Research Article

Simulation & Gaming
1–30

DOI: 10.1177/1046878120972458
journals.sagepub.com/home/sag
SAGE

A Longitudinal Study of the Skills and Attitudes Conveyed by Two Business Simulation Games in Pécs, Hungary

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Abstract

Background. **Business simulation games** have been used since 1979 at the University of Pécs. Since 2000, two games have been taught: a **green business simulation** developed on site and known as **BUSINESS SIMULATION CHALLENGE** and the **MULTINATIONAL MANAGEMENT GAME**. In this research we report on a **longitudinal study** of the results of the two business simulations; and investigate the effects of the **Green Business simulation**.

Method. This survey-based research included 329 students that completed a questionnaire on business simulations since 2000. Surveys were carried out to measure the effect of the two simulations. There are data from three periods up to recent years. Frequency tables, univariate ANCOVA, T-tests and cross-tabulation were used to analyse the data.

Results.

- Generations' attitudes and skills do not change with the passage of time, and the skills and knowledge, conveyed by the simulations can be considered as constant throughout the period.
- This study confirms that main managerial skills are developed with simulation games but there is no need for enhanced mathematical and financial knowledge.
- The green simulation successfully developed the green attitude of students, but only in cases where the green option was rational.

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- More educated students enjoy greater challenges, namely the need for deeper analysis.
- Simulation courses in universities provide a higher level of motivation than do commercial simulations.

Conclusion. It can be stated that almost the same results can be achieved by general purpose simulations which have a different focus (analytical or strategy-oriented game). Results also indicate that more simulation courses in universities would stimulate higher student motivation.

Keywords
business simulation games, MULTINATIONAL MANAGEMENT GAME, BUSINESS SIMULATION CHALLENGE, green business simulation, longitudinal study, long-term effects

Introduction

Simulation games have proved to be efficient for education and forms the basis of future developments. Although all simulation games have limited variables and numbers of users, the complexity of games is increasing. Faria et al. (2009) divided the development of business games into 5 phases. The first - from 1955 - saw the beginning of the use of simulation games. In the second phase - from 1962 - commercially published business games appeared, and in the third phase - from 1966 - the complexity of these games showed a significant growth. In the fourth phase - from 1986 - PC simulation games appeared, whilst in the current phase - from 1998 - the games started to use the Internet. According to Zawacki-Richter and Latchem (2018), network-linked computers became tools of collaborative learning in 1997.

Naylor (1971) defined *business simulations* as "A numerical technique for conducting experiments with certain types of mathematical models, which describe the behaviour of a complex system on a digital computer over extended periods of time." We refer to business simulation as computer software which simulates a company. The simulated company operates in markets where there are competitors. Groups of students make the decisions to operate the simulated company. The competitors are managed by other groups of students or simulated by computers.

Business simulation as a teaching tool.

Researchers (Pérez & González, 2012; Romme, 2003; Farrel, 2005; Lin, et al 2018; Almeida, 2017; Hernández-Lara et al., 2019) indicate that simulations take a more pragmatic direction and make the student think about realities that occur in the business world - which allows the students to integrate knowledge in a single business exercise. The simulation game provides an interesting and participative learning environment and considered to be an effective learning tool. The most important

benefits of using the simulation game are innovation, leadership, strategic thinking and problem solving. Learning outcomes are not homogenous by age, younger students also able to learn more from the simulation they used.

Simulation games and student satisfaction with courses

Research (Grimes & Willey, 1990; Léger, 2006; Pongpanich, et al, 2009; Liu, et al, 2009; Chang, 2003; Arias-Aranda & Bustinza-Sánchez, 2009; Buil, et al, 2019) demonstrate that students who used a simulation game not only improved their problem-solving ability but left the class with more positive attitudes to the discipline also. The primary use of simulation games is to increase the student's interaction and teamwork, followed by providing experiential learning. The students had better conflict management handling modes helping teamwork than those students who were not involved in business simulation. They are more intrinsically motivated if they feel that their need for competence and autonomy are satisfied.

Using simulation games can also cause dissatisfaction with the course as it is very different to the traditional lecture-and-test courses. In some cases, hard efforts do not result in winning the game. Highly motivated students may feel dissatisfaction if they lose the game to their peers who were not working as hard. (Tao, et al, 2012) Even if students have high motivation, they still need knowledge to proceed with the learning and operation of the simulation game (Tao, et al, 2009).

Simulation games vs. traditional teaching methods

Research (Betts & Knaus, 2006; Cook & Swift, 2006; Kenworthy & Wong, 2005; Li,et al, 2007; Tompson & Dass, 2000; Wolfe, 2016) shows that students prefer the simulations to case studies and other exercises. They found business simulation better than textbooks for increasing interest in the course, understand sales force issues, and develop decision-making and problem-solving skills. Simulation groups experienced significantly more enjoyment and usefulness. There was also better achievement orientation, directiveness, team leadership, and impact and influence. Students claimed that the game experience was superior to traditional lectures. Simulations produce significantly higher improvements in self-efficacy than do case studies. Those participants totally engaged in the experience, created truly rational, goal-oriented and correct strategies.

Although most research proves the positive effects of using simulation games, researchers (Mitchell, 2004; Wellington & Faria, 1991; Rogmans & Abaza, 2019; Wolfe, 2016) also found contradictory results. Their research showed no significant differences in any of the outcomes measured when using simulation games and case studies. Nevertheless, they positively recommended this teaching method. Sometimes the students learning with the simulation game did not perform better in examinations than the control group who did not participate in a simulation game. They also state that simulation games are not always necessarily effective since effectiveness may be partly determined by the level of student motivation and other student characteristics.

Background

The context, in which the simulation is used can be considered as very important (Freitas & Oliver, 2006). At the University of Pécs, Faculty of Business and Economics, a Decision Games course was launched using US software in 1979 (BUSINESS SIMULATOR, 1978). This simulated a company's operation on a mainframe - offline at system level, practising complex design activities and developing skills. In the '90s a DOS-based business simulation was used. It was an own developed simulation game, named BUSINESS SIMULATION CHALLENGE (Kiss, 1997), which is the predecessor of the BSC (Business Simulation Challenge, a Green Business Simulation). This latter game was introduced in 2000 into education. A detailed description (Kiss, 2003) and a research paper (Kiss, 2006) provide an overview of the BSC simulation. The BSC was introduced together with an international simulation - the MULTINATIONAL MANAGEMENT GAME (MMG) - (Edge et al., 1980; Keys & Wells, 1997). A comparative review of the MMG was published by Keys (1997). A more detailed explanation of the two games are available in the appendix (Appendix C), but they are shortly introduced in this section.

Business Simulation Challenge

The BSC is a general functional business simulation. It comprises all significant functional areas (production, finance, and marketing), and so promotes the understanding of the relationship between these functional areas. The simulation is transparent (White Box) - not often used in simulations (Maier & Größler, 1998). Additionally, it has a unique feature - a green framework for the general functional simulation.

