DEVELOPMENT AND IMPLEMENTATION OF BUSINESS GAME FOR FEDERAL CENTER OF TECHNOLOGICAL EDUCATION

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Abstract. *The Brazilian Government has been recently discussing with universities the strategies to establish new methods and teaching techniques which motivate students and enhance the teaching-learning process throughout the country. As far as we, engineering professors, are concerned, the need of teaching-learning process enhancement seems to be the imperative core of the problem. In this sense, it is necessary to devise means that allow students to engage themselves in classroom tasks, analyze these activities critically, draw some effective insight from this analysis, and apply its results. Similarly is the process experienced spontaneously in one's daily life called "inductive process" and its simple observation nature. On the contrary, an "established truth", which we currently see in our classrooms, belongs to the "deductive process". The previous paragraph claims a kind of learning called experiential learning. It is divided into five phases: experiencing (activity participation); reporting (sharing observations and reactions); processing (discussing the dynamics patterns); generalizations (inter-relating real world and principles); application (planning more effective behavior). The business game technique applies the experiential learning in an organized manner which differentiates it among others as a relevant higher-education quality improvement tool in institutions where the theory versus practice relation is strongly demanded. In order to ratify the business games effectiveness, a case study series applied to Industrial Engineering and Management classes at CEFET RJ, conducted from 2006 to 2010 is presented. Through these cases it can be inferred that the business game tool facilitates and encourages students learning, especially regarding to the National Quality Foundation Management's Excellence Model requirements. This study also promotes identifying the areas where students of both majors – Engineering and Business – have learning difficulties or show their best skills. Finally, our experiment leads to the conclusion towards the teaching-learning process improvement in a public institution through this proficient business game tool.*

Keywords*: business games, simulation, teaching-learning, national quality foundation*

1. INTRODUCTION

The use of Business Games and Corporate Simulations has been increasing in the Brazilian academic field in the last few years, which can be observed not only by the increasing number of articles presented in local and international congresses, monographs, dissertations, theses or books on this subject, but also by the number of professionals working in this market (Barçante & Castro Pinto, 2007).

In Brazil today, games on logistics, HR, finance, marketing are developed and applied, whether or not computer-based, and each author develops and applies the game that is more convenient to them. However, according to the bibliography referenced, there has not been much concern about developing a game based on internationally recognized managerial models, such as the Management Excellence Model of the National Foundation for Quality, the EFQM Excellence Model or the ISO set of Standards (Barçante, Brochado e Pithon, 2010).

From these assumptions, we have developed and applied a business game based on the Management Excellence Model. Here we present the whole process of elaboration and some of the results obtained by this game. But first we need to introduce the concepts on models, management models, and business games.

According to Barçante (2010) it is usual in Brazil to see people on the streets that could not memorize the multiplication table, and they perform the four operations to charge and to give change to people who buy the things they sell, for they recognize the importance of a specific knowledge to get by. When we know what it is for and we need the application, we do not need anyone to deliver the knowledge. We go get it at the source.

Brazilian schools generally apply the motto – Do as we teach you, and that is enough. – and that eliminates creativity and the capacity for critical analysis.

The meaning of learning may become clearer as we try to understand it from its essential, important or accidental viewpoint.

Essential is something that you will have to take care of immediately. It is connected to your present and it cannot really be postponed. Living the essential is living the present time. Taking care of the essential is what people should have as a priority.

Important is something that is about to become essential, but is not quite there yet. Therefore, preparing for the important is "important", but not more than taking care of the essential.

What about the accidental? That is something that we do not know when or even if is going to happen. Worrying about the accidental is a rather non-objective way to spend time.

If learning is an activity in which motivation plays a significant role, how can someone be motivated to learn something that they consider accidental?

If a professor – understood as someone who facilitates the learning process – wants his/her students to learn something, he/she will have to convince them that the topic in question is essential or, at least, important.

Learning unfolds appropriately as one perceives the usefulness of the application of what is being learned: "I need to do this; how is it done? – That is the great opportunity for learning.

Therefore, if you do not like country life, learning how to open trails or to recognize wild edible plants may be something related to an accidental event. If you do like country life, however, learning how to open trails and recognizing wild plants becomes important. It is expected that when you are lost in the jungle it is not too late to notice that having learned how to open trails and recognize wild plants has become essential.

