



Virtual forums as a learning method in Industrial Engineering Organization

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Abstract. This paper describes the experiences of educational improvement and innovation carried out in a multi-cultural environment with students of different nationalities of the Engineering School along 5 years. The experiences in class were based on virtual forums to study problems of Engineering Management. The case of the Harvard Business School (HBS) method, adapted to Industrial Organization Engineering was used. The methodology was applied in several subjects in the Area of Industrial Organization from 2007 to 2012. The objective was to change the classic face-to-face educational model of Industrial Engineering School to a new paradigm based on collaboration. We will focus on the essential problems and peculiarities of the implementation of this particular e-learning educational system in Industrial Organization Engineering.

Keywords. Collaborative work - Teaching innovation - Teaching evaluation - Virtual forums - Industrial Management - Case-based Learning Method.

1 Introduction

The principles of Industrial Organization are complex and difficult to explain and understand. On the other hand, certain subjects of Industrial Management require the study of practical and complex situations adapted to the reality of current socio-economic and business environment.

The Industrial Organization Engineering studies the internal aspects of any enterprise: tangible elements, (labor force, means of production, etc.) or intangible ones (patents, logistics, production process, image, brand or technology) and tries to explain their different relationships with the complex economical and industrial environment.

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It is particularly important to get a proper connection between theory and practice, between pure science and applied science, something that is not trivial and constitutes one of the most difficult aspects to explain, especially from the pedagogical point of view.

To solve the dilemma of connecting the industrial reality to the theoretical concepts it was decided to implement the Harvard Business School Case Method, but adapted to the Engineering approach idiosyncrasy.

In summary, the Case Study describes a real business-engineering and organizational situation. The students have to analyze the problems or issues and work together in a coordinated manner, analyzing the variables and the context involved in the situation, to finally reach a consensual solution.

The problem consists in resolving the cases in the proper way because teaching in the School of Engineering has been based in traditional lectures and students do not participate in practical cooperative experiences to study such problems and situations. The theoretical and practical traditional classes are usually lectures of one session with basically no group participation.



2 Methods

In the following sections we present, in brief, the essential methodological aspects of the e-learning experiences and the distinguishing features of the activities performed.

2.1 The context

The study was part of the Innovation and Improvement Program developed under a series of experiences during five successive academic years, from 2007 to-2012 in the five different subjects of Industrial Organization.

2.2 The objective

We wish to determine if the usage of a learning method based on virtual debates and deliberations in discussion forums:

- a) It could be a satisfactory means for the resolution of practical business cases.
- b) If in a practical way should represent a new and actual opportunity for collaborative learning and really improve the way of teaching of Industrial Organization.
- c) It is a good method to provide a more flexible and diverse way of learning with a greater role of the student, autonomy, discipline and creativity.

2.3 Theoretical aspects

A learning process can be characterized by the existence of a positive synergy of three systems: a learner model, a domain model, and a tutoring model. The tutoring model is based on the pedagogical strategy and the methodology applied, which pillars and foundations were basically two: the theory of Constructivism and the Case Method.

Constructivism was coined by Piaget [1] and Vygotsky [2] authors of the concepts of active learning and social constructivism.

Valeiras and Meneses [3] indicated:

- a) The importance of the concept of mediation and interaction of Vygotsky in constructive learning.
- b) The assimilation process within essential learning proposed by Ausubel et al. [4].
- c) The education for international understanding announced by Gardner [5].

Hernandez [6] declared "constructivism is characterized by creating knowledge through the transmission of information among people. In constructivism, learning is active, not passive".

Alfageme [7] develops one of the best-known cooperative learning methods through class experiences, based on "learning together", term coined by two of the researchers who studied this method from different points of view, Johnson and Johnson [8].

The Case Method is a teaching technique widely used especially in business schools through the description of a specific situation in a given discipline to learn about some aspect through collective analysis and decision making.



Hernández and García [9] mentioned that "in 1870, the new Dean of the Harvard Law School (HLS) decided to replace the lecture by a method of interactive learning based on the Socratic dialogue and the production of a casebook by the students." In 1920, the Harvard Business School (HBS) introduced the Case Method, starting with the subject of Marketing.

The Case Method we have put into practice is the "abstract brief case" as indicated Hernández and García [9] "was proposed by R. Glenn Hubbard, Dean of the Columbia Business School, who began to enter into this school in the fall of 2007". We try to improve the Case Method in two ways: by providing less amount of information to students and giving some clues about possible solutions. This procedure makes the method less complex and more appropriate for the student of the different subjects in Industrial Organization Engineering.