Environmental simulations are usually specific: they concentrate green issues during the simulation. Ulrich (1977) listed 27 such games, where an environmental problem is examined (such as the FISH GAME). Recently, there have been good developments in this field, such as the *NAPURO* (Gatti, et al, 2018) which teaches sustainable strategy and Corporate Social Responsibility. The BSC, however, is a complex general functional game, including the *green elements*, and, as such, it is unique. The green framework comprises green innovation, green production, environmental penalties, and increased market share according to the greenness of the company. Choosing green is optional, and so other factors, such as student capability, the level of experience etc. also influence the profitability of the firm, and the green option is not an obvious option at all. Investment and product development provide possibilities for establishing a *green* business, although they are more expensive than the other options (technologically advanced - *traditional* -, or *cheap*, not environmentally conscious variants. As ones reward, increased market share provides an opportunity to counterbalance the higher initial investment. In BSC, students decide the time spent on the decision and they will receive the results immediately.

Multinational Management Game

The MMG is also a general functional simulation game providing challenging decision-making exercises. It is suitable for teaching Strategic Management, International Business or Business Seminars. According to Machuca (2000), traditional business games are of the Black Box type; the MMG simulation is such a game. Players simulate companies which produce an IBM-compatible computer and a memory extension kit. The game gives a balanced coverage of business, marketing, manufacturing and finance. Teams of players have complex evaluation criteria, which can be weighted by the umpire (Keys, et al, 1992). The MMG is an offline game in the sense that students make their decisions, send them to the umpire who will "run" the main software to operate the market simulation.

Managerial Skills

Research (Chang, 2003; Faria & Wellington, 2004; Lainema & Hilmola, 2005; Olhager & Persson, 2006; Chang, et al, 2009; Cousens, et al, 2009; Adobor & Daneshfar, 2006; Saarinen, et al, 2012; Kriz & Auchter, 2016) demonstrates that the skills which simulation games convey are common in the case of most simulations. Simulation games are mostly useful to *understand functional interrelationships*, to develop general problem identification and *analytical skills and to develop decision-making skills*. One of the main purposes of using simulation is to give the students *decision-making experience* and to integrate theory with practice. Simulations maintain the task-orientation of the participants and help the students to understand *how different business processes conceived, emerged, and linked together*. The simulation made for a better understanding of the *interactions between different production units*. Students became more interested in the course and also *became involved in discussion with teammates to work on appropriate game strategies*. The simulation developed mostly student's *skills of collecting information, negotiation, and problem-solving skills*. Those participants who showed interest in leadership roles had the opportunity to *develop their leadership skills*. *Teamwork* and the development of *business administration and business plan preparation skills* are also important in respect of business simulations.

These features discussed in this *Managerial Skills* section, also characterise the two games examined, and they will be more closely examined in this paper. Firstly, in the *Methodology* section the measurement tool, the database and the statistical tools used are reviewed. In *Findings* the results of the investigations are described in detail, according to the analysis of managerial skills and the green features of the BUSINESS SIMULATION CHALLENGE. The *Conclusion* closes the study and suggests policy implications.

Methodology

Long-term research is not common in the area of business simulations. Most research uses a survey at a given time, not showing any changes over timing (Petri & Wangenheim, 2017). Some surveys cover a few years, such as Lainema and Hilmola (2005) with a four-year survey period and also Kenworthy and Wong (2005) with a two-year period,

but their results were not analysed on a time horizon. Kriz and Auchter (2016) examined the long-term entrepreneurship effects of a computerized simulation game using a survey carried out over 6 years, and a follow-up survey after 2-5 years of using the simulation game. Weiss (2008) undertook long-term research, citing ten years of student satisfaction with a negotiation simulation game, but this game was not computerized.

There are many research projects attempting to evaluate the outcomes of business simulation games. However, there is no common, widely accepted research taxonomy or common methods to assess learning outcomes (Feinstein & Cannon, 2002; Gosenpud, 1990). Measuring the positive effects of using such games can be done in the following way:

- post-experience surveys of the students (Farrell, 2005; Lainema & Hilmola, 2005; Chang et al., 2009; Tao et al., 2009; Hernández-Lara et al., 2019; Buil et al., 2019),
- post-experience reports or essays written by the students (Siewiorek et al., 2012; Sai, 2017),
- post-experience interviews of the students (Lin and Tu, 2012),
- pre- and post-experience surveys of the students (Grimes & Willey, 1990; Tompson & Dass, 2000; Romme, 2003; Olhager & Persson, 2006; Cousens et al., 2009; Guillén-Nieto & Aleson-Carbonell, 2012; Hwang & Cruthirds, 2017),
- comparing the post-experience of the students with other teaching method experiences (Betts & Knaus, 2006; Cook & Swift, 2006; Kenworthy & Wong, 2005; Li et al., 2007; Arias-Aranda & Bustinza-Sánchez, 2009; Mitchell, 2004),
- measuring student satisfaction with the simulation course (Léger, 2006),
- mail surveys sent to Professors (Pongpanich et al., 2009; Liu et al., 2009; Chang, 2003),
- comparing students' results, such as final scores or marks to those from traditional teaching method courses (Wellington & Faria, 1991; Tao et al., 2012),
- studying mistakes students made during the simulation game (Pasin & Giroux, 2011).

The above list shows some of the main features:

- most of the evaluations are subjective, based on the personal opinion of the students.
- most of the evaluations are performed after the experience.

The surveying process was introduced in this study's two simulations in 2000 and has been followed consistently since then, even though that now it is recognised: there are more precise processes, such as using two questionnaires, one before and one after the experience.

The questionnaire

The research is based on a questionnaire, regularly filled in by participants of the courses (see the questions used in the questionnaire in Appendix B). The research is

being carried out following the ethical requirements of the University of Pécs. The questionnaire contains c*lassification information* (*gender, education level, etc*.) to find the classification power of these variables. There are also "yes or no" questions for the *managerial skills.* These questions refer to mathematical financial skills and to those traditional skills for which (mainly general) simulation games are used: strategy formulation, planning, decision-making and teamwork.

Attitude (Likert scale type) questions are also used - first for the evaluation of the specific BSC questions, mainly regarding green features, but also for the usefulness of the White Box theory. Finally, there are questions about the *preferences* of the participants for one of the games. The detailed variable list is described in Appendix B, together with the questionnaire.

Database: Since 2000 - irregularly, but predominantly in three time intervals - surveys were carried out to measure the effect of the two simulations. The total sample size was 329. Students completed the questionnaire anonymously at the end of the course. Anonymity encouraged the students to provide honest information. The detailed questionnaire is shown, in Appendix B, whilst the years and the group features of the respondents/courses appear in Table 1.

