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## **Teaching Management for future Industrial Engineers: A practical approach from the beginning to the end**

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### ***Abstract***

*This paper accounts for an integral academic experience that, by means of an action-research approach, was effectively carried out over a sample of 344 participants, distributed in 12 different groups belonging to the bachelor degree program of Industrial Engineering at a Colombian university. To this end, a set of pedagogical practices, based mainly on study cases supported by ICT tools were implemented. In this study, we include a summary of each case constructed. Also, it is described the assessment process. Outcomes indicate that according to students' perception, there is a clear superiority of these initiatives over traditional teaching processes based on conventional lectures, even after 6 months of the experience. Besides socializing, this work contributes by encourage the transferring of this knowledge into some other contexts in favor to propose further approaches, and help the creation of better educational processes for future professionals in industrial engineering, as well as other professions*

**Keywords:** *Pedagogy in management; teaching-case methodology; ICT for education; action-research.*

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### ***Resumen***

*El presente estudio documenta una experiencia académica integral que, por medio de un enfoque de investigación-acción, se llevó a cabo de manera efectiva sobre una muestra de 344 participantes, distribuidos en 12 grupos diferentes pertenecientes al programa universitario de Ingeniería Industrial de la Universidad Industrial de Santander (Bucaramanga, Colombia). De esta forma, fueron implementadas un conjunto de prácticas pedagógicas válidas con el propósito de enseñar ciertos temas en las disciplinas de gestión. Estas*

*prácticas se basaron principalmente en un proceso de construcción y enseñanza de casos de estudio con sus correspondientes notas de enseñanza, y con un apoyo adicional de una plataforma TIC, que fue útil para permitir y fomentar la participación de los estudiantes en todas las etapas de su implementación. En este artículo, la experiencia se comenta brevemente, incluyendo un resumen de cada uno de los 4 casos construidos. Además, se describe el proceso de evaluación, llevado a cabo por los estudiantes en dos momentos diferentes. Los resultados más importantes arrojados indican que, según el juicio de los participantes, existe una clara superioridad de estas nuevas iniciativas sobre los procesos de enseñanza tradicional basados en clases magistrales convencionales; adicionalmente, existe una evolución positiva de esta percepción, incluso después de 6 meses del estudio. Además de socializar una experiencia positiva y productiva en la pedagogía de los temas de gestión, este trabajo contribuye con la posibilidad de transferir este mismo tipo de prácticas en otros contextos en aras de proponer nuevos modelos teóricos, que pueden ser comprobados empíricamente y ayudar a la creación de mejores procesos educativos para los futuros profesionales de la ingeniería industrial, así como para otras profesiones*

***Palabras clave:*** *Pedagogía en gestión; Metodología de enseñanza de estudio de caso; TIC para educación; Action-Research*

## **Introduction**

Teaching strategies and learning techniques have a significant preponderance in developing fundamental capacities of students of any level and program. Particularly, student-centered strategies are considered to date, a worthwhile effort that leads to good performance of future professionals in management-related areas. At the School of Industrial Engineering and Business (hereinafter, EEIE) of the Industrial University of Santander (hereinafter, UIS) this idea has been at the top of the agenda during these last 5 years, in spite of being considered by the entire community as a technical institution. There, pedagogical methods are aimed to properly educate future professionals in Industrial Engineering, who in turn look for a better performance projects, systems and organization (UIS, nd). From this point of view, since the sense of this program is very similar to the one that is claimed in management-related programs, designing and implementing pedagogical strategies can be shared among them, in order to deliver an effective educational process. Considering the above, it is a clear opportunity for a school like EEIE, to evaluate and eventually adopt new ways to deliver knowledge to their students.

Teaching with cases is one of those alternative techniques that have been evaluated both valid and efficiently by academic community, especially in business schools (Peters, Celucci & Ford, 2015; Yildiz & Palak, 2016). However, the process of regional case-construction together with case-implementation at institutions other than business schools in developing countries, is something that has been neglected by the literature to date. Our purpose with this work is conducting the whole academic process of creating, teaching and evaluating real study cases belonging to the student's environment, and account for obtained results. Our goal with this manuscript is, in turn, to present a rigorous approach of a valid educational practice and provide further evidence of the perception of this particular methodology by participant students.

The entire process carried out and described, corresponds to a conventional action-research approach, when interventions to real life are done and measured, in order to report corresponding results. The departure point of our work was represented by the construction of four local-based cases, that show a sense of "familiarity" with the students, due to their prior awareness of the companies involved. Then, case planification and implementation in the classroom of 2 mandatory courses took place, within the framework of official learning process, established by the EEIE. Finally, the assessment of the teaching experience in two different moments by a sample of 344 students was conducted, in order to obtain valuable feedback of the experience.

Our first contribution is to report a successful educational experience based on case-teaching method, where many details were taking into account to deliver a practice in a non-conventional scenario. Particularly, the fact to understand that industrial engineering students are eager of experienced this kind of exercises into the classroom is something that has to be noted for further applications. This experience can be replicated or adjusted for other programs in the field of engineering, which future professionals have noticed that somehow have to deal with social issues, that can be addressed through a more active educational approach.

The second contribution is based in our finding of a better perception of the activity, even after 6 months of their applications. This result is interesting as active methodologies tend to produce a positive first perception (probably because of their sense of "funny activities") but a decreasing of the same perception after time. Again, the way to define, plan and implement an activity is important to deliver meaning, but the content and its treatment during the activity is critical to obtain sustained results.

And finally, the third contribution is the potential link of this study to other approaches, scenarios or contexts that can be comparable and therefore complemented. In these study, we claim that the efforts made were worthwhile to implement such practices in the classrooms of future industrial engineers in the context of Colombia, especially for issues related to ad-

ministrative and managerial issues. However, a door can be opened to many other possibilities that can both understand better the phenomenon, and/or prove prior theoretical propositions through empirical works.

