (see graph Rules Knowledge in Fig. 3). Students who mastered the rules (32 %) should be in advantage according to the others who had not paid attention to conditions in which the competition took the place (68 %).

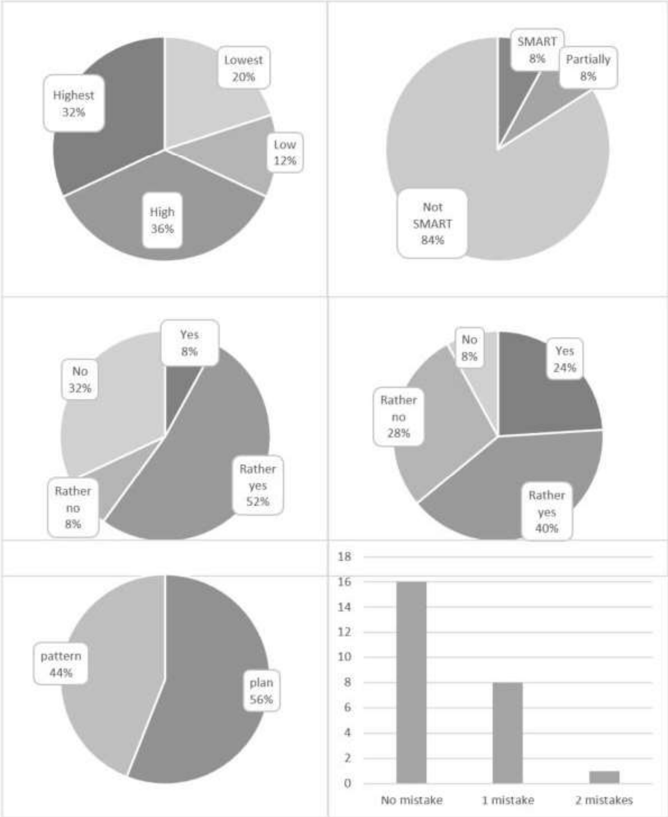


Fig. 3: Students results in observed categories

In the previous course of Strategic Management students were taught to use SMART approach for proposing any strategic goal, which means to set goals: specific, measurable, acceptable, realistic, and reachable in time. The game rules offer such a possibility, even more, the rules itself are giving students the exact wording of goals in SMART form. Despite that fact only 8 % of students were able to fully follow the SMART approach of goals setting, 8 % of students were partially successful with setting the SMART goals, and 84 % of students were just not able to formulate SMART goals (or just to copy them out from the game rules, where the goal is explicitly expressed) – see SMART goals setting in Fig. 3. Setting the goals is not only about being SMART, but goals should correspond with the context in which they are set. In our case this context is represented by game rules and the main goal of the game was to ' … supply electricity to the most cities in his network with the power plants and resources he has ' (Friese, 2004: 7). With this criterion we examined whether the set goals are appropriate and achievable in the game. As it is seen in Fig. 3 – Goals correspond to game - fully corresponding goals had only 8 % of students, rather corresponding goals had 52 % students, and 40 % of students were not able to formulate appropriate goals. In proposing the strategy the setting of goals is followed by strategy formulation. These two steps are tightly linked and proposing strategy have to be based on set goals. Therefore we examined whether students strategies correspond to their goals they set before. In 64 % of cases the strategies were based on goals students set before, although only 24 % of cases did match perfectly – see Fig. 3 – Goals correspond to strategy. The last criterion we examined - strategy setting category - was type of strategy students used. We used two of Mintzbergs´ five views on strategy (Mintzberg, Ahlstrand, and Lampel, 1998) – plan and pattern, as they fit best to our intention and conditions. Mintzberg et al. (1998) sees plans as intended strategy, whereas patterns sees as realised strategy. From this we can distinguish deliberate strategies, where intentions that existed previously were realised, and emergent strategies where patterns developer in the absence of intentions, or despite them. Students did not have to improvise with the strategy in 56 % of cases – see the Fig. 3 – Type of strategy – the rest of students (44 %) did not have clear strategy or was not able to perform strategy well and had to adapt to the situation they faced.

During the game playing students noticed their decisions into the forms and after the end of game playing students made after-action-evaluation. The strategic decisions in the game are following: (i) choosing a city to start with, (ii) choosing the power plant to or not to, (iii) choosing to or not to start ploy within the auction system. According to the after-action-evaluations there were 16 students who made no strategic mistake during gameplay, 8 students made 1 strategic mistake and 1 student made 2 strategic mistakes. Results can be seen in Fig. 3 – Bad decisions in gameplay.