Table 1. The courses, years, educational level (Bachelor or Master) and the number of respondents

	Courses	BA	MA	Total
1	Hungarian Szeged 2000	0	28	28
2	Hawaii Group 1 2001	0	17	17
3	Hawaii Group 2 2001	0	17	17
4	BABA BA 2002 Spring	28	0	28
5	BABA BA 2002 Autumn	11	0	11
6	BABA BA 2003	8	0	8
7	Hungarian MA 2003	0	15	15
8	BABA BA 2007	24	0	24
9	Hungarian MA 2008	0	18	18
10	BABA BA 2008	28	0	28
11	BABA BA 2011	24	0	24
12	Hungarian BA 2011	25	0	25
13	Hungarian BA 2016	27	0	27
14	Hungarian BA 2017	27	0	27
15	BABA BA 2018	12	0	12
16	BABA BA 2019	10	0	10
17	Hungarian BA 2019	10	0	10
	Total	234	95	329

The time intervals concerned are: 2000-2003, 2007-2011 and 2016-2019. There are six Hungarian nationality groups. The first group is from Szeged, Hungary; there are two groups from Hawaii (2 and 3) and the others are from Pécs, the home of the University. There is an English language Bachelor course in Business Administration (BABA), which are mixed groups including Hungarian students. The simulation was run at Bachelor level after 2008, and so, there are many fewer Master than Bachelor students in the sample. The educational language is Hungarian in the Hungarian groups, but otherwise English.

Table 1 shows how students differ in terms of their background: by language, academic level and previous experience (these are classification variables in this study) - and also in generation terms (the passage of time). One purpose of the study is to show that, in spite of different backgrounds, the main skills are developed or acquired equally. However, the effect of generations (in Section 4.1.3 and 4.2.2) and the classification variables (Section 4.3) are also examined.

Statistical methods

Summary tables (Frequency tables) are used to demonstrate the basic features of the database. Cross-tabulation is used for examining the relationships with classification variables. Both the frequency tables and cross-tabulations are frequently used analytical tools (Kiss, 2006). A Paired Samples t-test (for the two games) is used to compare the mean values of the "Yes" answers' ratio, given for the question of the efficiency of the managerial skills. An Independent Samples t-test is used for the comparisons of the users of commercial and educational simulations. ANCOVA (Univariate Analysis of Variance with Covariate; General Linear Models in the SPSS program package) is carried out to test the long-term effects within the database. ANCOVA is also a popular analytical tool; MANCOVA and ANCOVA were used for comparing two (not business) simulations by Dedeaux and Hartsell (2018). There is no reason to assume in the case of this questionnaire that the distances between the Likert scale elements would differ; therefore, these variables could reasonably be treated as scale variables regarding the accuracy of their mean values. SPSS 26 is used for data processing.

Findings

In this section, general managerial skills are analysed, and then an analysis of the BSC features follows. Finally, the relationships with the classification variables are examined.

General managerial skills

The first examination is of whether the two games would satisfy requirements against business simulation. As described earlier, both games are general functional games, but the BSC rather needs a type of strategic thinking, whilst MMG needs more analytical skills. However, both games need both types of skills. These data were collected only from 2007 onwards.

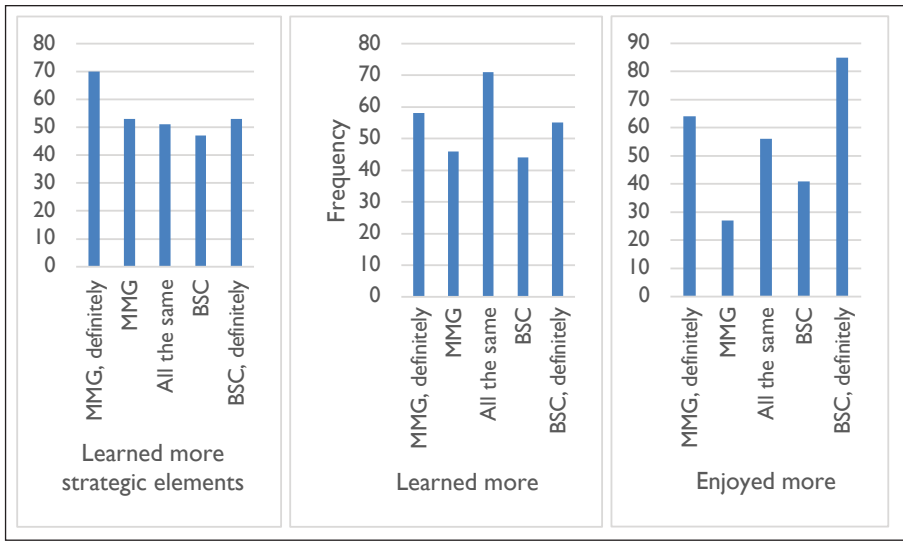

Figure 1. A comparison of the two games: three typical patterns

General overview of managerial skills

The questionnaire has a question on skills: does the game help in the development of the given skills? The results show that the traditional game-skills - that is, planning and analysing, strategic thinking, decision-making and teamwork skills, which are the most important, are rated highly. On average over 50% responded positively on improving their skills. As a result, both games fulfil the basic requirements of a business simulation. However, the mathematical and financial knowledge are lagging behind, which signify that there is no need for enhanced mathematical and financial knowledge. There is only one significant difference in the two games: financial knowledge, which is needed more in the MMG than in the BSC. Strategic thinking development has the highest value in the BSC and decision-making skills in the case of the MMG - as expected. However, both games are very good in developing those skills, and there is no significant difference between the mean values. Detailed results are given in Table 2. The strength of the relationships is indicated by the two tail significance (p) value in the last column (sig.) of the paired comparison of the mean values of the skills of the two games.

These skills are developed by playing numerous sessions, and in these games the number of sessions can stretch from 6 to 25. The long perspective allows students to plan for the long-term. Fewer sessions do not help to develop strategic thinking, but they are useful for the development of other skills, as discussed earlier.

Preferences of participants

A type of "which game is better?" question was also asked of the students. (The list of questions is described and explained in the *Methodology* chapter). Only three characteristic patterns are shown, in Fig. 2, relating to the *Learned more strategic elements, Learned more* and *Enjoyed more.*

Table 2. The ratio of "Yes" values in examined skills in pairs in different years; their means, standard deviations and the paired t-samples significance value

Game	Knowledge/ Skill	2007	2008	2011	2016	2017	2018	2019	Mean	Std. Dev.	Sig.
BSC	Mathematical knowledge	8.3%	6.8%	19.1%	33.3%	33.3%	50.00%	20.00%	24.4%	15.4%	.378
MMG		29.2%	20.9%	22.9%	29.2%	20.8%	41.7%	15.00%	25.7%	8.6%	
BSC	Financial knowledge	12.5%	31.8%	17.00%	11.1%	25.9%	50.00%	20.00%	24.1%	13.6%	.371
MMG		50.00%	51.2%	40.4%	33.3%	54.2%	50.00%	35.00%	44.9%	8.5%	
BSC	Planning and analyzing skills	58.3%	65.9%	68.1%	59.3%	59.3%	80.00%	80.00%	67.3%	9.4%	.000
MMG		62.5%	74.4%	66.00%	79.2%	70.8%	83.3%	60.00%	70.9%	8.7%	
BSC	Strategic thinking	70.8%	70.5%	72.3%	81.5%	74.1%	90.00%	55.00%	73.5%	10.8%	.424
MMG		45.8%	67.4%	80.9%	66.7%	87.5%	83.3%	55.00%	69.5%	15.4%	
BSC	Decision making	62.5%	70.5%	74.5%	55.6%	85.2%	80.00%	65.00%	70.5%	10.3%	.069
MMG		62.5%	76.7%	80.9%	58.3%	95.8%	83.3%	85.00%	77.5%	13.1%	
BSC	Teamwork skills	66.7%	61.4%	48.9%	59.3%	77.8%	60.00%	75.00%	64.1%	9.9%	.656
MMG		62.5%	69.8%	66.00%	45.8%	87.5%	50.00%	65.00%	63.8%	13.7%	