In the next section of this article, we review the relevant theoretical contributions related to active-learning methodologies and teaching-case methodology in business schools. Then we explain the methodology carried out, when we explain every step, from the case-construction and planification, the case-implementation, to the data collection and analysis for the assessment of the experience. Next, we discuss the results obtained, and finally, we conclude by highlighting important findings, limitations of our research, and areas where further research is needed.

## **Theoretical Background**

Teaching with the use of case studies is considered a widely justified practice by academics and scholars given the fact that instead of being a passive actor, the student becomes the center of the entire process. By a rigorous process of case-teaching, the role of the student is active and interactive, with a great chance to express their criteria and built their character. Likewise, it is stated that the case method is a pedagogical strategy that is more than proven for teaching managerial disciplines (Ellet, 2007), with special emphasis in social sciences topics. Law, Business, Psychology and Sociology are just a few examples of some application areas of this pedagogical method.

The requirement for educational innovation or transformation of the educational process where it is set aside low motivation of students to teaching methodology with a theoretical approach and emphasizes the importance of implementing enterprise learning, strengthening experience through practice and production of the "in situ" knowledge involving flexible and innovative teaching methods to encourage independent learning and student motivation, involving tasks such as processing of real information, deployment of skills for problem solving and enrichment of decision-making, are aspects that constitute a weak environment that promotes learning in EEIE (Serrano, 2013). Given this, the use of laboratories, role play games and case study methodology are the most common, innovative and effective mechanisms in teaching to date (Contreras & Ruiz, 2015). However, it is the Teaching Case Methodology which is particularly important because as a pedagogical strategy is more than proven for teaching managerial disciplines (Ellet, 2007), because it allows to the student the application of the knowledge while in the theoretical approach, the knowledge is delivered (Jakka & Mantha, 2012).

In her work, Serrano (2013) analyzes the academic units of undergraduate programs in industrial engineering from prestigious universities around the world and identified which

among other activities, in their chairs incorporate the Teaching Case Methodology developed in conjunction with the globally leading companies, with the ideal of promoting practical training experience. It is the case method, a technique or practice innovation cognitive learning tool that performs a simulation of reality through the use of language and presents an organized educational dialogue, which transfers the student knowledge about the facts of business reality described through the definition of a problem and its possible solutions, in order that it is familiar with the process of analysis and complex decision making and practical work help you relate the events with the thought and ideas (Blank, 1985, HBS, n.d.; Muñoz and Santoyo, 2013; Brodin, 1978; Miller et al., 1999; Shamos, 1960). However, not only the Business Management courses can be benefited from the use of this methodology of teaching innovation but equally in the Operation Research courses. Penn et. al (2016) say in their work, the Case Teaching Methodology is used in a variety of contexts where the most important advantage of the tool is the development of the skills and competencies of the learner.

According to Abrahams and Millar (2015), practical work with case methodology has two levels of effectiveness where (1) there is compatibility between what the professor tries students to learn with the tasks performed by them and (2) where there is compatibility between what students learn in relation to the learning objectives proposed. By challenging students to take an action or view with respect to a problem presented in one case and deal with it, it implies the involvement of the intellect, the emotions and intuitions, whose impact is that students develop mental agility and power, as they would in their professional lives (Angelo and Boehrer, 2002).

Raju and Sankar (1999), focuses on the perceptions of students and teachers as to the usefulness of teaching cases and learning methods and presents the views of those involved in where the facility is highlighted by the cases allow students to examine the environment, process information, understand and validate previously acquired theoretical knowledge about the subject raised in the case. Also determine the effectiveness of the case method is general for many disciplines since the student regularly have the opportunity to communicate ideas and findings to their peers. Considering the above, the overwhelming effectiveness of using the case study methodology is evident where problem solving skills are developed through this method of active learning (Popil, 2011) who becomes to a necessity in the teaching of the EEIE and specially in the courses that are related with managerial sciences.

Furthermore, Pedraza and Bravo (2011) indicate that the presence of organizational contexts of globally recognized companies in the content of the cases, it is a reality outside from the local business context of EEIE student and this is a disadvantage applying this learning tool. Given that the notion of learning has evolved and is now seen as a process in which students develop their own understanding by assembling facts, experience, practice and participation (Oblinger, 2004).

Now it is even more valuable when the process is fully covered; from the same construction of cases and their teaching notes, their preparation and their effective implementation in the classroom. This makes us think closer to the reality of the context cases; which could awaken an additional interest in the process involved, and clearly more effective in learning outcomes. Documentation and evaluation of educational experience is necessary to the extent that the socialization of these activities support the improvement of teaching and improving teaching methods, adapting them to the emotional factors and motivation of students they determine the changes that are susceptible teaching processes in which the active participation of the same orientation in the case, contact with reality and its interpretation seeks to generate knowledge (Deniz et al., 2008; Sinatra et al 2008;. Scott et al 2007;. Kickul & Fayolle, 2007; Koc, 2011)

## **Methodology**

**Case-Construction and Planification.** For the construction of the case studies, we considered some business situations and initiatives in our own context (Department of Santander, Colombia) which were interesting and useful topics concerning some areas covered by business management like sustainability, new ventures creation, business ethics, organizational behavior and new trends in strategy.. Specifically, cases developed were: (1) the Empresa Colombiana Gas (ECOGAS) now Transportadora de Gas Internacional (TGI), with content focused on the social impact and loss of value share from the sale of a company that provides a natural resource that was strategic and logo in a region such as Santander, ( 2) the Acueducto Metropolitano de Bucaramanga S.A. E.S.P. (AMB) with content focused on sustainability policies contrast with data from social and environmental impacts generated by the bottled water industry and aimed at analyzing the appropriateness with regard to the adoption of business models that are not sustainable and evaluating the identity of a person leading a company and is susceptible to a phenomenon called "Green Washing" referring to the efforts of the organizations to project a more positive image of corporate social responsibility for what is actually true and therefore deserves recognition (Glavas and Godwin, 2013), (3) CREZCAMOS SA focused on brand positioning strategy aimed at vulnerable sections of the population and how a manager gives up control of his business as long as the latter to thrive and grow in the market, and (4) ALICIA WONDERLAND focused strategy social media marketing, new technologies and youth entrepreneurship. In order to define the themes contained in each of the cases aimed at teachers interviews they had under charge of the courses of the Business Management and a group of students who had already studied the subjects were performed. Table 1 shows the topics addressed with their respective learning methodology.