Experiment´s discussion

Students did fully recall the need of SMART goals only in 8 % of examined cases and only 8 % of students were able to propose the goals fully corresponding to the managerial situation they faced. If students set any goals 24 % of them were able to propose a corresponding strategy. These results are quite negative because of low rates. On the other hand 56 % of students proposed strategy with intended purpose (plan) and 64 % of them did not take a wrong strategic decision during the game.

These results show the dominant inability to use properly the competency of planning, which according to Lombardo and Eichinger (2009) means to accurately scope out the length and difficulty of tasks and projects; to set objectives and goals; to develop schedule; anticipate and adjust for problems and roadblocks; measure performance against goals; and evaluate results. On the other hand students showed the ability to foresee the situation, in major to take a good decision when needed.

As our intention was to find out what can be taken from playing the board game with students to the strategic management teaching, the statistical dependence of six variables on students grades from Strategic management course were calculated. The results we present in Table 1.

Testing dependence between:	Pearson´s chi square	P value	α
Level of rules knowledge vs. Grade	0.0188537	0.89079	0.05
SMART goals setting vs. Grade	na	na	na
Goals correspond with the main goal of the game vs. Grade	0.0267094	0.87018	0.05
Strategy correspond to the goals vs. Grade	0.0712251	0.78941	0.05
Type of strategy vs. Grade	0.0509907	0.82135	0.05
Mistakes evaluation vs. Grade	0.3216257	0.57063	0.05

Tab. 1: Dependence between monitored variables and grades

According to statistical test in Table 1 we found out no variable is dependent on the grades. Dependency between setting the SMART goals and students´ grades from previous Strategic management course could not be calculated as they did not meet the statistics´ conditions. Above mentioned results mean that the grades students gained in previous course did not have any influence on their behaving during the game (in each case is $P > \alpha$). As the grades from previous course represent the recognized level of knowledge which students achieved or demonstrated during the exam (written and oral) and the game we can see as a model of real strategic situation, therefore we can say students do not use their knowledge of strategic management in situation(s) or in the moment(s) where/when this knowledge should be used.

This result brings further analytical question: "Why do not students use the knowledge they probably have when facing the "real" managerial situation?" The most likely answer is: "They do not possess adequate knowledge. Or enough capacities as mentioned by Gao, Li, and Nakamori, (2003)." The probably explanation is that we predominantly teach them explicit knowledge and we do not focus enough to tacit knowledge despite the fact we use variety of experiential learning tools during the course. This finding is in accordance with Kolb´s statement that "simple perception of experience alone is not sufficient for learning". (Kolb, 1984: 42)

From the view of above presented results we agree with Mintzberg (2004) who said that many essential managerial skills can be learned only from personal experience and who also suggested a major change in management education which would allow students to gain more experience. Such a major change might be a change in portfolio of teaching tools which can provide more personal experience for students and thus can increase the tacit knowledge level. Therefore here comes another important question: "How to ensure the transfer of specific tacit knowledge on students during the Strategic management course?"

Teaching tool´s proposal

The ability to adapt to the business environment, to choose and follow an appropriate strategy, to critically assess the market situation, to minimize loss or maximize profit - every graduate of management courses should possess the ability to handle. To ensure the transfer of specific tacit knowledge we reflect the experience we had with the above described experiment. As the board business game can be used as tool for the knowledge transfer evaluation, we came up with the idea to use it, in different form, as a teaching tool of specific tacit knowledge. There is a strong support in the literature why to use the games for management teaching. For example Wawer et al (2010) see the individual games as scenarios describing possible market situations, which are very likely to be encountered in the real world. Business games offer an entertaining way to hone these crucial skills in a virtual environment, thus without impacts on the real world. It can be assumed the more realistic the game conditions are, the more realistic the decision making procedure must be applied. And there is also an agreement upon the time on the usefulness of games in teaching management. For example Schrieber (1958) sees the teaching purposes of games used in management teaching as to give the experience in decision-making, to develop a universal method of analytical thinking, to practice interactions between students, and to see the connections, links between issues (to broaden the view to the issue). And from more recent times 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.

Therefore we decided to use the board-game "Power plants" as case study for the proposal of teaching tool enabling the tacit knowledge training.

Conditions for successful tacit knowledge training

We found three basic conditions which must be met for successful tacit knowledge training:

1. Specificity of trained tacit knowledge.
2. Repeatability/availability of the situation in which training runs.
3. Changeability of the training situation´s conditions.