2.5 The Tools

The tool used was the "discussion forums" which, for many authors such as Lee [10] and Bourne [11], increase motivation and participation of the students. Aoki and Pogroszewski [12] concluded that the virtual learning in general and the discussion forums in particular are essential tools to evaluate traditional teaching but have to be structured and adapted to the new educational needs.

Can "discussion forums" provide learning in environments in where it is based on deep practice? Could the method proposed be useful to enhance Industrial Organization learning process? - This was our major aim.

Alfageme [7] estimated that forums provide three types of values:

- a) Improvement of social interaction: integration, cohesion, cooperation, solidarity and empathy.
- b) Personal relationships: self-esteem, expectations, self-control, respect, valuation and confidence.
- c) Educational values: productivity, academic performance, construction of knowledge, participation and responsibility.

Time	Asynchronous intervention and lack of control of the duration and frequency of interventions
Proposal	Training of the tutor - Coordinator - moderator in technology and management Good management facilitates the progress of exchanges
Tech	Lack of technical mastery and agility of their use Impersonal nature of the means of communication
Proposal	Graphical interfaces with photographs of students...
Pedagogy	Students are accustomed to compete and not to share information Difficulties to situate each intervention at the right spot Mixing of messages on parallel talks "chat confusion" or communicative disorder Loss of context or difficulty to follow the thread of the conversation Problems of cohesion or coherence between opinions and answers
Proposal	Guidance and coordination of the moderator which should encourage the development of the skills of interpersonal relationship or personal balance and academic and social skills
Communication	Overload of messages and frequent simultaneous sending of many messages by different participants Facilities that prevent "chat confusion"
Proposal	To include "tagged messages" facility automatically
Management	Difficulties to process the results and classify responses
Proposal	To have extensive facilities online for processing the information exchanged

Fig. 1 Problems, enhancements and solutions of forums according to the authors

The tool used was Virtual Forums of "Aula Global (AG)" a proprietary and closed application and during the final stages "AG2" a more advanced version, lightly more open and partially based on "Moodle".

The development of the series of forums provided a new way of focusing the teaching in Organization Engineering Management subjects (Fig. 2) but at the same time bring a considerable sequence of difficulties to the scenario (Fig. 3).

The tool applied does not classify messages and we had to design a system of classification and arrangement as Chi et al. [13] did in their experiences.

The key point is to differentiate the interactive responses and the contributive ones from the rest of interventions. The interface was also very poor, austere and inflexible.

Thomas [14] expressed the need to improve interaction with graphical interfaces to facilitate it.

Advantages
Greater autonomy to teachers in the design and publication of study materials and in the management of the teaching process
Saving time classroom to carry out part of the activities on the own discussion forums
Considerable improvement of the information available and the level of knowledge of the students: each member of the team can ask questions and exchange information (may attach documents) in real time
Teamwork is built and constitutes the basic an essence of the method
The answers are ordered in time and are recorded individually and collectively
The teacher has all the essential process of the exchange of information and the progress and can vary the scope of the educational objectives during the development of each phase of the work
Speed and agility: the teacher responses must be received quickly speeding up the decision-making towards the final solution
Improvement of evaluation: largest and most accurate information available will allow a more fair and accurate student assessment
New possibilities and more advanced application environments: problems with simulation of circumstances more complex that even could also vary during the period of the discussions can be addressed
It allows adapting the training activities to the new model of continuous assessment of the European Space for Higher Education in which the activity of the student is the epicenter of teaching



Fig. 2 Advantages of forums in Industrial Organization Engineering

All those issues and difficulties had to be enhanced through a series of appropriate actions and methods that were developed along the whole experiment process. It was therefore necessary to develop rules and standards of conduct, define specific types of interventions and determine certain rules for the use of forums (Fig. 3).

3 Results

This work of experimentation, given its diversity and spread, is rich in situations and has brought to us an array of empirical data which has allowed to develop an in-depth analytical study whose extensive description is not feasible to describe here. There were developed 39 different forums (between 8 and 12 students of more than 10 different nationalities per forum).

We use an exhaustive process of time-series clustering analysis and coding, after a previous task of summarizing and classifying messages and conversations. Several patterns and structures of behavior were determined.

