

The Industrial Engineering Undergraduate Game

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Abstract. The Industrial Engineering Undergraduate Game, JOGAI, is used in the subject called Business Simulation (*Simulação Empresarial*) of industrial Engineering undergraduate course of CEFET-RJ. It is a playful and interactive game that involves several variables from its conception to the classroom applications. No one plays any roles and the negotiations are as close to real life as possible, determined solely by the parties involved. JOGAI simulates a supply-customer chain involving gems, precious metals, and jewelry. The whole market participates in the assessment of companies – suppliers, customers, audit committee, and game simulator, according to previously defined criteria.

I. INTRODUCTION

Some people are not able to memorize the multiplication table as it is formally taught in Brazilian schools, however they can 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 (Barçante & Castro Pinto, 2007).

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.

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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.

II. LEARNING THROUGH GAMES

II.1 Knowledge, Skill, and Attitude

According to SAUAIA (1989) we can make an analogy between a person who is preparing to drive a car and another person who is preparing to manage a business.

The driver must be fully skilled, which means that he is assumed to:

- Knows traffic laws, which is proven by means of a written test;
- Have a minimal skill in handling a vehicle, obtained during practical driving classes and proven by means of a practical test behind the wheel;
- Take a proper attitude, i.e., being responsible, ethical and humane towards pedestrians and other drivers. Generally this is not put to the test when a driver-to-be gets a license, but a considerate driver is expected to have it.

Those three conditions are the minimum expected for a person to be able to drive a car, considering that only the repeated exercise of taking to the street will be able to

consolidate, with time, the experience of a mature driver, with or without traffic accidents or tickets.

Such maturing certainly takes some time, some costs and risks, the intensity of which shall be tolerable or not depending on each driver.

We may thus summarize the uncertainty underlying that process by means of the following questions:

- How long does it take a newly-licensed driver to become a good motorist?
- What risk is that person running until he/she becomes a veteran?
- What is the cost of that development?

Likewise, a business administrator must be perfectly skilled to perform his/her duties, which means that such administrator is supposed to have:

- theoretical knowledge about the business;
- managerial skills to handle the material and human resources available;
- the appropriate attitude, being ethical, responsible and humane towards the society with which he/she operates.

Similarly, these three conditions are necessary, but not sufficient, since only the repeated exercise of managerial actions may consolidate, in time, the experience of a mature administrator.

Therefore, the uncertainty underlying the training and development of an administrator may be summarized in the following questions:

- How long does it take a newly-graduate to become a good manager?
- What risks is a trainee facing until he/she becomes a veteran manager?
- What is the cost of such development?

Among the many and diverse responsibilities of an administrator is minimizing the risks of his/her business, monitoring the use of resources as time goes by and aiming at all times at fulfilling the company's mission.

JOGAI allows a student to experience all this at a relatively low cost, and in a rather controlled environment, without incurring in unnecessary risks, and during a previously determined period of time.

II.2 Experiential Learning

Experiential Learning (Wolfe & Byrne, 1975) is divided into four distinct and complementary parts:

Design: focuses on the initial efforts by the learning facilitator to set the phases of the program. Define educational goals, producing or selecting activities to be performed by participants, identifying the factors that affect the learning process and creating an implementation plan. This is the phase where the theoretical bases are defined so that participants may visualize the experience within the desired context.

Conduct: conducting and controlling the project designed in the previous phase. The previous design of the activities may be changed to ensure adequate involvement with

learning. The implication of this phase is making the experience not only structured, but also closely monitored.

Evaluation: this phase, usually conducted by the facilitator, is focused on the participants, who evaluate the experience they have been through. They must be able to express themselves clearly and demonstrate aspects of the learning they have just acquired by the conduct of the experience.

Feedback: this should be almost a continuous process throughout the experience, from beginning to end. By monitoring the process, the facilitator reinforces the positive aspects that have arisen and mitigates – or even eliminates – the negative ones. It is important to stress to the participants that failing is allowed, knowing that mistakes teach us to do it right.

The literature on Gaming and Learning views a few aspects as critical:

- Enabling the immediate application of what has been learned;
- Promoting the participation of learners;
- Offering opportunities for interaction with peers;
- Emphasizing the individual as a whole: emotion and cognition;
- Creating conditions for making contact with the environment;
- Including situations of variability and uncertainty;
- Proposing the exercise in a structured and oriented manner;
- Enabling the evaluation of the experience by the participants;
- Including feedback comments offered by the facilitator.

III. GAME MANUAL

III.1 Who Is Who?

JOGAI simulates a customer-supply chain composed of mining companies (at least two, with two students each), goldsmiths (at least three, with at least three students each), jewelry stores (at least two, with two students each), an Audit Committee (at least three students), Government and Exporter (played by the facilitator).

III.2 What Does Each One Do?

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.

III.2.1 JOGAI Structure

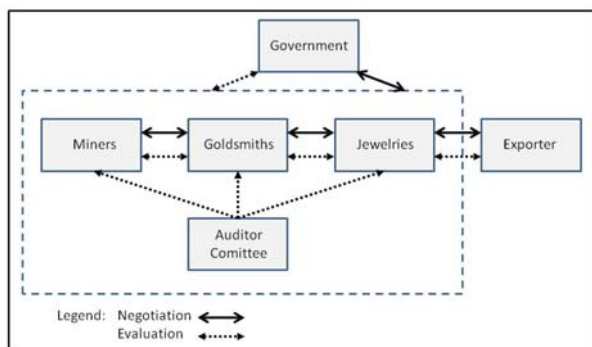


Figure 1: JOGAI Structure

III.2.2 JOGAI Raw-Material

Elka¹ Magic Pins are used. They come in five colors and four shapes, for a total of twenty different pins.