Specificity of trained tacit knowledge

The tacit knowledge we see as non-linguistic non-numerical form of knowledge that is highly personal and context specific and deeply rooted in individual experiences, ideas, values, and emotions (Gourlay, 2002). Due to these characteristics of tacit knowledge we have to provide that each student will practice precisely defined process to learn required knowledge. The characteristic "specifity of trained tacit knowledge" is fully compatible with statement of Nonaka and Takeuchi (1995: 69), who say that tacit knowledge 'can be also acquired through "internalization" involving the use of explicit knowledge in the form of documents and similar media, a method they claimed facilitates changing mental models '.

In the case of used board-game „Power plants", we found following examples of processes which can be precisely defined and therefore are suitable for tacit knowledge learning:

1. Process of the proposition and usage of goals in SMART format.
2. Process of the setting goals relevant to the context of the situation.
3. Process of the proposition of strategy corresponding with the set goals in the situation.
4. Process of the strategy follows in the "real" situation.
5. Process of the strategic failures identification.

Repeatability/availability of the game

The characteristic of repeatability is based on premise of relationship between skill learning and repetition (Poldrack et al, 1999). The more repetitions the students will do the higher probability of knowledge acquisition they have. Along with repeatability comes the availability. To ensure the students will be allowed to repeat the training situation, the training situation has to be widely accessible.

In our case study of the "Power plants" we decided for the online form of the game with the artificial inteligence to ensure the repeatability and availability of the training situation. Online form of the game will ensure the accessibility and artificial intelligence will ensure the possibility to repeat the situation any time without the supervision of any administrator or even teacher.

Therefore we programmed the server which assigns each player a unique identifier and generates a game board setting. The game board is set up at the beginning of each game and remains unchanged until the end of the on-going game epoch. The server also ensures the basic game rules and settings, including:

- Amount and distribution of resources.
- Generation of power stations and random set up of their properties:
- The power plant generation follows the price rule. The "technologically worst" and hence cheapest are the power stations burning the fossil fuels.
- Power plants operating on two different commodities (excluding wind) are always available for purchase.
- The wind power stations require no additional resources for their operation. This type or power plants cannot store resources.

- Game plan set up, and placing a player at a random location on the game board.
- Dynamic game board refreshing.

The random generation of the game board and player's starting location can naturally put a certain player into disadvantageous starting position. This is also desirable from the educational point of view, because in such situation a different set of strategies must be applied. After creating the game world, the solution consequently prompts individual players to make their turns. It ensures the game is played according to the rules, manages the consumption of resources, their availability and prices on the market. It also updates the list of available power stations, and governs the auctions.

Without seeing the actual game adversary, we cannot perceive the facial expressions of our opponents. This naturally highly reduces the space for bluffing, which is currently one of the key disadvantages of such computer game. Our research team considered scanning the facial expression of the individual players. This however goes against the idea of replacing the game adversary with the artificial intelligence. Naturally up to the point when a computer would be capable of efficiently imitating human mimics. This possibility is however on the theoretical level only.

The decision each player makes must be stored in the form of a vector, also called the vector of solution, to the solution database. The winning strategy is consequently presented to the intelligent agent, which uses it for learning. Such empirically gathered data are valuable, because the player can retrospectively follow the strategy utilized in game, and find out the important breakthroughs in the game. This function is priceless from the educational point of view.

The artificial intelligence

The game intelligence is formed by the perceptron neural network with one hidden layer, which adapts itself based on the gathered learning sets from winning strategies. The intention is to make the network capable of replacing a human player, and become fully independent. From the technical point of view, this is a standard artificial intelligence task. Porter (1990), Mitchell et al (2000), Baker, Gedajlovic and Lubatkin (2005) and many other authors describe various strategies companies utilize. Based on these findings a classical optimization algorithm can be designed, but the complex nature of the game mechanisms makes such a solution inappropriate. The behaviour of artificial neural network is highly unpredictable, because of the ability to predict as well as make mistakes. The student should thus feel like playing against a human adversary.

Changeability of the game´s conditions

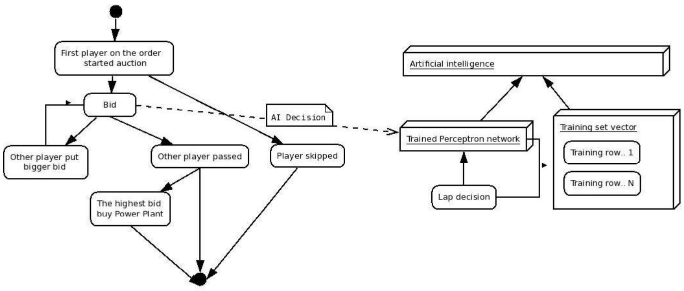
Unfortunately, the state space of conventional managerial games is usually quite limited. When keeping the game in a purely deterministic way, the players can soon get an understanding of the game principles and employ a collection of "hard coded" strategies that work only in the limited game domain. Therefore, the practical relationship with the real world scenarios would be negligible. To overcome this issue, the authors include various elements of chance in their games (rolling a dice, picking a random card, etc.). Certain games also incorporate the elements of bluffing and bidding. This makes the outcomes less predictable and the illusion of the game taking place in the real world much stronger.

