

**EXPERIENTIAL LEARNING AS A METHODOLOGY TO ENGAGE EDUCATIONAL INITIATIVES TO OPERATIONAL PROBLEMATICS IN MICRO COMPANIES****EL APRENDIZAJE EXPERIENCIAL COMO METODOLOGÍA PARA VINCULAR INICIATIVAS EDUCATIVAS A PROBLEMÁTICAS OPERATIVAS EN MICROEMPRESAS**

**Patricia Huanca Cortez, Agatha Clarice da Silva-Ovando**

*Centro de Operaciones Logísticas (CeOL)*

*Universidad Privada Boliviana*

agathadasilva@upb.edu

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**ABSTRACT**

One of the largest gaps about the superior educational system in Bolivia has been that undergraduate students enter the job market unready to face the complex reality and dynamic environment that companies have. Traditional methodologies in classroom establishes roles where the professor gives the student specific content to be learnt in the class and later applied in a fictional scenario. However, students may not see clearly how to take the content from lectures to a real context. Therefore, it is important to implement methodologies that bring students and teachers out of their comfort zone and allow them to analyse real companies' problems, proposing solutions and developing competences that are relevant to reality. On the other hand, from big to small companies, face different concerns daily: Efficiency, productivity, customer service, among others. Many of those issues may be trivial, however, routine usually blind the decision-maker to identify and seek for solutions. With the help of a fresh perspective provided by higher education students, companies would be able to identify, display resources and attention to small routinary problems. The implementation of experiential learning methods, such as Challenge-based learning, is an important alternative for both universities and companies due it offers a win-win relationship between them with direct and clear benefits and advantages. This paper gives special attention to micro companies, which are often beyond the scope of industrial and educational innovation activities, due to lack of interest, knowledge, or the preconception that because of having simpler processes, these businesses should not be given attention to.

**Keywords:** Experience-Based Learning, Challenge-Based Learning, Micro Companies.

**RESUMEN**

Uno de los mayores vacíos del sistema educativo superior en Bolivia ha sido que los estudiantes de pregrado ingresan al mercado laboral sin estar preparados para enfrentar la compleja realidad y el entorno dinámico que tienen las empresas. Las metodologías tradicionales en el aula establecen roles donde el profesor entrega al estudiante contenidos específicos para ser aprendidos en clase y luego aplicados en un escenario ficticio. Sin embargo, es posible que los estudiantes no vean claramente cómo llevar el contenido de las clases a un contexto real. Por ello, es importante implementar metodologías que saquen a los estudiantes y docentes de su zona de confort y les permitan analizar los problemas reales de las empresas, proponiendo soluciones y desarrollando competencias pertinentes a la realidad. Por otro lado, desde las grandes hasta las pequeñas empresas, se enfrentan a diario a distintas preocupaciones: Eficiencia, productividad, servicio al cliente, entre otras. Muchos de esos problemas pueden ser triviales, sin embargo, la rutina generalmente ciega al tomador de decisiones para identificarlos y buscar soluciones. Con la ayuda de una nueva perspectiva proporcionada por estudiantes de educación superior, las empresas podrían identificar, desplegar recursos y atención a pequeños problemas rutinarios. La implementación de métodos de aprendizaje experiencial, como el aprendizaje basado en retos, es una alternativa importante tanto para las universidades como para las empresas, ya que ofrece una relación ganar-ganar entre ellos con beneficios y ventajas directas y claras. Este trabajo presta especial atención a las microempresas, que muchas veces quedan fuera del alcance de las actividades de innovación industrial y educativa, por falta de interés, conocimiento o por la idea preconcebida de que por tener procesos más sencillos no se les debe prestar atención.