But there is a great difficulty in all that: satisfying everyone's interest in a classroom. That is where the importance of this work lies.

2. LEARNING THROUGH GAMES

The use of corporate games allows participants to be able to learn by means of a process in which they play as main actors of their learning, within a simulated environment. The final result is not the most important, but rather the planning and decision-making exercise.

The students take decisions and get as feedback information that is often not compatible with the decisions made or the results aimed. They then must revisit their decisions and try to understand what happened. This process of continuous evaluation provides a much higher level of learning than the methods known as "traditional".

According to Barçante (2010) the literature on Games and Learning deems some aspects as critical:

- Enabling the immediate application of the material learned;
- Promoting the participation of the trainees;
- Offering the opportunity of interaction with peers;
- Emphasizing the individual as a whole: emotion and cognition;
- Creating conditions to get in touch with the environment;
- Including situations of variability and uncertainty;
- Proposing the exercise in a structured and oriented manner;
- Enabling the assessment of the experience by the participants;
- Including feedback comments offered by the teacher.

2.1. What are business game?

Different approaches and ways to focus are used by each author to define Business Games.

Beppu (1984): business games are simplified mathematical abstractions of a situation in connection with the business world. Game participants, as individuals or as a group, manage the company as a whole or in part by means of management decisions for successive and sequential periods...

Martinelli (1987): the important and peculiar aspects of Business Games are their extremely dynamic character, their wide scope as a method of teaching and personal development, as well as the sequential aspect, which motivates and brings them as close as possible to the business reality which they are trying to simulate.

Wilhelm (1997): structured corporate games are systems that, by simulating various activities inherent to a company, are capable of creating situations that involve issues related to production, distribution and consumption, enabling the group to experience situations that involve the application of knowledge and skills according to an objective.

Gramigna (1993): a previously planned activity, in which players are invited to face challenges that reproduce their day-to-day reality.

Teaching technique, decision-making sequential exercise, mathematical abstractions, systems, activity, etc, these terms show the total lack of conceptual consistency of the various authors that approach the issue.

3. EXCELLENCE MANAGEMENT MODEL

According to Pereira e Santos (2001), management model is a set formed by a trilogy of principles, techniques and explanations. Their goal is to guide the conception and the operation of all the elements of an organization. This trilogy has evolved with time, which made the management models evolve from a mechanist and simple view of organizations to much more complex and dynamic models, which take into account the various processes and internal and external influences, whether they are intrinsic to the organization or environmental or regulatory.

Management models seem to have, at first, been supported and systematized within the philosophical foundations of thinkers like René Descartes, Isaac Newton and Francis Bacon, who influenced the culture from which such models emerged (REGINATO, 2010).

We shall consider the management models as classified according to a historical perspective, into three large blocks: mechanist, organic, and strategic.

The Excellence Management Model, "Fig.1", comprised of eight Criteria: 1. Leadership; 2. Strategies and Plans; 3. Customers; 4. Society; 5. Information and Knowledge; 6. People; 7. Process; 8. Results.

The Criteria incorporate state-of-the-art management for performance excellence skills and serve as a base for awarding and feedback for the National Quality Award applicants. They also add three important aspects top make companies more competitive:

- Supporting management practice, performance, and education improvements in organizations;
- Enabling communication and sharing of Best practices among all types of organizations; and
- Serving as a reference model to improvement of understanding and application of management practices.

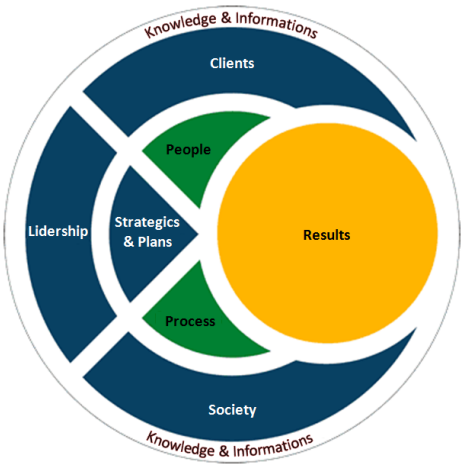

Figure 1. Excellence Management Model

4. JOGAI & JEP

JOGAI (Industrial Administration Game) & JEI (Industrial Engineering Game) are used in the Corporate Simulation subject of the 8th term of the Industrial Administration and Simulation subject of the 10th term of the Industrial Engineering undergraduate program at CEFET-RJ. The classes involve contents such as Vision and Mission; Excellence Principles; Costs x Pricing; Revenues x Expenses; DLP; Assets x Liabilities and Balance Sheet. The plays take place during the last six weeks of class. JOGAI comprises two plays, all evaluated according to the criteria presented herein. After each Play, a comparative analysis of the business is made during a general meeting.