Disadvantages, Problems and Advises
Greater commitment and availability: the Professor must almost daily access to verify the information changed and should have the necessary time. The success of a forum depends largely of the moderator. Professor and mediator must continuously check the advance in the objectives and verify if the arguments are the most appropriate
Each teacher must performs a daily monitoring of the development of the discussions with the aim of:
1. Redirect a particular situation, when the thread leads to a situation not suitable for the objectives of the debate
2. Provide general comments to particular topics
3. Ask students they summarizing discussions to reach points of agreement
Difficulty of processing of information: problems for classifying responses and to process the information in the absence of tools and facilities
Time consumption is sometimes excessive
Need to re-design study materials, content and teaching activities
Statistical Process Control Tools for the application of statistical methods are specially required
Teacher training: very specific methodology has to be applied
More training and access to tech tools is indispensable to operate in this environment

Fig. 3 Disadvantages, Problems and Advises of forums in Industrial Organization Engineering

Forums participation was voluntary and the percentage weight of the qualification of the debates in the final grade of the subjects varied between 10% and 30% depending on the case, kind of practice and subject. The duration of the discussion is very important according to Johnson et al [15] and in our case the duration debates ranged from 2 to 8 weeks.

4 Discussions

The topics for discussion were agreed with the students in most of the cases and the main objective was to have a high level of collaboration among all the participants. In this way, Soller and Lesgold [16] studied the most important aspects of a collaborative participation:



- Participants must share their ideas freely.
- All of them have to be actively involved in the discussions.
- Students should establish and share information and the possible solutions proposed.
- The members of the team should encourage others to justify opinions and explain their points of view.

It is important to distinguish the most suitable motivation type at the Engineering School. Serrano [17] found that the experiences of cooperative learning "tend to increase intrinsic motivation to learning". In that sense we try to strengthen the intrinsic factors in the individual that lead to further motivation, especially in engineering students. In such a way, almost the majority of participants (94, 6%) asserted that they were motivated in some way. What is more, 72.4% answered they were very motivated, 21.3% were quite motivated and only 4.1% of the participants did not feel motivated at all.

5 Conclusions

Teaching models of Industrial Organization are not a fixed formula that should be applied in a rigid and inflexible way, on the contrary they must be based on flexibility being carefully applied and arranged according to each particular situation.

Application of the forums in the area of Industrial Organization and in the singular field of Business Administration facilitates the simulation of situations taken from the business reality and allows a widely and deeply study of complex management situations and problems applying conceptual material to real-world. The forums method provides a more practical way to learn managerial skills stimulates students' thinking and encourages discussion.

There are not just problems related to the environment and the external systems and agents but also difficulties in the Organization, the Structure and the Coordination of the debates.

In the different proceedings, practical cases and laboratories of Organization Engineering the professor must be able to introduce, in an easy way, changes in the description and in the significant variables of the case to be studied and even in the objectives to be reached. The instructor must follow and supervise individually and collectively, in a daily basis, the activities of the students, has to be able to analyze the information, to classify and process the records of the conversations and to intervene at the most convenient time. These operations require of one powerful open, easy to use and agile management tool with a broad range of facilities.

The application of the virtual forums technique during the whole period of experiences demonstrated that at least one general classroom meeting to summarize the ideas and present and comment the result and the outcome at the end of the discussions should be necessary. The general meeting obviously could be developed using real time conferencing procedures.

Motivation in 'e-learning' environments is the engine of change and the tutor-moderator should encourage the Group motivation and get students to share the same objectives.

The current applications and e-learning facilities are clearly inefficient. It is necessary that the Education Institutions develop advanced online tools that allow introducing a high level of interactivity in an easy way, to facilitate coordination among the participants and to generate statistical evaluation summaries of activities and interventions, results and ratings.

The put in practice of the study of business cases online in such a way allows flexibility and new facilities and improvements on learning and understanding the complex practical subjects of Industrial Organization.



This research work has allowed us to know and improve the practical knowledge of the concepts of distance learning and the basic characteristics of virtual debates applied to the resolution of business engineering situations through discussion forums and represents:

- A new perspective of Learning Industrial Organization by collaborative learning.
- An analysis of the advantages of the introduction of virtual technologies and discussion forums.
- A new way of understanding and focusing the business administration and Industrial Organization learning processes through qualitative and quantitative methods that facilitate the students the managerial skills that companies and society are demanding.

This work opens the door to further research actions to improve the methodologies of collaborative working and the use of new emerging technologies especially in engineering studies where collaboration among students is a primary requirement.

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