**Table 1. Issues and methodologies in the area of Business Management in EEIE**

<b>Topic</b>	<b>Methodology</b>
The Organization	Explanation and discussion of the theory
The External Environment	Workshops confrontation of reality
Decision-Making	Role Play
Management and Strategy	Observation and discussion of specialized videos
The Structure	Explanation and discussion of the theory
Resource Management	Explanation and discussion of the theory
Leadership	Case Methodology
Work Teams	Role Play
Processes and Procedures	Explanation and discussion of the theory
Organizational Control	Explanation and discussion of the theory
Knowledge Management	Explanation and discussion of the theory
Learning Organizations	Observación y discusión de videos especializados
Organizational Structure and Design	Explanation and discussion of the theory
Strategic Management	Case Methodology
The New Approach to Human Resource Management	Lecture on the contents
Recruitment Process	Lecture on the contents
Performance Evaluation	Lecture on the contents
Compensation Systems	Lecture on the contents
Labor Welfare	Lecture on the contents
The Organization	Explanation and discussion of the theory

**Table 1. Continued**

Topic	Methodology
The External Environment	Workshops confrontation of reality
Decision-Making	Role Play
Management and Strategy	Observation and discussion of specialized videos

Source: Own

Prior to the information consultation it was decided that cases would be like the third generation, that is, they would focus mainly on decision-making, as indicated by the characterization methodology presented in the structuring and development of case EAN University. Consistent with this structuring is carried out using the methodology proposed in EAN University research notebook (Pérez, 2011). cases.

Also, It was took into consideration that in the process of writing a case it is necessary to carry two parallel processes, one is concerning to the search of information and its documentation, while the other is a scientific process of searching and testing continues hypothesis on data. The information collected was organized and evaluated for selecting more timely data to support the case and then write it in a global language to facilitate the understanding thereof to any reader. The four documents were provided in written form, in PDF format and were implemented using the Information and Communication Technologies (ICTs).

Below, summaries of the four case studies resulting from the process of construction are presented:

- **CREZCAMOS: a step forward to growth?** (Contreras, Marciales & Castro, 2015)  
*This is the case of the young entrepreneur Mauricio Osorio, who faced the challenge of turning an idea into a profitable and socially sustainable business model, named CREZCAMOS S.A., after recovering of the commercial dead of his former microfinance credit project called FUNDACOOOP. Osorio established the capital of his new company at the end of 2009, with the help of an European impact investor. At the end, Osorio and his team clashed with the uncertainty about the strategy that would allow them to grow and achieve the success they wanted. The Executive Board of this company scheduled a meeting in order to discuss the future strategic course of the company, looking for alternatives of growth with the intention of ensuring a viable future, and lead this microcredit company to achieve national coverage, and, at the same time, meeting the expectations of its shareholders, customers and employees.*

- **ALICIA WONDERLAND and the redesign of its model business**<sup>14</sup>

*In 2009, Sergio Andres Serrano Rios who was a student of sixth semester of Mechanical Engineering at the Universidad Industrial de Santander (Bucaramanga, Colombia), took the decision to start a small business of footwear with own design, using machinery for manufacturing footwear that their parents had an old family business and that it had failed in previous years. To start his project, Serrano had to overcome several drawbacks such as lack of family support, criticism of footwear designs and insufficient financial resources for the acquisition of the necessary raw materials and covering advertising costs. However, he managed to develop his idea and position among young people in Bucaramanga, differing among its competitors through bold designs, excellent quality and advertising campaigns via web, reaching steady growth in sales and making an impact on the community through job creation.*

*Once the company is established, Serrano decides to devote himself entirely to his business, so he sets out to create a business strategy that allows take towards internationalization and positioning in the young population to a higher level. Serrano commercial proposals raises to put consideration of the board (comprised mostly of family members) are: Focus on customizing shoes using web tools for designing and marketing, successfully reducing the production line by the very nature orders; and create a production line in order to target customers who purchase the product wholesale causing the increased production capacity of the plant, and the change in the pattern of marketing.*

- **AGUAVIVA: strategy exercise or sustainability?**<sup>15</sup>

*AGUAVIVA case shows the situation faced by the executive manager of the Acueducto Metropolitano de Bucaramanga S.A. E.S.P. (AMB) (Colombia), with respect to economic business unit corresponding to the production of bottled water AGUAVIVA, which leads to the question of the relevance of it, due to unfavorable economic results of the operation, coupled with the fact that the company engaged to the dairy sector, “Freska-Leche” canceled the maquila contract signed with the AMB because of the acquisition of Freska-Leche assets by ALQUERÍA SA in 2014, considering that ALQUERÍA S.A. within its product portfolio had not considered the production of bottled water. It also takes into account factors such as corporate social responsibility and Greenwashing that may be driving the AMB has been nationally recognized for this reason, because the production of bottled water has an impact on society and the environment. Taking into consideration the above as well as information*

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<sup>14</sup> Case study presented as a paper at the 50th Annual Assembly of the Latin American Council of Management Schools, CLADEA, Vina del Mar, Chile, September 2015..