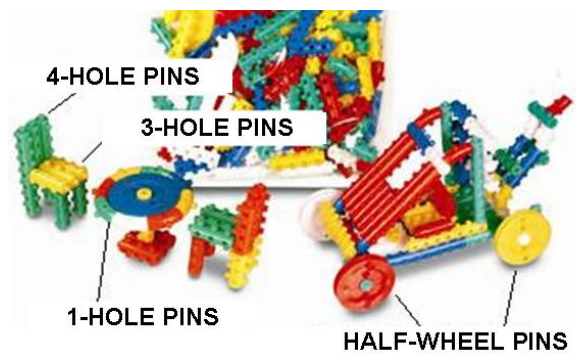


Figure 2: The Magic Pins from Elka

The colors represent the following raw-materials:

- White – Platinum
- Yellow – Gold
- Blue – Aquamarine
- Green – Tourmaline
- Red - Rubellite

III.3 Evaluation Criteria – maximum points

Evaluation criteria are based on the Excellence Criteria of the National Quality Foundation², which uses a number scale from 1 (worst) to 5 (best) performance in an aspect.

1. Leadership – 110 points (AC)

The Vision defined by senior management is clear.
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.
The manager assumes his/her place in the company.

2. Strategies and Plans – 60 points

The company has performed customer satisfaction surveys. (post-sale) (CM)
Actions are taken based on satisfaction surveys and customer complaints. (CM)
The company searches to set partnerships with its competitors. (AC)
The company takes actions based on the analysis of its competitors. (AC)
The company analyses the competitive environment in search of new opportunities. (AC)
Actions are taken in connection with the analysis of the competitive environment. (AC)
The company searches to set partnerships with the Supplying Markets. (SM)
Actions are taken based on the search for partnership with Supplying Markets. (SM)

3. Customers (CM) – 60 points

The company knows the expectations and the current and future needs of Customer Markets. (pre-sale)
The company evaluates and improves its product based on the information from Customer Markets.
The company has a line of products differentiated by quality.

4. Society – 60 points

People from the work force, suppliers and other stakeholders are made aware and involved in matters concerning social and environmental responsibility. (AC)
The company has set an ethics code. (AC)
The company communicates to the society the impacts and information concerning its products, processes and facilities. (EO)
The level of satisfaction of the community with the company is identified and evaluated. (EO)

¹ Plastic pins manufactured by Elka, a Brazilian toy maker. <http://www.elka.com.br/>.

² FNQ – National Quality Foundation – is a non-governmental organization created in 1991 with the mission to disseminate the Fundamentals of Management Excellence. <http://www.fnq.org.br/site/655/default.aspx>.

5. Information and Knowledge – 60 points

The information about competitors is used by the company. (AC)
The information about product quality is used by the company. (AC)
The information from customers is used by the company. (CM)
The information about operational performance is used by the company.. (AC)
The information about financial performance is used by the company. (AC)

6. People – 90 points (AC)

People are satisfied with what they do.
The Business function is empowered to act.
The Production function is empowered to act.
The communication is clear, objective and noise-free.

7. Processes – 110 points

Best average price paid in the purchase of raw-material. (GAME).
Best average price received in the sale of raw-material in the product. (GAME)
Value added: Price of final product sold / cost of raw-material purchased. (GAME)
Delivery lead-time (period from the moment the buyer confirmed the purchase until product is received by such buyer). (CM)
The criteria used to select and qualify suppliers are clear and well defined. (AC)

8. Results – 450 points

The company has met all expectations. (CM)
Profitability – ROI (GAME)
Market Share: amount of sales. (GAME)
Financial Share: Value of sales. (GAME)
Organizational Environment. (AC)
Ranking of companies that have best dealt with Supplier Market. (SM)
Considering all items evaluated, what score would you give the company? (EO)

Abbreviation represents who evaluates:

- AC – Auditor Committee
- SM – Supplier Market
- CM – Consumer Market
- EO – Everyone
- GAME – Performance at JOGAI

III.4 JOGAI

Game is divided into three parts: Plays, Information Consolidation and Feedback.

III.4.1 Plays

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 Engineering 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 is composed of two plays of about three hours each.

III.4.2 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.

III.4.3 Feedback

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

The final result of JOGAI – 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 JOGAI. In the figure below, the winners were Miner 3, Goldsmith W and Jewelry Store D, and the latter won the JOGAI.

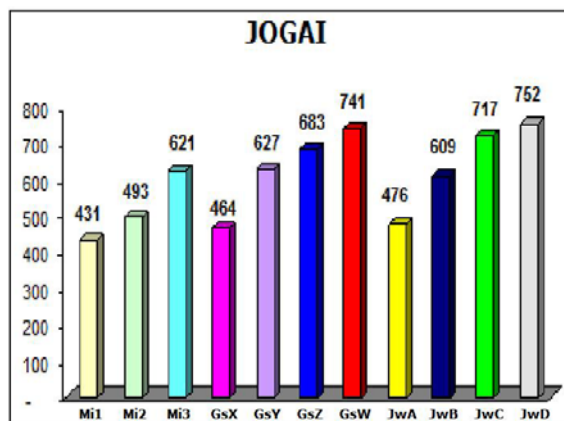


Figure 3: Presentation of JOGAI results

The feedback of JOGAI is based on the observations that the students make during all plays. The teacher plays the role of facilitator and, if necessary, the teacher may correct any wrong conclusions that students may make.



Figure 4: JOGAI overview

IV. CONCLUSIONS

JOGAI was implemented in the first semester of 2007 at the Engineering 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.

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