Seemingly, the left-hand graph in Fig. 1 is in contradiction with the results in Table 2, where the strategic thinking skill is more developed by the BSC. However, the latter referred to the whole game (less detailed, concentrating on strategy), whilst in Fig. 1 the graph refers to methodological elements such as analysing marketing situations, issuing shares, etc., which make up basic corporate strategy. The central graph in Fig. 1 is symmetric: some people learned more from the MMG and some from the BSC. "All the same" was the most frequent answer and some learning the same using either of the two simulations. The third graph showing which game was more enjoyable is again ambivalent. The BSC - maybe because it is an online game with immediate response - is more enjoyable for students, although the second highest frequency column is for those students who enjoyed the MMG more. Less decisive answers are fewer, showing that students have their own clear preferences about the games. Further analysis of the factors (Fig. A.1 contains graphs of all comparisons) shows that the *Black or White Box (MMG or BSC)?* and "*Long or short decision time?*" questions are positively answered for the BSC in both cases. Hence students prefer the transparency of the game and like the faster decisions. Also the BSC was considered easier to defeat and more enjoyable than the MMG in general. A short note from the authors suggests that there is a clear threshold in the BSC, which determines whether students have beaten the game or not. In the MMG there is no such threshold, but only the ranking difference between competitors. Where the MMG was more effective are the *More analysis* and the *Promotion of decision-making* areas: students had to analyse the situations more profoundly in the MMG, and so their decisions were more firmly grounded.

Long-term trends in kills

In this longitudinal study generational changes might reveal visible trends. In the period of managerial skills examined - from 2007 to 2019 - there are only random changes over the years. These can be followed graphically as Fig. A.2 depicts the changes in the main managerial skills. The significance of the changes, however, is not calculated. As a result, it can be concluded that the evaluation of the managerial data is independent of generations, and mainly depends on the actual composition of the student body in the given course, or on other factors not examined here.

Evaluation of the Green Simulation

An evaluation of the BSC was performed by a Likert scale-type questions with the traditional answers from "Not at all" to "Completely true". First, a general evaluation of the BSC is performed, followed by a longitudinal analysis.

General evaluations

Table 3 shows a summary table of the students' answers to the questions described in the *Methodology* section.

The transparency of the game is clearly acknowledged, given the high ratios of "True" and "Definitely true" answers. This factor was even more relevant than the evaluation of the traditional role of a general simulation game - an understanding of the functional relationships.

Table 3. Summary table of the answers to the effectiveness of the Green Business simulation

	Not at all	Not	All the same	True	Completely true
Statements	Count	Count	Count	Count	Count
„White Box theory" promotes understanding	11	30	82	111	62
Understanding of the relationships between functions	14	26	81	139	49
More conscious about the natural environment	57	76	89	57	33
Recognize the effect of the green, traditional and cheap strategy	12	21	64	118	100
Worth following a green strategy	6	22	54	124	107
Follow a green strategy if it is not profitable	57	72	90	54	15

Top management games or general business simulation games embrace many functional areas of a company (Summers, 2004). BSC covers all significant areas (such as production, marketing, and finance) and the results show that it enhances the understanding of connections between these functional areas.

The green features of the BSC also proved to be successful: students recognised and experienced the differences between the traditional, cheap and green strategies (see these strategies in the description of the BSC), and they are convinced that it is worthwhile following a green strategy. This is a good result from a sustainability point of view - even in this case, when the actual setup of the game could influence the profitability of the company, because this setup is a conventional one: a higher investment and operating cost should generate the return by the green image of the company/products.

A significant feature of the game is that - in spite of the results above - students would not be more conscious "automatically" of Nature and would not follow a green strategy if it were not profitable.

Long-term trends

According to the authors' personal perception, a "good" course has more enthusiastic students who are keen to give higher evaluations to "green" questions, including the White Box theory and the relationships between the functional areas. A regression analysis partly supported this: the different groups (Table 1) as independent variables had a significant influence at a 5% significance level to the general evaluation of the green questions (*GenerEval*=dependent variable). The coefficient of the *groups* variable is .024, t(314)=3.154, $p = .002$. The strength of the effect is very low (Adjusted $R^2 = .028$, F(1, 314) = 9.947, p = .002), but, as a result, the *GenerEval* variable was

included as a covariate during the examination of the time effect. ANCOVA is used (Univariate Analysis of Variance with Covariate) as statistical method.

One clear trend is shown in the usefulness of the White Box theory which is also significant. Fig. 2 shows the graph of the 20-year trend.

The downward trend supports the notion that students are less and less interested in the actual operation of the game and do not mind if it is a Black Box system.

As Table 4 shows both the *GenerEval* and the *survey_year* are significant at a 1% significance level (see the appropriate values in the "Sig." column in Table 4). However, the *GenerEval* variable had a much greater effect - as the Partial Eta Squared values show (.305 against .079). None of the other variables shows such a clear trend, although, Fig. 3 reveals further valuable knowledge.

The lower graph in Fig. 3 shows the level of the understanding of the main features of cheap, traditional and green companies' behaviour. The more the students are conscious in this area, the less they are willing to follow a green strategy if it is not profitable (see the upper graph in Fig. 3). Note the reverse motion in the two parts of the graph. All long-term trend graphs of the BSC variables are attached in Fig. A.3 in Appendix A.

Connections with classification variables

In some cases, there are connections between the variables of the green features and the managerial skills and the classification variables, namely: with gender, educational level and the earlier experience with simulation games. These connections are examined by cross-tabulation. Table 5 shows the summary of the years by classification variables.

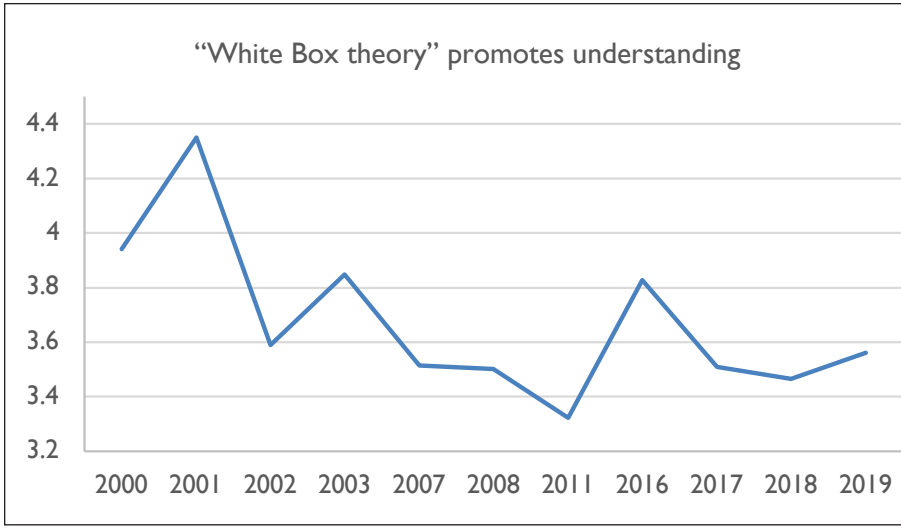

Figure 2. The long-term trend in the evaluation of the White Box theory

Table 4. Test of the between subject effect (survey year) of the White Box theory with ANCOVA, where the covariate is the general evaluation (GenerEval) of the greenness of the BSC.