<sup>15</sup> Case under review in the International Journal of Teaching and Case Studies. (<http://www.inderscience.com/jhome.php?jcode=ijtcs>)

*for the retrospective and prospective growth of the global market and the distribution of the Colombian market of bottled water, to deepen in the questioning of the relevance of the business in Bucaramanga and contrast that may have production processes with Corporate Social Responsibility policies, in this case the business unit AGUAVIVA.*

**- ECOGAS to tgi - loss of social value?<sup>16</sup>**

*In July 2004, a proposal to the Congress of Colombia, for the sale of Empresa Colombiana de Gas (ECOGAS) was presented. This important gas transporter was created in 1997 in the city of Bucaramanga and for more than 10 years was a business major in the department of Santander, also a pioneer in consolidating the culture of gas in Colombia, which generated profits net equivalent of USD \$ 90,163 for 2004. In the session where the government project to sell ECOGAS was discussed, presentation and defense of different positions by the Congress was allowed to lapse. Proponents considered necessary the income for the sale to stabilize the debt that was generated with the creation of it and free up resources for investment by the State, on the other hand, opponents ECOGAS was considered a strategic company for the development of Santander region. Finally, on December 6, 2006 the government at a public hearing, ended with great success the process of selling ECOGAS, the result had an impact on the public, generating a variety of opinions and questions about whether he had made the best decision for the region or if such action is carried out in order to cover irregularities and political interests in the process.*

**Case-Implementation.** Conventional lectures in the teaching-case methodology are based on guided discussions, where the professor is only the mean that boosts reflection into the students with a specific learning objective. This is considered a powerful student-centered teaching strategy that can impart students with critical thinking, communication, and interpersonal skills (Schwartz, 2015). According to CTL (1994), professors interested in involving the students in classroom discussion have found that teaching with cases can provide a rich basis upon which to develop students' problem-solving and decision-making skills.

However, our aspiration consists on transcending the mere learning and reflection over a topic, by creating a multi-level scenario that encourage participants into the possibility of creation meaning, and to make them feel able to transform reality. Something that combines rigor with the flexibility of using many tools in the process; learning of a certain study object with the development of several skills that will be useful in their future as professionals. That

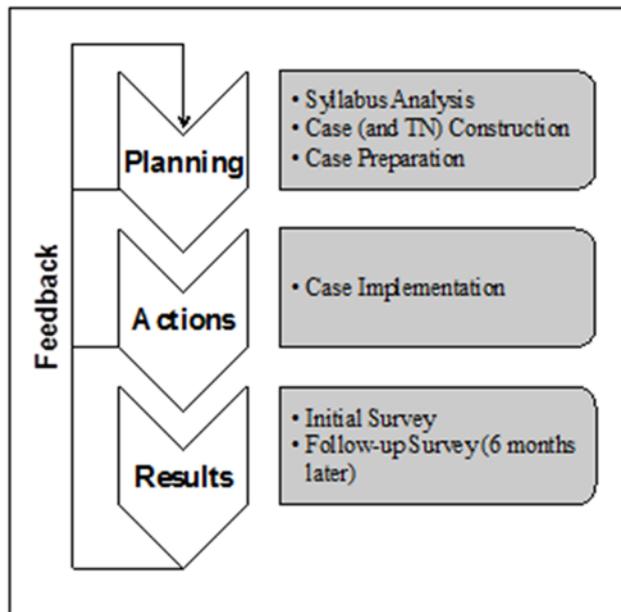
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<sup>16</sup> Case study presented as a paper at the 50th Annual Assembly of the Latin American Council of Management Schools, CLADEA, Vina del Mar, Chile, September 2015.

is the reason why this challenge was faced by intervening an educational process and somehow assessing its effectiveness by count of participant's own perception.

In this regard, and taking into account that the faculty of the School is constantly self-encouraged to probing and using innovative techniques in order to conduct their teaching process, we base our study in a typical action-research approach, where fact-findings are not merely analyzed in order to build a diagnosis, but to help to improve a problematic situation (Lewin, 1946). That was why we followed a systematic process, which besides the alignment with the theory (Lewin, 1958; Mills, 2000; and Potash and Kalmanowits, 2016) it also allowed us to make decisions that were effectively designed into the syllabus of two courses, and afterwards executed in the classroom with the support of ICT (See Figure 1).

**Figure 1. Process for the Action-Research Approach**



Source: Own

### **What did the exercise consist of?**

The implementation of this process was carried out in 4 consecutive semesters (years 2012-2013), within 12 different groups, equally distributed over 2 different courses belonging to the same area of study (Management) of the program of Industrial Engineering at the Universidad Industrial de Santander in Bucaramanga city, Colombia. The total number of participants was 344, which represents an average of 28.67 participants per group. We name them "participants", since it is possible that one student attend both courses in the same semester

or in different semesters. Needed to say, one of the authors acted as a professor for every scenario and conducted all the evaluations.

The courses are called: (1) Strategic Management; and (2) Managerial Skills, and are part of the ‘final sprint’ of the program (usually conducted during last year). Needed to mention, the cases and activities for each course were naturally different (See Table 2), but since the purpose of this work is exclusively related to the implementation of a singular technique into a specific educational process belonging to a special context, rather than whitening particular courses, no different treatment took place among these in order to make the corresponding data collecting and analysis.

