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Using games in business education: an evaluation experiment comparing games to other selected methods in teaching sustainable development concepts

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Abstract

Simulation games are recognized as useful and effective learning tools in the business world, as they create conditions within micro-worlds where participants can experience results of different strategies, which they want to undertake. This use of strategies enables game participants to explore multi-party decision rules and analyse factors that stimulate or hinder the personally desired decision outcomes. Within this context the purpose of the paper is to present the outcomes of an experiment evaluating and comparing an application of a serious game with other teaching methods in the academic study of sustainable development concepts as a part of bachelor's and master's degree curriculum in business management.

The tested hypothesis is that experiencing a designed situation during a simulation game can provide students with deeper understanding of presented complex issues and concepts more effectively than a lecture, text analysis, or discussion. A controlled experiment was conducted in the sustainable development class to test the hypothesis. The benefits from applying the designed simulation game in teaching compared to the selected methods were presented. The importance and value added of a debriefing as well as a designed evaluation of the compared teaching methods were discussed.

Introduction

Serious games are established teaching and learning tools in business. Abt (1970) has already defined them as games that have an explicit and carefully thought-out educational purpose and are not played primarily just for amusement. Corporations in employee trainings often use such games. Games are praised for their efficiency in exploring complexity and they can be used to model and simulate natural conditions in a designed micro-world (Martin et al, 2007).

There are simulation games, such as "Green and Great" and "Lords of the Valley" (CRS, 2014), that are designed with an aim to be experimental and efficient learning methods (CRS, 2014). Learning through experience in real life and in the business world always poses a huge risk and may be very costly because learning means allowing for mistakes and experiments while making decisions. The conditions created and simulated during games, which are simplifications of reality, allow undertaking strategies, taking chances and risks, as well as conducting in-depth analyses that one would not dare to make in real world situations. Examples of such games were described, not exclusively, by: Reeves and Leighton (2009), Aldrich (2009), CRS (2014), Pangiotis et al (2015).

An alternative, artificial world with set-up conditions designed to observe actors' behaviour within a micro-world of pre-defined rules can be a very informative and a self-assessing tool for the business actors. While dealing with the problems of common goods management, the effects of policy implementation, as well as possible scenarios of multi-actor behaviours, can be tested and simulated within the set-up reality. In such conditions, factors conditioning goals achievement can be analysed and simulated. Moreover, alternative pathways, strategies, and negotiations can be explored. Finally, expected risks and rewards from taking the defined decisions can be proved or disproved.

The paper presents the outcomes of an experiment evaluating and comparing an application of a serious game with other teaching methods in the academic study of the sustainable development concept. A controlled experiment was designed to evaluate and compare four different teaching methods such as a lecture, a text analysis, a discussion, and a simulation game. It was conducted in a sustainable development class to verify the hypothesis that a simulation game can give students deeper understanding of complex issues and concepts more effectively than other forms of education. The following sections describe the method of the conducted experiment, elaborate on its outcomes, and present the discussion of results.

Games as educational tool

In order to convincingly and successfully use games as an educational tool in business education, several basic questions must be answered, such as: Are games a good educational tool? Why, when, and for what purposes should games be used? What can be learned during the games and from conducting them?

Games, after engaging the participants, stimulate and encourage exploration of strategies or behaviours that would not have been taken into account in real life due to the risk of failure. Learning by doing is probably the most outstanding feature of the simulation games compared to other traditional teaching methods. In the debriefing after the game, the decisions of game participants and relevant reasoning as well as systems structures and other factors influencing the final results can be analysed and discussed thus, enabling the participants to understand the situation, its causes, and outcomes.

Games are more demanding and resourceful than some other methods of teaching. They usually require extensive preparation from teachers and sometimes from learners. Often they demand special design, set-up, requisites, and a computer-aided simulator. However, there are also some simple gaming exercises that can be quickly performed during lessons without much additional effort (e.g. Sweeney et al, 2011). Games as a learning strategy take more time in concept explanation and in the debriefing. They require from participants: thinking, engagement, and often leaving a comfort zone to try out new experiences.