Dependent Variable: "White Box theory" promotes understanding						
Source	Type III Sum of Squares	df	Mean Square	F	Sig.	Partial Eta Squared
Corrected Model	114.382a	11	10.398	14.372	.000	358
Intercept	1.859	1	1.859	2.569	.110	.009
GenerEval	90.646	1	90.646	125.285	.000	.306
survey_year	17.516	10	1.752	2.421	.009	.079
Error	205.479	284	.724			
Total	4195	296				
Corrected Total	319.861	295				

a. R Squared = .358 (Adjusted R Squared = .333)

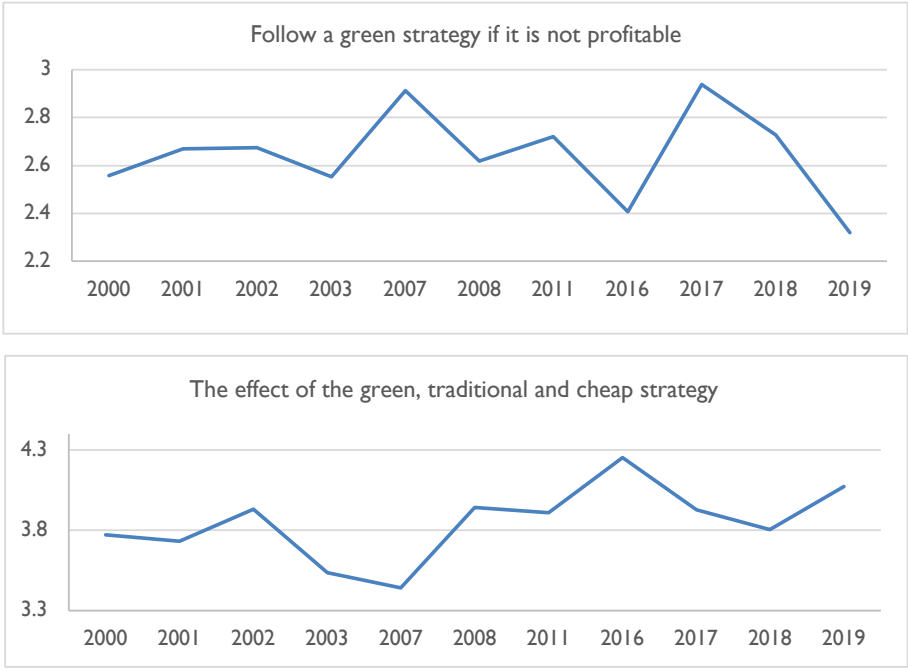

Figure 3. A comparison of the long-term trend of the evaluation of students of the green strategy - the marginal values, after removing the effect of the covariate (general evaluation of the BSC)

The course is more popular among males, and so more males filled in the questionnaire than females. The courses ran parallel in the Hungarian and the English language programmes, and so there are data from both language courses for those years. Hungarian language programme respondents number some 46%, whilst English

programme respondents totalled close to 54%. About 40% of the respondents had played a simulation game during their earlier studies. The reason for the high ratio of Bachelor students is that the course was removed from Master education in 2010. The classification variables will be analysed.

Gender - the gender of the student

In Table 6 there are three variables where there is a significant connection with gender.

Results show that the evaluation of the skills of males and females do not differ in general - in fact, only in three cases. The White Box simulation enhances understanding by males more than the females, furthermore the males beat the White Box BSC simulation easier than females. On the other hand, the BSC simulation develops the teamwork skills of females more than those of males. However, the significance value (Sig. column) is not much less than the 5% significance level, and the correlation level is low (Cramer's V values).

Table 5. Summary table of the years by the classification variables

	Educational level		Gender 1 – male 2 - female		Did you play similar games earlier?	
Year	BA	Master	Male	Female	Yes	No
2000	0	28	18	10	4	23
2001	0	34	10	13	12	9
2002	39	0	20	19	12	25
2003	8	15	16	6	17	5
2007	24	0	15	9	6	18
2008	28	18	28	17	21	25
2011	49	0	22	27	18	31
2016	27	0	19	8	13	14
2017	27	0	17	10	11	16
2018	12	0	6	6	5	7
2019	20	0	14	6	3	17
Sum	234	95	185	131	122	190

Table 6. Cross-tabulation results of the gender variable with managerial skills and green features of the BSC

	Explanation	Pearson $\chi 2$	Sig.	Cramer's V
White Box	Male's understanding is promoted better	12.368	.015	.205
Teamwork skills	Female's teamwork skills in MMG are developed better	9.327	.002	.219
Easier to beat	BSC was easier to beat by males, while MMG by females	14.587	.006	.232

Educational level - Bachelor or Master students

Four factors are in significant connection with whether students are at Master or at Bachelor level. Table 7 shows the results.

The Black Box MMG needs more analytical skills and forces students to analyse their decisions from the first rounds. This is called the make-decisions-and-observe-results loop (Zamora, et al, 2000). The BSC, however, allows for more real time "trial and error" experiments, even without the reasoning of the decisions. Master students already have a better background knowledge of managing the MMG than Bachelor students. As Master students are engaged more with the MMG simulation, they learn more from it and enjoy it more than the BSC. The White Box BSC simulation is more appropriate for Bachelor students who can better learn with this game and enjoy it. The factors in Table 7 support this statement. One good result is that Master students enjoyed more the greater challenge from the point of view of analytical capabilities.

Previous experience with simulation games

There are students, who already have experience with different simulation games. These games are either commercial games or simulations in education. The attitudes of these students are different in many cases, as the number of variables indicates in the case of nine attitudes there are significant differences. Details are shown in Appendix A (Table A.1).

Results support the Master-Bachelor comparison' results: Master students and students who have earlier worked with games are similarly well experienced. They needed more financial knowledge for the BSC (although this is not necessary at novice level). They also needed more the deeper knowledge in the MMG, together with the Black Box theory, which means a bigger challenge, and so they enjoyed the MMG more. Note that the correlation level is relatively low in each case (the Cramer V column).