**Table 2. Features of cases constructed and implemented**

<b>Course</b>	<b>Case</b>	<b>Subject</b>	<b>Schedule</b>
<b>Strategic Management</b>	ECOGAS	Competitiveness	3rd. Week
	ALICIA WONDER- LAND	Marketing Strategy	10th. Week
<b>Managerial Skills</b>	CREZCAMOS	Leadership	5th. Week
	AGUAVIVA	Sustainability	13th. Week

Source: Own

It should be noted that the program of Industrial Engineering at this University comprises a total of 10 cycles (1 cycle per semester), and therefore students demonstrate an age range between 21 and 25. The gender ratio in the sample was 63%-37%, with a female predominance. The hourly intensity for both courses was 4 hours a week for 16 weeks of conventional lectures, plus an important amount of time represented in class preparation, reading, individual study and other tasks. Besides, since the activities designed for this work were related with ICT, the teaching process was also been supported through the EDMODO platform ([www.edmodo.com](http://www.edmodo.com)), which is a sort of open, interactive, and free educational social network, that hereinafter is going to be called ‘the platform’.

Specifically, each implementation was done using two elements in which the subjects of study and their relevant topics were totally covered in each case. On the one hand, participants were engaged to a process of continuous interactions and task-oriented activities (both

in person and online); and on the other hand, the corresponding professor rigorously conducted a conventional student-centered teaching-case methodology. Each work-plan for each teaching case is suggested and described into the respective teaching note (TN).

In the first part, the cases were shared with participants (the same case for the entire group), accompanied with a set of relevant readings, videos and analytic questions. Random sub-groups were formed and identified through the platform in order to be asked to discuss each case and work out in a specific task, which is related with the substance of the corresponding case. Some tasks are focused on designing a better alternative (or decision) in order to construct a desired scenario, while others consist on interpreting the situation in a more macro level. However every task implies a prior submission by means of an interactive presentation (video, ppt, flash, etc.) that has to be uploaded to the platform in order to be observed by everyone in the group before the face-to-face lecture. Usually, the time given to achieve the entire objective was between 2 and 3 weeks in advance.

Later, a 4-hours class (with a 15-minutes break in the middle) is needed to discuss the substance of each case and the planned activity. Each student is invited to participate in the reflexive session, and each sub-group has the opportunity to present their conclusions, which are mainly derived from the feedback provided by the rest of the participants before (through the platform) and during the class. Participation was mandatory, but discussions had to be mediated by the professor in order to obtain a fluent and productive analysis.

**Data collection.** Our proxy for measuring effectiveness was the participants' insights manifested through their "judgment" about some features and outcomes derived of the activity. A first round of measurements took place at the end of the implementation of the second case in each group, followed by a second round (a follow-up survey with the same questions written and presented in a different form) that was applied after one semester of finalizing respective courses. Surveys were designed and applied using Google Drive, which link was submitted through the platform. Responses rates were 100% for the first round and 77.03% (265 participants) for the second one. This latter result is mainly due to the lack of direct contact with participants after finishing the courses.

Questionnaires were designed by attending recommendations of Krosnick and Presser (2010), where 4 bipolar open-ended questions (each with a 5-scale points possible answers: from -2 to +2) intended to ask the participants regarding the comparison of traditional methodology with the described methodology (local teaching cases + ICT), which was experienced by them during the respective courses. As said before, "judgment" was the only dimension that was effectively measured by each question, which had a specific purpose related

with the learning process: Professor performance (Q1); Resources used (Q2); Future contribution (Q3); and Overall perception of the activity (Q4); those were considered our 4 variables.

Note that, even though data collection process occurred in different courses after the implementation of different cases, and besides, as natural, there were different types of students (in terms of gender, age and social strata, among others), for the sake of this analysis they were globally analyzed, with total independence of these situations.

Rather than being developed statistically, data interpretation was based on a pragmatic inference (Schwarz, Knäuper, Hippler, Noelle-Neuman and Clark, 1991), where the comparison is logical and direct; given the nature of every variable, which as mentioned, is based on a bipolar scale (See Table 3). At the same time, it was made a comparison between results obtained in the first and second round in order to measure overall consistency and to detect a certain variation in their responses, due to further reflections or personal experiences that could occur during those 6 months of difference. Since the dataset is composed basically by observations of ordinal variables (only five possible options for each case) we treat this analysis in a more qualitative, than a quantitative way, meaning that besides a graphical summary of the distribution, the central tendency will be measured only by means of the mode and somehow the overall behavior of the variables for each time of observation.

**Table 3. Bipolar scale used in the instrument**

-2	-1	0	+1	+2
New methodology is extremely inferior than conventional methodology	New methodology is somewhat inferior than conventional methodology	Neutral point between new methodology and conventional methodology	New methodology is somewhat superior than conventional methodology	New methodology is extremely superior than conventional methodology

Source: Own

Furthermore, it is important to make clear that in spite the opportunity to measure consistency in the answer of each participant, by comparing both results of the questionnaire (round 1 with round 2), no one-to-one analysis took place since the purpose of this measurement was focused on determin global, rather than individual results.

**Results.** According to the participants’ assessment, it was clear since the beginning of this work, the high acceptance granted to the activities executed and described above. In a consistent way, for the first round as well as the second round of observations, every variable was positively evaluated, with several special mentions that are worth to highlight. The only strong exception for this overall scrutiny was the variable “resources” on the first round (although improved in the second round), which can be noted when observing Modes behavior (Table 4)