In general, teams are divided into:

- Three Mines – obtain concessions from the Government to operate precious metal and gem mines and sell these to the Goldsmiths;
- Five Goldsmiths – buy precious metals and gems from the Mines, produce jewelry and sell them to the Jewelry Stores;
- Three Jewelry Stores – buy jewelries from the Goldsmiths and export them.

The companies sell, buy, produce and evaluate. The Audit Committee only evaluates.The Mining Companies compete among each other, receive from the Government, on consignment, gems (aquamarine, tourmaline and rubellite) and precious metals (platinum and gold) and sell them to the goldsmiths. At the end of each play, they evaluate a few aspects of their customers.

The Goldsmiths compete among each other, buy raw-material from the mining companies, produce jewels, and sell them to the jewelry stores. At the end of each play, they evaluate a few aspects of their customers and suppliers.

The Jewelry Stores compete among each other, buy jewels from the Goldsmiths and export them. At the end of each play, they evaluate a few aspects of their suppliers.

The Audit Committee evaluates all companies for several aspects such as Vision, Mission, Ethics Code etc.
The Exporters provides goals in connection with market demands for Jewelry Stores to meet.
The Government manages the Game as a whole.

4.1. RAW MATERIAL

Elka Magic Pins, "Fig. 2", are used. They come in five colors and four shapes, for a total of twenty different pins.

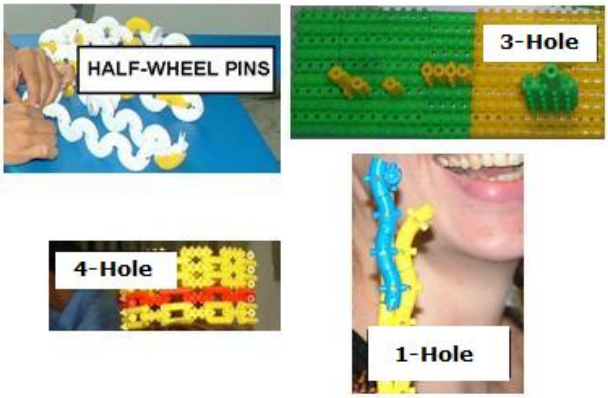

Figure 2. Raw Material

The colors represent the following raw-materials: White – Platinum; Yellow – Gold; Blue – Aquamarine; Green – Tourmaline; Red – Rubellite.

4.2. EVALUATION CRITERIA

According to Barçante (2010), the Evaluation Questionnaire is based on the Excellence Criteria of the National Foundation for Quality, using a scale of 1 (worst) to 5 (best) in each criterion.

Abbreviation represents who evaluates: AC – Auditor Committee; SM – Supplier Market; CM – Consumer Market; EO – Everyone; GAME – Performance at JOGAI.

1. Leadership – 110 points (AC)
1.1 The Vision defined by senior management is clear.
1.2 The Mission defined by the senior management considers the organization's values, focus on the customer, mutual respect and trust, ethical behavior, the participation of people, and high performance expectations.
1.3 The manager assumes his/her place in the company.
2. Strategies and Plans – 60 points
2.1 The company has performed customer satisfaction surveys. (post-sale) (CM)
2.2 Actions are taken based on satisfaction surveys and customer complaints. (CM)
2.3 The company searches to set partnerships with its competitors. (AC)
2.4 The company takes actions based on the analysis of its competitors. (AC)
2.5 The company analyses the competitive environment in search of new opportunities. (AC)
2.6 Actions are taken in connection with the analysis of the competitive environment. (AC)
2.7 The company searches to set partnerships with the Supplying Markets. (SM)
2.8 Actions are taken based on the search for partnership with Supplying Markets. (SM)
3. Customers (CM) – 60 points
3.1 The company knows the expectations and the current and future needs of Customer Markets. (pre-sale)
3.2 The company evaluates and improves its product based on the information from Customer Markets.
3.3 The company has a line of products differentiated by quality.
4. Society – 60 points
4.1 People from the work force, suppliers and other stakeholders are made aware and involved in matters concerning social and environmental responsibility. (AC)
4.2 The company has set an ethics code. (AC)
4.3 The company communicates to the society the impacts and information concerning its products, processes and facilities. (EO)
4.4 The level of satisfaction of the community with the company is identified and evaluated. (EO)
5. Information and Knowledge – 60 points
5.1 The information about competitors is used by the company. (AC)
5.2 The information about product quality is used by the company. (AC)