It is not clear whether students with previous experience are more motivated in any case - which could be supported by their previous participation in simulations (commercial games), or "normal" students who took courses previously want to be involved more deeply in games. In order to examine this question an independent samples t-test was run for the two groups. In the case of the majority of the skills, there were no significant difference between the "commercially" and "officially" educated students, except in respect of two skills: the White Box and the "which game do you enjoy more" questions. Note that less experienced students used the White Box theory and enjoyed the BSC more. Table 8 summarizes the results of these cases.

Table 7. Cross-tabulation results of the Master vs. Bachelor students with managerial skills and green features of the BSC

	Explanation	Pearson $\chi 2$	Sig.	Cramer's V
Learned more strategic elements	Master students learned more from MMG and Bachelors from BSC	15.822	.003	.240
Easier to beat	BSC was more difficult for the Bachelor, MMG for the Master students	9.904	.042	.190
Enjoyed more	Bachelor students preferred BSC while Master students preferred MMG	28.742	.000	.324

Note that higher mean values favour the BSC. The table supports the view that those students who officially (*in education*) participated in a simulation game earlier are "more expert" than those, who played a *commercial* simulation earlier. Hence, it is worthwhile teaching more simulations since familiarity with games in general makes for deeper understanding of the knowledge and skills conveyed.

Conclusion and Policy Implications

This article reports a longitudinal study of 20 years use of business simulations at the University of Pécs, Faculty of Business and Economics. Since 2000 the students were surveyed of their perceived effectiveness of two business simulations: the BSC and the MMG. The results of this longitudinal study are shown in this paper.

First, the main managerial skills conveyed are examined. The main skills - decision-making, planning and analysing, strategic thinking, and teamwork - are developed well. There is no need for enhanced mathematical and financial knowledge. Despite the fact that the first game (BSC) is a strategy-oriented game, which provides immediate reactions, whilst the second (MMG) needs more time, analysis and players have to wait for the results, there is no difference between the taught main managerial skills. A Paired t-test was used for testing this assumption.

Bachelor and Master students prefered different simulation approaches. Whilst the White Box BSC simulation is more useful and enjoyable at Bachelor level, the Black Box MMG simulation is preferred by Master students who learn more strategic elements from this simulation. The 20-year trend of the evaluation of the White Box theory shows that students are becoming less interested in the actual operation of the game.

The longitudinal study of managerial skills supported the notion that generational attitudes and skills do not change with time, although the skills and knowledge, conveyed by the simulations randomly changed during the period. Univariate ANOVA is used to prove this assumption.

The green simulation (BSC) conveyed the necessary knowledge of green thinking, and students recognised the differences between strategies. These are cheap strategy (outdated technologies, not environmentally friendly), traditional strategy (state-of-the-art technologies but not caring about the environment) and green strategy (also state-of-the-art technologies, but with clear environmental consciousness). Also students recog-

Table 8. Results of the Independent samples t-test comparing students experienced in commercial and in educational simulations.

Questions	Type of simulation	N	Mean	Std. Devia-tion	Std. Error Mean	t-test for Equality of Means	df	Sig. (2-tailed)
Black or White Box (MMG or BSC)?	In education	13	2.080	1.320	.366	-2.830	64	.006
	Commercial	53	3.230	1.310	.180			
Which game have you enjoyed more?	In education	13	2.000	1.528	.424	-2.051	64	.044
	Commercial	53	2.920	1.439	.198			

nised that, in spite of the higher investment and operating costs (as the game is currently laid out) it is worth following a green strategy, as it may be profitable in the longer term. However, statistical analyses proved that business students, the leaders of the next generation, will not work only on an ethical basis, and profitability will always be a decisive factor. Fortunately, there are numerous examples of the profitability of green strategies. Even, when students were convinced of the usefulness of green strategies, they would not necessarily be more conscious of the natural environment.

As with managerial skills, green attitudes were also examined over the longer-term. Based on the Univariate ANCOVA method, we can also state that the attitudes did not show any clear trends of change, apart from their evaluation of the usefulness of the White Box theory, where students needed the transparency of the processes progressively less.

Finally, the effects of the classification variables were examined with the help of cross-tabulation. These variables are: gender, educational level (undergraduate or graduate) and previous experience with simulations. The last was also divided into two groups: those who had played a commercial game or had played a simulation in education. Usually, the connections are rare and weak, but one main feature is clearly shown: more experienced students are more motivated for the deeper understanding of the games. This means that they enjoy the greater challenge of analysing the processes of the games. Also, those students who had experienced the simulation in education proved to be more expert than those who had experienced a commercial simulation. This last statement was proved by an Independent Sample t-test.

Policy implications can also be drawn from the above results. More simulation courses in universities stimulate higher student motivation, and so it is worth running more simulations or providing a second course of the same simulation, where a deeper understanding of the games (the knowledge conveyed and skills) is possible.

Sustainability education could also benefit from simulations, since a well-designed simulation is able to provide appropriate skills and knowledge for students. Hence, appropriate simulations would result in a younger management generation who - partly, at least - could do business according to green principles.

Acknowledgments

The authors would like to thank C S Chadwick for his help in language editing.

Declaration of conflicting interests

The author(s) declared no potential conflicts of interest with respect to the research, authorship, and/or publication of this article.

Funding

The author(s) disclosed receipt of the following financial support for the research, authorship and/or publication of this article: This research has been supported by the National Research, Development and Innovation Office (No. K 132276).