**Table 4. Modes per Variable (Round 1 Vs. Round 2)**

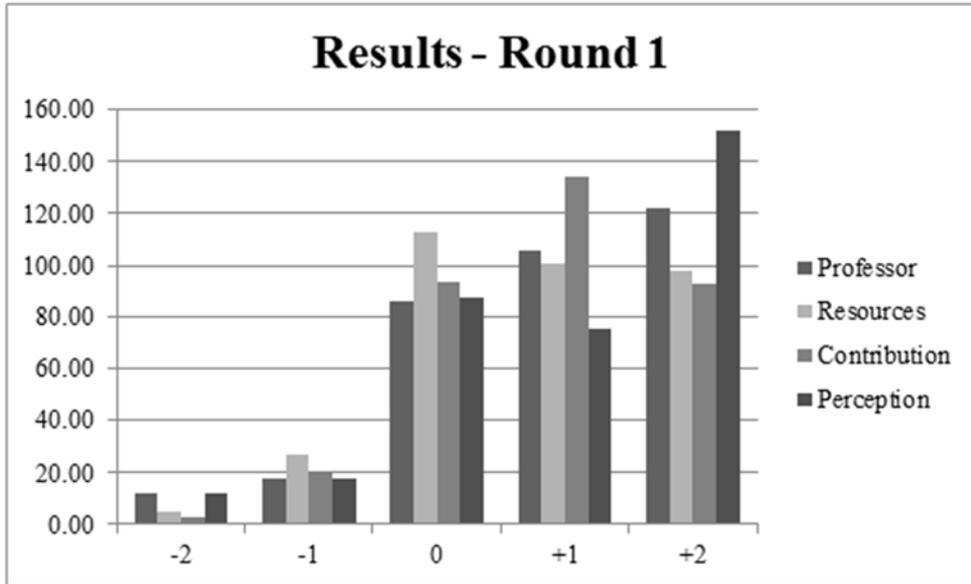
Variable	Round 1			Round 2		
	Mode	Mode Frequency	Mode Percentage	Mode	Mode Frequency	Mode Percentage
<b>Professor</b>	+2	122	35,47%	+2	114	43,02%
<b>Resources</b>	0	113	32,85%	+1	83	31,32%
<b>Contribution</b>	+1	134	38,95%	+2	134	50,57%
<b>Perception</b>	-2	152	44,19%	+2	136	51,32%

Source: Own

When observations of positive values are summed (+1’ and +2’), it is noted that for the first round of observations (happened just after the implementation), the positive judgment of participants for the variable “professor” where 66.28% of the responses, which suggested a preference of the professor’s role in this new methodology over the traditional one. In the same line, but in a lower value, the other variables were also considered superior, with the exception of the variable “resources”, that in certain way, showed a virtual majority of a neutral result (32.85% of observations were ‘0’) and an important figure of 9.30% that implies that for this specific item the new methodology was inferior than what it has been done before (-1’ and -2’ together). This means that somehow, participants did not feel that too

much value was added through the educational resources that were used in order to implement these new practices. See Figure 2.

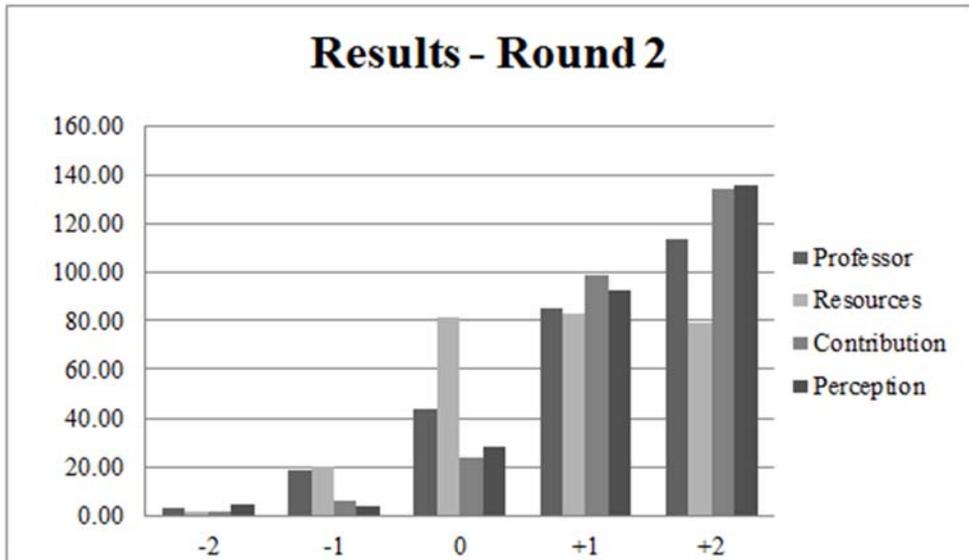
Figure 2. Comparison of Item's Results – Round 1



Source: Own

Likewise, for the measurements made after 6 months (second Round), it was even more evident the good perception that the new activities effectively constructed into the participants' minds. However, interestingly for this stage, the variables "contribution" and "overall perception" became the leading indicators, with a mark of clear favorability of this new methodology over the traditional one, given by 87.92% and 86.04% of the responses in this direction, respectively (obtained when '+1' and '+2' values get together in each variable). Under this same analysis, with regard to the variables "professor" and "resources", slight improvements in student perceptions was noted among rounds of observations. For the case of the former variable, total favorability moved from 66.28% to 75.09%; while for the case of the latter, this same impression moved from 57.85% to 61.13%. See Figure 3.

Figure 3. Comparison of Item's Results – Round 2



Source: Own

As mentioned before, even though, no statistical analysis was applied for the dataset, a simple adjustment with further “statistical” interpretation was carried out to obtain latter results. This was made by turning the bipolar scale into a unipolar scale, by means of the equivalence with a 1-5 nominal numeration (where the value of ‘1’ was assigned to ‘-2’, ‘2’ to ‘-1’, ‘3’ to ‘0’, ‘4’ to ‘+1’, and finally ‘5’ was assigned to ‘+2’) and calculating corresponding averages in pursuance of a calculation their percentage variations. Note that this transformation is useful only for this purpose because of the variables nature and the original meaning of the bipolar scale; in other words: these new values are not valid to being assumed as typical “up-to-five” measures for each variable. See Table 5.