**Palabras Clave:** Aprendizaje Basado en Experiencias, Aprendizaje Basado en Retos, Microempresas.

**1. INTRODUCTION**

Enterprises from different fields face many struggles due its lack of resources; being them financial, human, schedule, or tools to face and solve the problematics related to quality, productivity, logistics, and operations in general. Academia should be able to aid companies to find innovative solutions for every-day issues, however, separation between the academic field and industry continues to be a problem for universities in Bolivia and around the world.

Not only the cooperation among those important actors of society in Bolivia is still unclear, but the outcome of higher education professionals also presents a disparity of what industry requires. The Bolivian and Latin American reality shows that there is still a significant skills gap between what new professionals offer and what employers require.

According to an analysis carried out by the Inter-American Development Bank (IDB) in 2015, around 30% of vacant positions in the Bolivian labor market are not filled because there are no applicants with the skills required to perform the job. Because of it, companies include among the basic requirements, a certain level of experience that allows them, in a certain way, to guarantee the development of skills. This leads to a negative reinforcer behavior of the situation, hindering recruitment of new professionals, restricting them to be more competitive in the labor market. As a result, around 13% of young people with advanced studies are still unemployed [1], leading to informal job offers spread, as well as worse working conditions, lower wages, and an increase in unemployment rates. This trend is replicated in the region and demands to improve the quality of university education and the development of skills and competencies required by companies from this level [2].

On the other hand, companies in the region are still hesitant to take the risk of hiring inexperienced professionals, considering that their own market does not offer them stability, and they need to ensure that their investment in personnel helps them prosper in an unfavourable market. As an example of the uncertainty in which local companies find themselves, by 2018, 2 134 companies registered in the commercial registry, from which 528 closed operations in the same year, representing nearly 25% of all companies registered.

During 2020, the registration of new companies decreased by 7% [3]. On the other hand, it is known that the mortality of small companies in Bolivia occurs 9% of the time between 0-1 year of life, 45% closes during the first 2 to 3 years of life, 32% between 4 -9 years of life and 18% after 10 years of operation.

Furthermore, it is known that from all legal established companies, nearly 35 932 are classified as manufacturing industries and more than 3 300 companies engaged in agriculture, hunting, fishing, and forestry [3]. The productive sector presents high variability and continuous challenges; turning this category into potential external partners for the university to implement the Challenge-based Learning methodology.

In this same context, it is pertinent to describe and reiterate the characteristics of the industrial and productive system of Bolivia and the importance of micro and small enterprises. 80% of all companies established in our country are micro companies and have between 1 and 10 employees. 37% of existing companies in Bolivia are dedicated to wholesale and retail trade, a much higher percentage compared to only 11% dedicated to industry, which accounts for the economy of our country is not generating goods, on the contrary, these are mainly imported for sale in the domestic market, when the promotion of the industrial sector would be optimal [3].

These only demonstrates the importance of identifying and dealing with the problems faced by micro and medium enterprises, given also that 60% of the employment generated in countries of the Andean Community, to which Bolivia belongs, come from these companies [4]. In this sense, it is vital that, as a university and as a society, the MSEs needs, shortcomings and requirements are considered when connecting the higher education system and the economic and productive system of the country.

The scope of this study was determined to those companies that have a high representation in the Bolivian economy, which are the ones with the least resources. It is known that the classification of organizations can give different levels, however, for this paper, companies were classified according to their size, this element is directly related to the number of personnel and approximate income (See Table 1) [5].

**TABLE 1 - COMPANIES' CLASSIFICATION BY SIZE**

Size	Criteria		
	Annual Volume of Transactions (USD)	Productive Assets (USD)	Personnel Occupied
Micro company	Up to 30 000	Up to 10 000	From 1 to 10
Small company	From 30 000 to 40 000	From 10 000 to 50 000	From 11 to 20
Medium company	From 40 000 to 120 000	Larger than 50 000	From 21 to 50

Source: Adapted from [5].