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Appendices

Appendix A - detailed figures

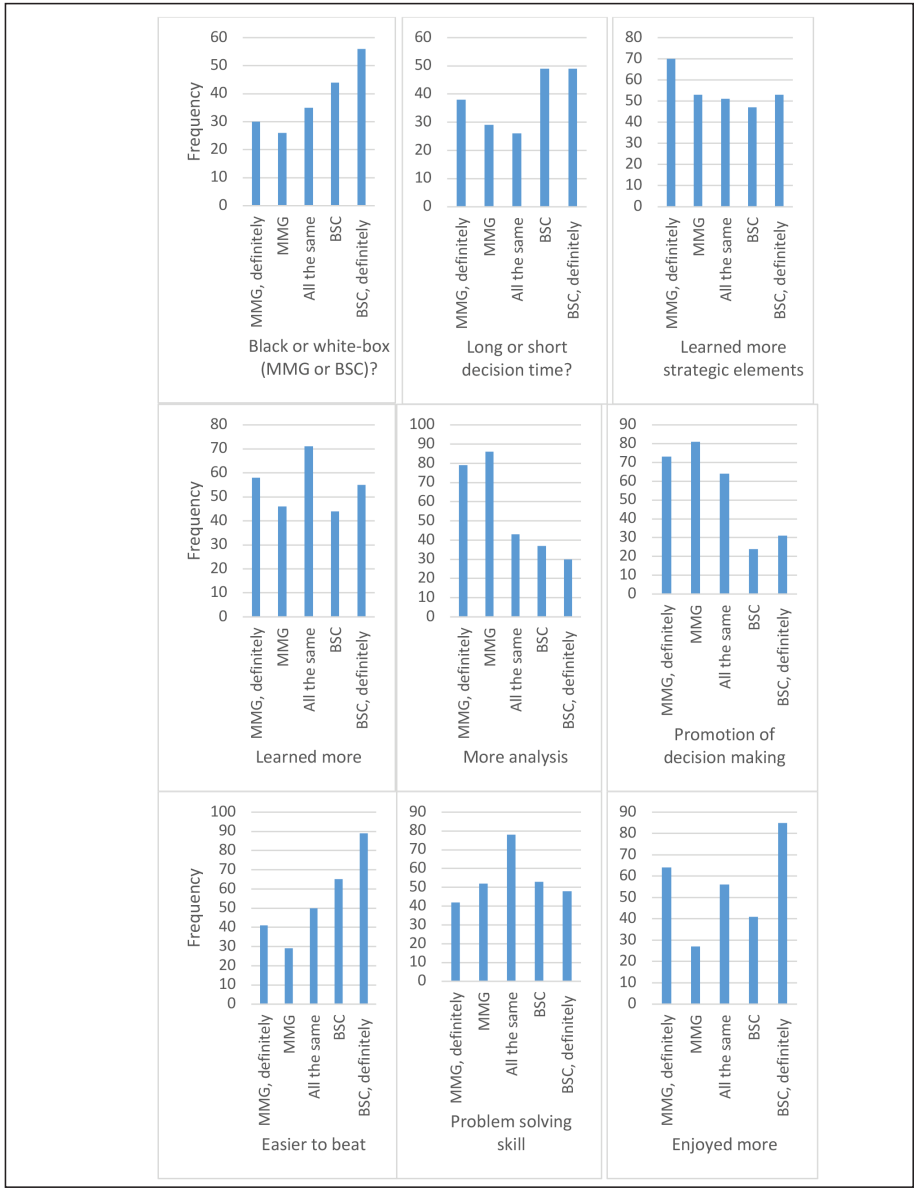

Figure A.1. Preference of the managerial skills of the two games

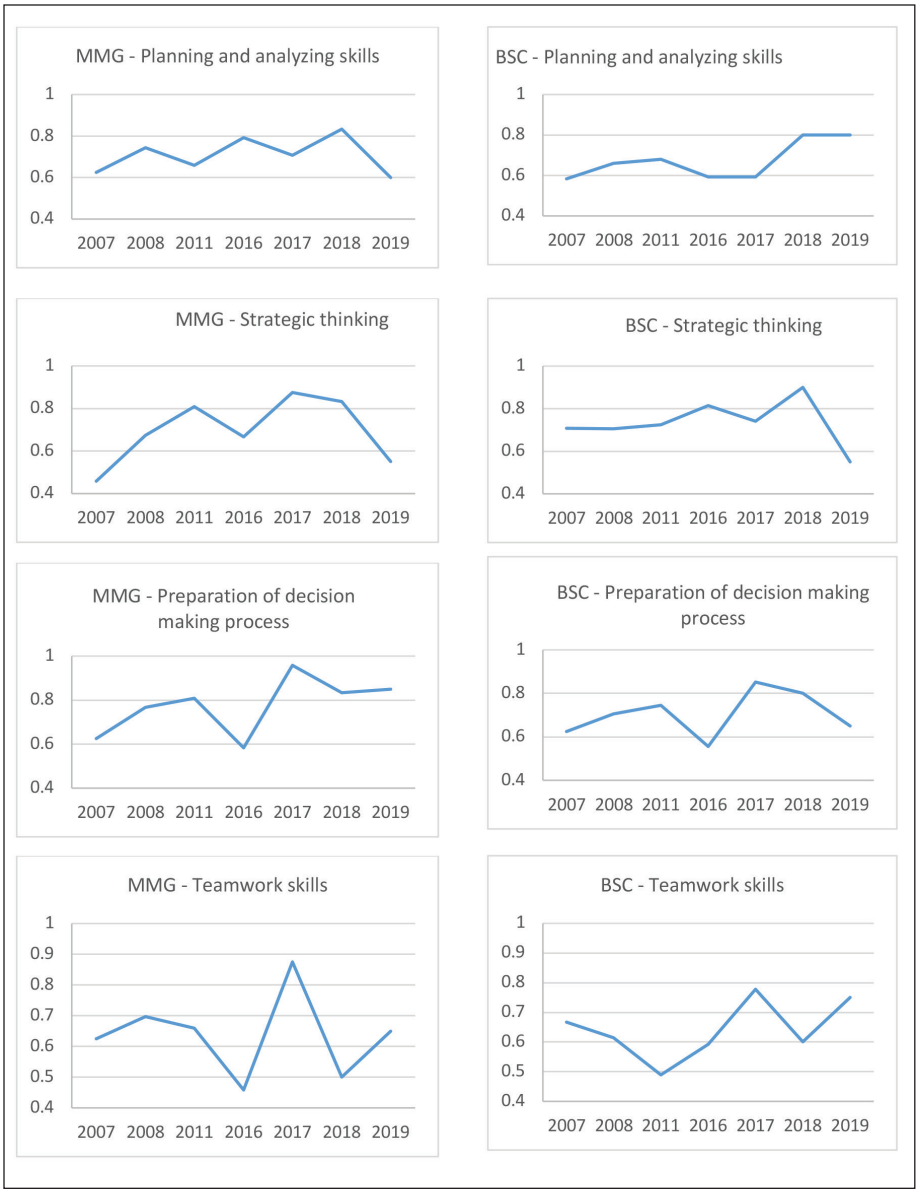

Figure A.2. Estimated marginal means for the main managerial skills of the two games

Figure A.3. Estimated marginal means for BUSINESS SIMULATION CHALLENGE (the green simulation)

Table A.1. Cross-tabulation results of the students with previous simulation experience (experienced students) and students without such experience but with managerial skills and green features of the BSC

Statements	Explanation	Pearson χ^2	Sig.	Cramer's V
Worth following a green strategy	The green strategy is less important for experienced students.	10.158	.038	.182
Follow a green strategy if not profitable	Less from the experienced students follow a non-profitable green strategy	10.894	.028	.197
BSC - refreshing financial knowledge	More experienced students needed financial knowledge for the BSC	4.391	.036	.149
MMG - planning and analysing skills	More experienced students needed planning and analysing skills for the MMG	7.851	.005	.201
MMG - strategic thinking	More experienced students needed strategic thinking skills for the MMG	11.865	.001	.247
MMG - decision-making process	More experienced students recognised the decision making feature of the M-G	6.461	.011	.182
Black or White-Box	More experienced students prefer the Black Box game (MMG)	11.511	.021	.245
Learn more strategic elements	More experienced students learned more strategic elements from MMG	10.476	.033	.198
Which game enjoyed more?	More experienced students learned more strategic elements from MMG	16.235	.003	.247

Appendix B

Questions from the questionnaire used in our research. Variable names are displayed before the questions in brackets.