**Table 5. Equivalences and variation (Round 1 Vs. Round 2)**

<b>Equivalence</b>	<b>Round 1</b>	<b>Round 2</b>	<b>Variation (%)</b>
<b>Professor</b>	3,90	4,09	4,91%
<b>Resources</b>	3,76	3,82	1,68%
<b>Contribution</b>	3,85	4,35	12,78%
<b>Perception</b>	3,98	4,32	8,57%
<b>TOTAL</b>	<b>3,87</b>	<b>4,14</b>	<b>7,03%</b>

Source: Own

In this sense, one notice that all the results evolved from one round to the other in a positive direction, meaning that original results that were in line with the consideration of a clear sympathy of this methodology over other pedagogical activities were maintained, and even enhanced through the time. Special mention has to be made to the behavior of the variable “contribution”, which rose by 12.78%, followed by the variable “perception” that also rose by 8.57% from one period to another. To highlight: when comparing, the overall value of the experience (average of averages) was graded a 7.03% better in the second measurement in relation with the first assessment.

## **Discussion and Conclusion**

Results obtained in this work are coincident with other exercises carried out by other scholars in diverse knowledge areas. However, the novelty of this activity is represented by the complete intervention of the educational process, from the beginning (adaptation to the syllabus and construction of teaching cases with their corresponding teaching notes) to the end (entire implementation with immediate and postliminary assessments).

In this attempt, we identify some practices, embedded into a methodology, in which the role of students becomes very active in terms of their motivation and participation in the classroom; specially when are compared with more traditional methodologies such as conventional lectures, conferences and workshops. This statement is coherent with Angelo and Boehrer (2002), who mentioned that the power of the teaching case methodology (heart of what was designed and implemented in this work) lies in the active participation of the students because they can determine the relevant facts, analyze them, and draw conclusions about the causes of the problem and the decisions to make.

The broad judgment of the interventions that took place during this work, gave a clear signal of the openness and favorability that students can confer to diverse responsible and focused initiatives into the classroom in order to achieve predefined learning outcomes, even months

after the experience. This supports the idea that experimentation and willingness to novel processes represents an interesting door that is permanently open, and indicates that new opportunities to expand and socialize knowledge can also be engaged from this point of view; especially when using approaches like Action-Research where reality can be positively affected in order to measure and account for.

Results obtained suggest that the students can engage once they perceive discipline in the organization and preparation of the entire process. Particularly when many details are taken into account, and make the experience more interactive and more “fun”. Presumably, the fact of being immersed in different rhythms and activities during the sessions, make them feel responsible of the process too. Obviously, this is an attitude perceived for the general audience, with several exceptions, which correspond to deviant cases that can be analysed through further studies.

We want to make clear that although our findings that are aligned with an evident superiority of the perception about the new methodology over traditional practices; they do not necessarily imply that the learning objectives were effectively achieved. That is why it is important to conduct further researches that, for instance, can measure the real long-term impacts of these kinds of initiatives, meaning that further robust longitudinal researches are encouraged to conduct. Moreover, there is room for other relevant studies that intend to resolve related research questions like the effects of other emergent methods such as Challenge-based learning and/or Social pedagogy that enables students not only to solve collaboratively problems but also to identify them in the society.

Theoretical implications of this work can be represented in further studies that correlate certain factors like the adoption of new pedagogical methodologies or the use of factual and close experiences with the participants, with their performance both as students or as future professionals; also can be related with more general constructs like educational quality or impact to the society. This study can even transcend the academia into more organizational environments, where new methods of training can be analyzed (and probed from a practical perspective) in order to create an adequate set of competencies for employees and achieve objectives of competitiveness and sustainability for their organizations.

A natural limitation of this work is given by its own nature of being a single case of study that reports a single experience (probably an interesting and positive one), but that cannot be generalized as if it were a discovery of a “revolutionary knowledge”. On the contrary, the main contribution of this study is mainly the possibility of transferring this same experience into some other contexts, which can prepare the ground for strong theoretical models that in the long term can be rigorously tested.

## References

- Abrahams, I., & Millar, R. (2008). Does practical work really work? A study of the effectiveness of practical work as a teaching and learning method in school science. *International Journal of Science Education*, 30(14), 1945-1969.
- Angelo, T., and Bohrer, J. (2002) "Case Learning: How does it work? Why is it effective?", [online], University of California, [www.soc.ucsb.edu/projects/casemethod/caselearning.pdf](http://www.soc.ucsb.edu/projects/casemethod/caselearning.pdf)
- Blank, S. (1985). Effectiveness of role playing, case studies, and simulation games in teaching agricultural economics. *Western Journal of Agricultural Economics*, 10(1), 55–62. Retrieved from <http://www.jstor.org/stable/40987676>
- Brodin, G. (1978). The role of the laboratory in the education of industrial physicists and engineers. *The role of the laboratory in physics education*, 4-14.
- CTL. (1994) "Teaching with Case Studies", *Speaking of Teaching*, Vol. 5, No. 2, pp 1–4.
- Contreras, O. E., & Ruíz, E. T. (2015). Pedagogical Innovation: Key Driver for the Educational Process of Future Industrial Engineers--The Case of Industrial University of Santander (UIS), Colombia. *International Journal of Information and Education Technology*, 5(3), 220.
- Contreras, O., Muñoz J. A., & Hernández, J. P. (2015). CREZCAMOS:¿ Un paso adelante hacia el crecimiento?(Crezcamos: A step forward to growth?). *Tec Empresarial*, 9(3), 39-49.
- Deniz, H., Donnelly, L. A., & Yilmaz, I. (2008). Exploring the factors related to acceptance of evolutionary theory among Turkish preservice biology teachers: Toward a more informative conceptual ecology for biological evolution. *Journal of Research in Science Teaching*, 45, 420–443.
- d.school (2011) "The Bootcamp Bootleg", [online], Stanford University, [dschool.stanford.edu/wp-content/uploads/2011/03/BootcampBootleg2010v2SLIM.pdf](http://dschool.stanford.edu/wp-content/uploads/2011/03/BootcampBootleg2010v2SLIM.pdf)
- Ellet, W. (2007). *The case study handbook: How to read, discuss, and write persuasively about cases*. Harvard Business Press.
- Glavas, A., & Godwin, L. N. (2013). Is the perception of ‘goodness’ good enough? Exploring the relationship between perceived corporate social responsibility and employee organizational identification. *Journal of Business Ethics*, 114(1), 15-27.
- Harvard Business School. *The HBS Case Method*. [Online] Available: <http://www.hbs.edu/mba/academic-experience/Pages/the-hbs-case-method.aspx>.
- Jakka, S. R., & Mantha, S. R. (2012). Case Study Method of Teaching In Management Education. *Journal of Business Management & Social Sciences Research*, 1(3).
- Kickul, J. & Fayolle, A. (2007). Research in Entrepreneurship Education: Introduction and Overview. En FAYOLLE, A. (Ed.), *Handbook of Research in Entrepreneurship Education*. Aldershot: Edward Elgar Publishing.