The micro and small manufacturers face operational problems, just as larger companies. Although the complexity level of those may not be high, small entrepreneurs struggle to provide long term solutions, even to trivial issues. This occurs due to many factors, from the lack of resources to invest in robust solutions, to the limitation of tools to find the potential causes of and select the best alternative. Higher education educators can see this as an opportunity to engage their students and generate a positive impact in this sector's environment.

Therefore, this study aims to identify and determine the benefits of experiential learning for universities, students, and micro companies in the industrial and business environment. To achieve this goal, the research question of this paper is: What are the benefits perceived by students and micro companies from the implementation of experiential learning based through challenges?

This study was carried in a Bolivian university, specifically in the Production Management course provided to Business Administration and Industrial and Systems Engineering students. The challenge was applied to micro companies located the city of Cochabamba – Bolivia and related to various industrial categories. By accomplishing this goal, the researchers expect that the university and students will be aware of the benefits of experiential learning and will be willing to devote more time and effort in implementing these methodologies during their career.

Likewise, other members of the teaching staff may perceive changes and improvements in the level of learning and will be willing to modify the curricular design of their classes, also invest more time and effort, turning careers and university into an innovative center in the country. In this way, the university also benefits, by becoming a benchmark of the academic environment, generating a better positioning in the university educational environment, better perception, greater influx of new students, among other benefits.

## 2. LITERATURE REVIEW

It is believed that higher education has a significant role in developing social, economic, and technological aspects in society, and in consequence, in developing better job prospects to their environments [6]. Educational innovation in universities is a response to a large effort of universities to respond to external demands from different actors near academia: governments, companies, society, etc., where universities have been developing methodologies to improve the quality of the competencies obtained by students during their academic studies [7].

The contribution made by novel educative methodologies of universities in the quality of the outcome professionals can be seen as part of the reputation of the house of studies, its competitiveness and overall positioning in the mind of their communities. Therefore, the implementation of novel learning methodologies can be seen as a strategic action to improve the quality of the education [8], adapting, and remaining relevant to their region [9]. It could be said that innovative educational models help universities to achieve excellence.

Further, the innovation in education will influence and change the model of learning, generating new tools and spaces to benefit the students [10] [11], and the application of those will lead lecturers to enhance their educational activities and diversify the resources used in classes [12].

### 2.1. Experiential learning

Experiential learning can be defined as “[...] a process that allows the individual to build their own knowledge, develop skills and control their values directly from the experience.” [13].

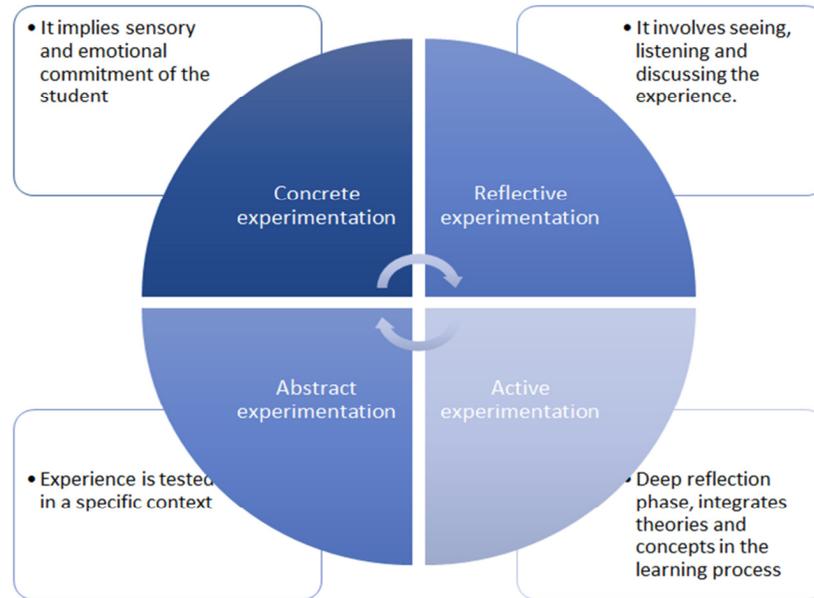
John Dewey [14] was an early promoter of the idea of learning through action and reflection. This kind of learning method is different from the traditional methods. In traditional classrooms, the teacher or professor is the main source of knowledge and transmits it through traditional tools and magistral classes to the students. There is none or few activities that allow students to apply the theory, they “learn” from the teacher.