Role-playing and/or computer-based interactive learning environments have proven to be highly successful in business, social, and military contexts. (CRS, 2014) Within the business context, the application of simulation games can be very wide. In particular, games are effective in studying and practicing effective collaboration, as well as exploring the benefits and costs of participation. Designed for the improvement of human resources management, games allow participants to practice teamwork and acquire interpersonal skills, boost their individual, personal development as well as enhance internal cooperation within a company. Using games in staff training can even lead to improvements of

information flows or to innovations in management operational structures within companies. Within the field of strategic management simulation, games allow participants to explore risky strategies and their consequences. The domain of sustainability is very interesting to explore, for instance, the systems dynamics concepts, their consequences, and the strategies of common pool resources management.

Games are useful also for research purposes such as data collection, behavioural understanding, and conducting controlled experiments. Exploring collective and personal business strategies in a game can help people to make decisions about investments. An example of such an application to help farmers develop a local product is presented in Martin and others (2007). Moreover, games can be important in decision making to analyse and understand policies, implementation issues, and consequences. A good example is the Floodplain Management Game (Stefanska et al, 2011) that was further developed into the Lords of the Valley (CRS, 2014). A gaming exercise was designed to explore problem-solving and relational activities for river floodplain management. The purpose of the game is to explore complexities and uncertainties of multi-party collaboration. The game Lords of the Valley was conducted several times with water management stakeholders and other actors in Poland. In such situations, decision making rules of various stakeholders with regard to management in the floodplain are made explicit as well as their risk-prone or risk-averse behaviours towards flood risk. These games provide insight into the possible consequences of different strategies of land use management taken by the game participants and allow the analysis of decision rules of stakeholders' actions. Internal dynamics of the teams can be observed, e.g. how they are making decisions, sharing information, and how the actors are dealing with uncertainty and risk. An interesting overview of case studies presenting applications of action research from around the world, including participatory observation, serious games, and role-playing exercises within the field of climate change adaptation is given by van Buuren and others (2014). The action-oriented research methods to exercise feasible governance strategies and instruments for climate adaptation can be used to satisfy the need for both policy-relevant information and scientific knowledge.

Comparative evaluation analysis

A vast literature compares conventional classroom teaching methods with e-learning and distance learning environments (e.g. Black, 2002, Sun et al., 2006) that helps to grasp the criteria and factors that are considered important for the evaluation of learners' progress and teaching methods. Usually the assessment focuses on students' outcomes, such as grade, test scores, student attitudes and overall student satisfaction towards the educational methods.

The effectiveness of a teaching method depends very much on the factors such as learner motivation and aims, attitudes towards education, and willingness to learn, that can be enhanced by learners' personal abilities, personal learning style, initial skills, and preference towards methods (natural or acquired in the education process), as well as teachers' expertise and competencies in delivering the context, design of the methods. and quality of their delivery (clearly and effectively planned and delivered processes, transparent achievable goals, adjusted to the learner's abilities and preferences, engaging personality of the teacher, and timing). The above-mentioned factors are chosen from the P.C. Sun et al (2006) review of critical factors that affect learner satisfaction. Moreover, the teaching method should be suitable for the defined learning goals, such as acquiring factual, procedural, or conceptual knowledge or desired competency acquisition.

The evaluation analysis presented in this paper makes an effort to account for the above-mentioned factors in the designed evaluation process of the chosen teaching methods.

The hypothesis of the serious game conducted in the class on „Sustainable Development“ at the Faculty of Management AGH University of Science and Technology in Krakow, Poland, was that experiencing a designed situation during the game can teach students more than a lecture, analysis of literature, papers and case studies, or a discussion. A controlled experiment was conducted in the class to test the hypothesis. Thirty students took part in the experiment. The class composition was quite heterogeneous in terms of sex (70% female and 30% male), nationality (students from: Italy (10%), Spain (10%), Portugal (10%), Germany (10%), Turkey (30%) and Poland (30%), and age (between 20 and 28 years old). A class was in turn experiencing four teaching approaches to the four basic concepts of sustainable development. First, the concepts were presented to the group and students were asked to complete the first questionnaire. The questionnaire was assessing their preliminary knowledge about the concepts and defining the study goals for themselves with regard to each concept separately. Then, the concepts were presented one by one using different teaching approaches. Each teaching approach was evaluated right after the delivery concerning the level of understanding of the concept, the fulfilment of the defined learning goal, and the perceived effectiveness of the teaching method. At the end, the final questionnaire revealed students' preference towards teaching methods before and after the exercise as well as the comparison of the effectiveness and the efficiency of the methods.