5.3 The information from customers is used by the company. (CM)
5.4 The information about operational performance is used by the company.. (AC)
5.5 The information about financial performance is used by the company. (AC)
6. People – 90 points (AC)
6.1 People are satisfied with what they do.
6.2 The Business function is empowered to act.
6.3 The Production function is empowered to act.
6.4 The communication is clear, objective and noise-free.
7. Processes – 110 points
7.1 Best average price paid in the purchase of raw-material. (GAME).
7.2 Best average price received in the sale of raw-material in the product. (GAME)
7.3 Value added: Price of final product sold / cost of raw-material purchased. (GAME)
7.4 Delivery lead-time (period from the moment the buyer confirmed the purchase until product is received by such buyer). (CM)
7.5 The criteria used to select and qualify suppliers are clear and well defined. (AC)
8. Results – 450 points
8.1 The company has met all expectations. (CM)
8.2 Profitability – ROI (GAME)
8.3 Market Share: amount of sales. (GAME)
8.4 Financial Share: Value of sales. (GAME)
8.5 Organizational Climate. (AC)
8.6 Ranking of companies that have best dealt with Supplier Market. (SM)
8.7 Considering all items evaluated, what score would you give the company? (EO)

4.3. THE GAME MODEL

The game model, "Fig.3", is divided into three parts: Plays, Information Consolidation and Feedback.

Play: Each company must find the most appropriate way to organize itself, in such a way that the students may put in practice, in a synergic manner, the knowledge obtained during the Industrial Administration Undergraduate Game, among which we may highlight business planning; work organization; decision-making; business controls; negotiation; business time management; general conflict handling; appropriate allocation of human, financial and material resources; market knowledge and monitoring customer current and future needs and expectations.

JOGAI & JEI is composed of two plays of about three hours each.

Information Consolidation: After each Play, the students consolidate the information obtained during the game with the purchase of raw-material, product sales (quantity and values), investments, and make evaluations. They record all information in an Excel file containing three worksheets: Fiscal Note, Evaluations and Complementary Information.

Feedback: That is the culminating point of the games, where important facts concerning knowledge, skills and behaviors experienced during each play are commented and debated and results are presented.

The final result of the games – made with every evaluation category – is presented in the form of bar graphs where every bar shows the points that each company obtained during the Play, and the maximum score is 1,000 points, according to the model in use.

One Miner, one Goldsmith and one Jewelry Store win their respective segments and the one with the highest score wins the games.

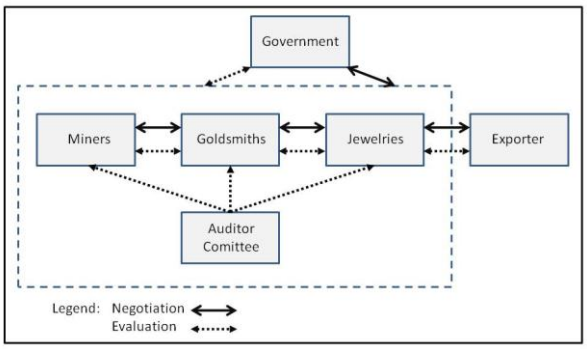

Figure 3. The game model

4.4. STATISTICS ANALYSIS

We opted for one-way ANOVA using the F-statistic (RYAN, 2009) that indicates the size of the difference between the groups, depending on the size of variation within each group - to check the results of the various groups associated with each of the companies in the game. This test provides the verification of the possible existence of a statistically significant difference between the average results for each group Miners, Goldsmiths e Jewelries.