Classification information

1. *gender:* Gender: ☐ Female ☐ Male
2. *earlier:* Did you play similar business simulations earlier? (you can choose multiple answers)
   in education: ☐ Yes. in a classroom
   Please specify simulation name(s): ……
   Commercial ☐ Yes. commercial simulation games (i.e. SimCity. etc.)
   ☐ No

Further variables (not in the questionnaire) are appended at the recording of the questionnaire:

- *educational_level* - Bachelor(undergraduate) or Master(graduate) student (appended at the recording of the questionnaire);
- *education_language* - the language of the education (Hungarian or English); and
- *survey_year* - the year of the survey (from 2000 to 2019. also appended at the recording of the questionnaire).

Questions about the BSC

Questions only related to the Business Simulation Challenge

3. *whitebox:* How could the „White Box theory" (you can see the exact operation of the system) promote the better understanding of the business and market processes? (Such elements are in the game: forecast details. and accounting details.) (*whitebox*)
   Not at all ← ☐ ☐ ☐ ☐ ☐ → Definitely yes
4. *relationships:* Could BSC game promote the better understanding of the relationship between functional areas?
   Not at all ← ☐ ☐ ☐ ☐ ☐ → Definitely yes
5. *conscious:* Are you more conscious about the natural environment because of this game?
   Not at all ← ☐ ☐ ☐ ☐ ☐ → Definitely yes
6. *effect:* Could you recognise the effect of the green. traditional and cheap strategy?
   Not at all ← ☐ ☐ ☐ ☐ ☐ → Definitely yes
7. *follow:* In your opinion: is it worth following a green strategy?
   Not at all ← ☐ ☐ ☐ ☐ ☐ → Definitely yes
8. *notprofitable:* Would you follow a green strategy if it is not profitable?
   Not at all ← ☐ ☐ ☐ ☐ ☐ → Definitely yes

Generated question is *genereval* which is the mean value of the answers of the cohorts in Table 1.

Managerial skills:

9. In your own opinion which of your following skills were developed by BSC? (you can choose multiple answers)

b_mathematic: ☐ Refreshment of mathematic knowledge
b_plan: ☐ Planning and analyzing skills
b_st_overview: ☐ Strategy overview
b_finance: ☐ Financial knowledge
b_decision: ☐ Decision making and decision preparing
b_teamwork: ☐ Teamwork skills
☐ Other. please specify: ……

Questions about the MMG

Managerial skills:

10. In your own opinion. which of your following skills were developed by MMG? (you can choose multiple answers)
    m_mathematic: ☐ Refreshment of mathematic knowledge
    m_plan: ☐ Planning and analyzing skills
    m_st_overview: ☐ Strategy overview
    m_finance: ☐ Financial knowledge
    m_decision: ☐ Decision making and decision preparing
    m_teamwork: ☐ Teamwork skills
    ☐ Other. please specify: ……

Questions for preferences
Please tick the box according to the fact that the middle box means neutral opinion.

11. *black_white:* Which one do you prefer? Black Box (you can't see the algorithm of the game. like MMG) or White Box (you can see how the software calculates everything. like BSC)?
    Black Box (like MMG) ← ☐ ☐ ☐ ☐ ☐ → White Box (like BSC)
12. *prefer:* Which one do you prefer?
    1. Long-time for decisions and less number of periods (like MMG)
    2. Short time for decisions and more periods (like BSC)
    1. (like MMG) ← ☐ ☐ ☐ ☐ ☐ → 2. (like BSC)
13. *l_strat:* From which game could you learn more strategic elements?
    MMG ← ☐ ☐ ☐ ☐ ☐ → BSC
14. *l_more:* From which game could you learn more?
    MMG ← ☐ ☐ ☐ ☐ ☐ → BSC
15. *m_anal:* In which game have you had to make more analysis?
    MMG ← ☐ ☐ ☐ ☐ ☐ → BSC
16. *gr_decis:* Which game promoted the group decision in a better way?
    MMG ← ☐ ☐ ☐ ☐ ☐ → BSC
17. *beat:* Which game was easier to beat?
    MMG ← ☐ ☐ ☐ ☐ ☐ → BSC
18. *prsolv:* Which game developed better your problem solving skill?
    MMG ← ☐ ☐ ☐ ☐ ☐ → BSC
19. *enjoyed:* Which game have you enjoyed more?
    MMG ← ☐ ☐ ☐ ☐ ☐ → BSC

Appendix C

Description of the Business Simulation Challenge (BSC)

The Business Simulation Challenge is a green, general functional strategic simulation game. Groups of students simulate the management of a company producing and selling products in four different markets. The game simulates the washing powder/detergent market (although it can be applied to other markets also). It is structured on a monthly basis. The market size is the same throughout the game, but the demand is based on the actual pricing and marketing activities of the companies. The model of the simulation is based on scientific research.

Students have to make their decisions for each period based on the results of the previous period. They make decisions on production, marketing and finance. The time spent on decisions is determined by the students. After making their decision they can move to the next period and receive the results immediately since their competitors are simulated by computer. (There are two computer-simulated opponents in the game). The number of periods is limited to 24.

BSC is a White Box theory simulation which provides transparency through a user interface. Students are able to see all operations and follow all calculations of all companies within the simulation in a spreadsheet format. Forecasts of the results of the decisions are also available. This enhances the level of understanding of the game.

There are green options for the students, such as investing into green equipment and developing green products. They will be rewarded by higher green image and bigger market share. Umpire can also control the behaviour of the green business environment. This green environment facilitates the profitable operation of the firm.

There are seven scenarios in the game. Students have to play the game starting from the basic level and go on to more difficult scenarios if they have succeeded in the given scenario. The evaluation consists of profit, market share and cash. Students have to win against the computer-simulated opponents in all indicators to win the game. The evaluation of the results is based on the number of levels achieved by the students.

Description of the Multinational Management Game (MMG)

The MMG (Version 3) is an international simulation game, operating in three industrial areas: USA, Europe (Germany) and Asia (Malaysia). This general functional strategic game simulates the computer manufacturing industry in yearly periods. The simulated company produces and sells two products: computers and a memory expansion kit. The industry's parameters are based on scientific research. The market is influenced by the marketing and the R&D expenditure of the companies.

Groups of students play against each other, and there are no computer-simulated competitors. Each decision round in the game simulates one year of operation providing a true strategic element. There is a predefined time for making the decisions causing time pressure on participating students. After each round of decisions the umpire processes them by central instructor software to calculate the results. Students receive a corporate summary report which comprises the financial, marketing and manufacturing information and also the evaluation indicators.

MMG is a Black Box simulation and so the internal calculations are not shown. Students have to figure out the internal logics of the simulation to make better decisions. There are no forecasts and the parallel decision-making of several groups of students increases the uncertainty. Overall, the MMG has slower gameplay compared to BSC, as there are no forecasts available and more time is needed for each decision round.

The MMG has a true international character. Students can make decisions on exporting, manufacturing and sales. The company can build subsidiaries in each location. Each market has different characteristics regarding demand and other parameters. Financing the company can be solved by incurring debt or issuing new shares. The outcome of the decisions is heavily dependent on other teams' decisions. The evaluation is based on the cumulative points calculated from seven different indicators: market share, return on sales, return on assets, debt to total assets, quality/technology, return on equity (ROE) and share price.

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