The reason for such design of the controlled experiment was that the students could experience all the methods and compare them in order to choose the most effective and efficient one.

Experiment conduct

Concepts to be studied were chosen from interesting issues concerning systems dynamics, which is an important domain for understanding sustainable development ideas, their practical implications, and solutions to the complex problems at stake.

The following four concepts were chosen:

- when there are delays between action and consequence, expect overshoot,
- the surprising power of exponential growth,
- climate change requires habit change,
- the tragedy of the commons.

All of the concepts could be designed and conducted as part of a game (see Sweeney et al, 2011). In the designed experiment, the concepts were presented with different methods as indicated in Table 1.

Table 1

Analysed concepts and tested methods

Concepts	Methods
When there are delays between action and consequence, expect overshoot	Lecture
The surprising power of exponential growth	Text analysis
Climate change requires habit change	Discussion
The tragedy of the commons	Simulation game

Source: own elaboration

All the teaching methods to be evaluated-- lecture, text analysis, discussion, and simulation game-- had the same teaching objectives incorporated in the methods, namely: explanation of a general idea, deeper explanation of the concept, practical implications, and examples as well as hints for students' own benefits gained from understanding the concept.

Results of the experiment

The evaluation showed that with regard to each concept the group was divided almost half and half to those who wanted to get to know the concept only in general and those who wanted to know more about it, e.g., how the concept can be used in practice and what are its implications for their lives.

Revealing ex-post their general preferences about the learning methods: 70% of the students declared that they learn most when they see and 50% that they learn most when they do things. At the same time, 90% of students declared that they had preferences about the methods before the experiment, in that more than half preferred discussion, about 35% gave their preference to lecture, and the same amount to the game. Only 30% of students after the experiment declared that the way the methods were delivered had an impact on their preferences.

The concepts were not perceived as having equal difficulty levels at the beginning of the course by 60% of the respondents. The easiest was 'climate change requires habit change', more difficult were the concepts: 'when there are delays between action and consequence, expect overshoot' and 'the surprising power of exponential growth', the most difficult was 'the tragedy of the commons'. After the lessons 'the tragedy of the commons' concept, which was delivered through the game, the highest increase in level of understanding by the students was shown. The students also reported that the simulation method was the most effective. The least effective in delivering the concept was perceived to be text analysis. It was visible in both the direct assessment of the effectiveness of the method as well as the ex-post knowledge assessment.

Students ranked the simulation game as the method bringing them the deepest understanding of the concept, next was discussion before the text analysis and the lecture, which was last. Similar was the ranking concerning assessment of effectiveness of the methods. The only difference was that the discussion was appreciated at the same level as the game, as the most effective. However, when it comes to efficiency of the concepts delivery discussion as requiring the shortest amount of time to understand the concept was in the lead, whereas the game was least efficient. Most of the students

were excited about learning by doing and praised discussion and game as interactive, leaving the long-term memories enhanced by experience. However, very often the comments showed that a lecture is the most clear and direct way of knowledge delivery, whereas games are complicated and their results are not obvious and easy to draw on conclusion by the participants. The reason for such assessment can be attributed to 90% of the students indicating lecture as the most often used method in their studies, the one they are most comfortable with, at the same time pointing to the simulation game as the least often used by teachers. Finally, 50% of the students indicated that debriefing discussion in the game was essential to understand the concept.

Discussion of outcomes

Comparing the educational aims of the game with the learning practice of the students, it could be stated that in the designed experiment the game application fulfilled the expectations of both the teacher and the students. The hypothesis that a simulation game can teach students more than other methods was shown to be true as the simulation game was ranked in the evaluation as bringing them the deepest understanding of the concept. Moreover, some students wrote exciting comments about the game (eg. "Most interesting was the game. Lessons brought by the game will last in the memory for a long time.", „The most interesting, new, and difficult was the game. It show the consequences of actors' behaviour.“). At the same time, the other evaluated methods were also praised for their merits. The overall assessment of the discussion showed that students perceived it as having similar advantages as the game, and in particular it was favoured in terms of efficiency of the concept delivery.