The test:

$$H_0 : \mu_1 = \mu_2 = ... = \mu_k$$

H_1: At least a μ_i *is different, and* $\mu_i = 1,2,...,k.$

The values found for the F test results for each item, referring to games JEG and JOGAI are shown in the table below:

F TEST FOR EQUALITY OF MEDIUM ON THE RESULTS OF EACH ITEM

ITEM	JOGAI	JEG
Item I	0,6253	1,9859
Item II	0,2846	0,0398
Item III	0,7168	0,5463
Item IV	2,7287	0,3701
Item V	0,3506	0,4206
Item VI	1,0208	0,2012
Item VII	0,2172	0,5597
Item VIII	0,2853	1,5261

With all calculated F values are smaller than, to each case:

JEG: $F_{TAB} = 3.42 \Rightarrow$ we cannot reject the null hypothesis in any items.

JOGAI: $F_{TAB} = 3.52 \Rightarrow$ we cannot reject the null hypothesis in any items.

Thus, when analyzing the difference between the mean results of the companies (miners, goldsmiths, jewelries) during the semesters in which the games were simulated, have detected no significant difference between the results presented in the game.

It was found that both quantitatively measured variables (items 7.1, 7.2, 7.3, 8.2, 8.3, 8.4) as the variables measured qualitatively (other items), they do not show a statistically significant difference.

With these data we can see that the game tends to a cohesive result, in which all enterprises seek a favorable outcome, trying to provide not only greater profitability for your business, but also for the same internal factors that can satisfy both suppliers and their customers, respecting the rules and trying to maximize the benefits generated by this behavior with the "Auditor Committee".

These perceptions are confirmed by data found in which the values of F test are presented in the calculations made smaller than the tabulated value considering a significance level of 0.05. And so $F_{CALC} < F_{TAB} = 3.42$ for the case of JEG, as $F_{CALC} < F_{TAB} = 3.52$ for games played in teams of Industrial Administration - JOGAI.

5. CONCLUSIONS

JOGAI & JEI were implemented in the first semester of 2007 at Undergraduate Course of CEFET-RJ.

We may notice that some variables are smaller than in a common class, such as the degree of absenteeism, and the number of students missing class. Other variables have grown, such as the degree of class participation and the interest of students for the subjects involved.

We have found some difficulties, especially concerning the control of the degree of eagerness and the noise made by the students, most of which in their late teens.

One thing is for sure, it is very rewarding to see students who usually just “attend class”, and who are not sure of what they will do for a living, dive headfirst into the simulated market trying, by means of failed attempt vs. successful attempt, to get an opportunity to make a difference in their daily real lives.

6. ACKNOWLEDGEMENTS

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7. REFERENCES

Barçante, L. C., 2010, "The Industrial Administration Undergraduate Game", Proceedings of 41th International Simulation & Gaming Association, Spokane, WA, USA. (to be published).

Barçante, L. C. & Castro Pinto, F. A., 2007, "Games, business and companies: Business Games". Ed. Qualitymark, Rio de Janeiro, Brazil, 112p.

Barçante, L. C., Brochado, M., Pithon , A. J. C., 2010, "Business Games as an instrument of social entrepreneurship: application of the learning process", Proceedings of XXX National Meeting of Industrial Engineering, São Carlos, Brazil , <http://www.abepro.org.br/biblioteca/enegep2010_TN_STO_113_744_16467.pdf >.

Beppu, C. I. (1984). "Simulation games in the form of business applied to the teaching of accounting" Dissertação de MSc, São Paulo: FEA-USP, 200 p.

Gramigna, M. R. M.(1993). "Business game", Ed. Makroon Books, São Paulo, Brazil, p.

Martinelli, D. P. (1987). "The use of business games in management education". Dissertação de MSc, São Paulo: FEA-USP, 262 p.

Pereira, M. I. & Santos, S. A. (2001). "Management model: a conceptual analysis". São Paulo: Pioneira. 71 p.

Reginato, L. 2010. "A sectoral study on the relationship between environmental variables external management models, management controls and business performance". Tese de DSc, São Paulo: FEA-USP, 369 p.

Ryan, T. (2009). "Modern engineering statistics". Ed. Campus, Rio de Janeiro, Brazil. 344p.

Wilhelm, P. P. H. (1997). "A new perspective of recovery and use of business games". Tese de DSc, Florianópolis: EPGEPS-UFSC, 136 p.

8. RESPONSIBILITY NOTICE

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