- Koc, M. (2011). Let's make a movie: Investigating pre-service teachers' reflections on using video-recorded role playing cases in Turkey. *Teaching and Teacher Education*, 27(1), 95-106.
- Krosnick, J. A., & Presser, S. (2010). Question and questionnaire design. *Handbook of survey research*, 2, 263-314.
- Laufer, W. S. (2003). Social accountability and corporate greenwashing. *Journal of Business Ethics*, 43(3), 253-261.
- Lewin, K. (1946) Action research and minority problems. *Journal of Social Issues* 2(4): 34-46.
- Lewin, K. (1958). *Group Decision and Social Change*. New York: Holt, Rinehart and Winston. p. 201.
- Millar, R. (1998). Rhetoric and reality: What practical work in science education is really for. *Practical work in school science: Which way now*, 16-31.
- Millar, R., Le Maréchal, J. F., & Tiberghien, A. (1999). Mapping 'the domain: Varieties of practical work. *Practical work in science education*, 33-59.
- Mills, G. E. (2000). *Action research: A guide for the teacher researcher*. Prentice-Hall, Inc., One Lake Street, Upper Saddle River, New Jersey 07458.
- Muñoz , M. and Santoyo, V. H. (2013). Guía metodológica para la redacción de estudios de casos. Universidad Autónoma De Chapingo. [Online]. Available: <http://bv.ciestaam.edu.mx/attachments/article/72/Munoz%20Manrubbio--Guia%20metodologica%20para%20redaccion%20de%20estudios%20de%20caso.pdf>.
- Oblinger, D. (2004). The next generation of educational engagement. *Journal of interactive media in education*, 2004(1).
- Pedraza, A. C., & Bravo, E. R. (2011). Changes in Pedagogical Tools. *Revista EAN*, (71), 84-99.
- Penn, M. L., Currie, C. S., Hoad, K. A., & O'Brien, F. A. (2016). The use of case studies in OR teaching. *Higher Education Pedagogies*, 1(1), 16-25.
- Pérez, R. I. (2011). Metodología para la estructuración y desarrollo de casos.
- Peters, C., Cellucci, L. W., & Ford, K. (2015). Cases in the Classroom. *Journal of Case Studies*, 33(1), 1-10.
- Potash, J. S., & Kalmanowitz, D. (2016). *Social Action Research Methods and Art Therapy*. The Wiley Handbook of Art Therapy, 626-635.
- Raju, P. K., & Sankar, C. S. (1999). Teaching real-world issues through case studies. *Journal of Engineering Education*, 88(4), 501.
- Ramus, C. A., & Montiel, I. (2005). When are corporate environmental policies a form of greenwashing?. *Business & Society*, 44(4), 377-414.
- Schwartz, M. (2015) "Teaching Methods for Case Studies", [online], Ryerson University, [www.ryerson.ca/content/dam/lt/resources/handouts/CaseMethodBestPractices.pdf](http://www.ryerson.ca/content/dam/lt/resources/handouts/CaseMethodBestPractices.pdf)
- Schwarz, N., Knäuper, B., Hippler, H. J., Noelle-Neumann, E., & Clark, L. (1991). Rating scales numeric values may change the meaning of scale labels. *Public Opinion Quarterly*, 55(4), 570-582.

*Teaching Management for future Industrial Engineers: A practical approach from the beginning to the end*

- Scott, P., Asoko, H., & Leach, J. (2007). Student conceptions and conceptual learning in science. In S. K. Abell & N. G. Lederman (Eds.), *Handbook of research on science education* (pp. 31–56). Mahwah, NJ:Lawrence Erlbaum Associates.
- Serrano, L. F. (2013). *Diseño de un plan estratégico para la Escuela de Estudios Industriales y Empresariales de la Universidad Industrial de Santander*. Universidad Industrial de Santander.
- Shamos, M. H. (1960). *Science and the Humanities. Re-thining Science Education*. Fifty-ninth Year Book, National Society for the Study of Education.
- Sinatra, G. M., Brem, S. K., & Evans, E. M. (2008). Changing minds? Implications of conceptual change for teaching and learning about biological evolution. *Evolution: Education and Outreach*, 1, 189–195.
- UIS. Universidad Industrial de Santander. (n.d.). *Objetivos del Programa Académico de Ingeniería Industrial*. Retrieved February 14, 2016, from <http://www.uis.edu.co/webUIS/es/academia/facultades/fisicoMecanicas/escuelas/estudiosIndustrialesEmpresariales/programaAcademicos/ingenieriaIndustrial/objetivos.jsp>
- Yildiz, M. N., & Palak, D. (2016). Cultivating Global Competencies for the 21st Century Classroom: A Transformative Teaching Model. *International Journal of Information Communication Technologies and Human Development (IJICTHD)*, 8(1), 69-77.