There are several factors that can influence drawing conclusions in such experiments. First, in the conducted experiment the statistic probe was very small to generalize the outcomes on a population. Then, a concept might be better suited to be presented by one method than the other and it can influence the outcomes. Next, the results of the experiment may depend on the quality of the delivered teaching method. Lecture can be unclear, too difficult, complex, and poorly presented. The text for the analysis can also be too difficult, complex, and unclear. The discussion very much depends on the preparation, knowledge, and experience of discussion participants as well as on engaging and evoking questions. In the discussion participants learn from each other. It is a two-way communication where rising doubts can be clarified, but only until the level of knowledge of the fellow-participants. Discussion is a good way of enriching the context. Lecture, as well as text analysis, brings expert knowledge on board. To the large extent, these methods are based on one-way communication with the risk of not reaching the audience at all, in case people get lost in the context. However, when questions allowed, the understanding might be as planned. In simulation games, characteristics of all the previously described methods are present and it is even more engaging than the discussion as taking action is required from the participants. Experiencing consequences of actions is evident to the participants. There is discussion in the debriefing that is essential in a good game of educational aspirations. However, it is possible that understanding the full complexity of a simulation game might not be feasible for the players. This depends very much on the game design and set-up, the complexity of the rules, and finally on the debriefing. The comparison of the analysed methods is presented in Table 2.

Table 2
Comparison of the analysed methods

Teaching methods	Communication	Engagement	Knowledge	Experiencing consequences	Assessment, competency acquisition	Collaboration joint-problem solving, exchange of views
Lecture	One-way (to a large extent)	Low	Expert	Described	No	No
Text analysis	One-way (to a large extent)	Low	Expert	Described	No	No
Discussion	Two-way	High	Participants	Discussed	No	Yes
Simulation game	Two-way	Very high as action is required	Participants	Experienced	Yes, through Debriefing	Yes

Source: own elaboration

There are factors hindering gaining maximum benefits from the methods. Personal learner's ability is one of them. Different methods may be better suited for different types of personalities. A simulation game presents a model (a designed and controlled part) of the real life complexity within the aim to experiment and possess knowledge or competences. Interpersonal behaviours can hinder or misguide understanding of the pure concept in the simulation game in the same way as behavioural factors are questioning the basic rules of rational economics deduction principles.

Conclusions

Simulation games are very effective and at the same usually very demanding teaching methods. To their merits belongs, among others, very high level of participants engagement bringing experience driven, deep understanding of the concept.

Depending on the various factors and criteria, adequate teaching methods can be selected to deliver the concepts most effectively and efficiently. While different methods are suitable for different goals and the successful teaching very much depends on the adequately designed and professionally conducted method as well as on learners ability to appreciate it, the words of Confucius remain valid: „Tell me, and I'll forget. Show me and I may remember. Involve me, and I'll understand." The conducted experiment doesn't prove that every concept is suitable to be presented using a simulation game. However, using the synergies of conventional and unconventional teaching methods in order to enrich the content is a good way of evoking learners' potential and interest.

The conducted experiment can be seen as a pilot study for evaluation of using games in teaching complex sustainable development concepts to an international audience at the university level. The study was conducted on the international group of students, bringing in variety of teaching and learning experiences. Therefore, its results can be meaningful for further research on the most effective teaching methods of sustainable development concepts within the international context. Further research can be

conducted concerning, for example, implications of cultural differences on teaching and learning preferences using games. It is desirable as the perceptions and reactions in low-context and high-context cultures as well as rule-based and relationship-based cultures are very different (Hooker, 2003). Questionnaires eliciting not only teaching and learning preferences and experiences, but also students' background, as well as cultural preferences can be used in follow up research. Such study can help to understand the effectiveness of using games in international business education within the sustainable development field.

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