The deterministic software utilizes for such tactics only pseudo-random algorithmic mechanisms. Human players are usually capable to learn how such functions work after several iterations. The intelligent system in comparison, imitates the behaviour of human beings, and acts in a nondeterministic way. Moreover, the game intelligence adjusts its settings based on the varying initializing conditions. It is thus close to impossible for a player to learn anything more than basic game rules. The system behaviour is much closer to the human being behaviour and the illusion of playing against a real player is more realistic.

Following Thompson (2010) we can propose that the game strategy is the key point of the whole solution. It evolves dynamically. The implemented strategies differ according to the resources and the power stations available. While in the classical game scenario, students get the understanding of the available types of power plants, and structure of the game world, the intelligent software solution flexibly generates these values. The "technological development" of the power plants can also have varying pace, be slower or faster, depending on the required situation. Therefore, students are forced to abandon trivial strategies, and modify their plan gradually. When the intelligent agent acts in a human-like way, it can choose the optimal strategy depending on the game round and development. In that case, students would have an ideal educational tool at hand. The aim is to create an artificial solution that will not be differentiable from a human being in a game play.

While in one epoch, it can be beneficial to save money and invest them after several game rounds; in other epochs such a strategy can lead to the loss of important power plants and inevitable defeat. From the game strategy point of view, it may be important to save money and focus on purchasing the power plants, which in turn enables the player to store plenty of resources and thus sell out the game market. This can force the opponents to restructure the portfolio of the power plants owned. Another possible strategy relies on early purchase of the short and thus cheap wiring between cities, without actually supplying them with energy. Such investment into infrastructure means a financial disadvantage for the game adversaries in the later stages of the game. By Becker (2011) we suppose the player can also rely on the 'eager finish', when the last turn means a complete consumption of resources, which would normally affect players' performance in further rounds, but is irrelevant because of the actual victory. This idea is relevant for "Power Plants" game too. Each of these strategies and their combinations lead to various scenarios of bidding and bluffing during the power plant purchasing stage. Such intentional manipulation of game adversaries introduces a real world situation for the students, where the decision making is dependent on the environment (Nemerow, 1996), where the available information influences our reasoning.

To affirm the benefits of artificial intelligence to changeability of trained situation let us see onto very specific part of the game - power plant auction (Fig. 4). This game lap is typical for "clever" human decision. Each player must calculate with a lot of unknown variables. "How will change my adversary's strategy, if I try to buy a better power plant?", "Start auction?", "How much money can I spend?", "Can I bluff and manipulate with them to by Power plant, which I really don't want?"



Thanks to this example it is visible that for realistic behaviour the system must use something more than the randomness as we see in Fig: 4.

Fig. 4: Artificial intelligence decision mechanism implemented for the auction

Figure 4 shows the Artificial intelligence decision mechanism implemented into the power plant auction. The system makes decision via internal strategy. This strategy should be de facto optimal solution for game.

We understand that possible ways of addressing these situations are countless, and each of them represents a feasible study variant, and thus a beneficial educational game.

Becker (2011) has described the impact of business games as a tool of experiential learning. In comparison with their approach, we do not rely on the predesigned set of game strategies, but instead propose a solution capable of learning from the recorded games. 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), Wolfe (2000) or Hawtrey (2007). This way the game keeps its dynamic character, which is difficult to predict, and players thus must gradually work on their strategy.

Conclusions

Due to our experiment we have found out that even in the course designed with the experiential learning techniques the successful training of tacit knowledge is not always provided. This result is consistent with Mintzberg´s (2004) or Jarosova´s (2005) findings that it is necessary to improve the ability of students to apply knowledge in the real managerial situations. Mintzberg (2004) predicts a major change in the management education but he does not specify it closer. We see this change as a change in the approach to teaching, as Huddleston and Unwin (1997) described, where the teacher becomes a manager of education and will use different teaching tools which can provide more personal experience for students and thus can increase the tacit knowledge level. Having the experience from conducted experiment we proposed a solution in the form of business game with the artificial intelligence and specified the conditions necessary for the proper functioning of the tool. The business games based on the artificial intelligence solution can be used in the education of students of management courses. The nondeterministic character of the game generated using such an agent can further approximate the real market situation, and thus support the players in acquiring the important managerial skills and insights into the practical work of managers.

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