Learning through experience on the other side, proposes a role change in and outside the classroom. One of the main changes is the approach taken, since the experience is the main element in the learning process, from which the reflection phase initiates from the events experienced that leads to strengthen theoretical concepts. An active attitude is needed from the student, promoting the motivation and retention of the contents. Challenge-based Learning is a kind of experiential learning, and it is based on the Kolb Model, which shows how experience is involved in the whole learning process [13].

The “Learning Based on Challenges” has its origin in two institutions: Apple and the VaNTH ERC Engineering Research Center. On the one hand, Apple implemented in 2008 a project called “Apple Classrooms of Tomorrow-Today”, which promoted students to work in teams, but not only among classmates, but also including teachers and related external specialists in these teams to the subject of study [15].

On the other hand, the VaNTH ERC Institute, composed of the universities of Vanderbilt, Northwestern, Texas, Hardward and the Massachusetts Institute of Technology (MIT), implemented a method called Challenge Based Instruction (CBI), taking as reference the idea of “How People Learn” (HPL), which is defined as a learning process focused on integrated elements such as: students, knowledge, evaluation, community and instructional design Software Technology Action Reflection (STAR) Legacy Cycle. This cycle is based on the collaborative work of the students to

solve a problem implemented several phases that range from the definition of the challenge, the generation of ideas to the presentation and publication of solutions [15].



**Figure 1:** Kolb Model: Learning through Experience.

Source: Adapted from [13].

Experiential learning implemented through Challenge based learning, has been implemented in important universities to these days. In Latin America the “Instituto Tecnológico de Monterrey” is the pioneer implementing this methodology. Between the main characteristics of this approach, a challenge must be placed in a real problematic situation, relevant and linked to the environment, which implies the definition of a challenge and the implementation of a solution [16].

In addition to this, university education faces important challenges, since they must prepare students who do not only develop traditional skills like math, language and science, but also have to be able to act in a technological dynamic environment and possess transversal skills such as critical thinking, decision making, problem solving and work collaborative [16].

Various authors have been working on the identification of relevant sets of hard and soft skills to provide to all stakeholders of these methodologies. For example, critical thinking, effective communication, teamwork, proactivity, which are critical to work coordination in real environments [17] [18] [19] [20].

Challenge-based learning experiences have been developed to adjust the learning outcomes to compressed modules of classes, without losing quality in the learning process [21]. To address the overall context of the components of a complete challenge experience, Salinas et al. [22], defined two levels for this environment. First, the educational requirements will help educator to find the learning outcomes and competencies relevant for the class. Connected to it, the second element is the educational strategy, where the lecturer must design not only the process to enable learners, but as well the spaces where the process will take place, and the approaches to the methodology. These advances were carried in parallel with this study, therefore provided a basis for the methodological design of this work.

### 3. METHODS AND PROCEDURES

#### 3.1. Venture’s election

Initially, the challenge was designed for the class of Production engineering II for both faculties at the University: Engineering and architecture, and Business studies and Law. This class had two parallels, each containing 34 and 20 students. To guarantee better results, all students were merged into groups of 4 to 6. Each group was assigned to a small company to study.

Most of the companies selected had a specific profile, and the first approach of choice was its participation in a program held by foundation focused on the development of micro and small firms in Bolivia, which develops productive training

programs to micro- companies. Further, some specific characteristics of this type of venture raised, as for example, the fact that they are family businesses, usually with less than five workers (usually members of the same family), with irregular income of no more than \$ 500 per month. This observation was not a rule in all ventures, however, there were very common among those in the sample.

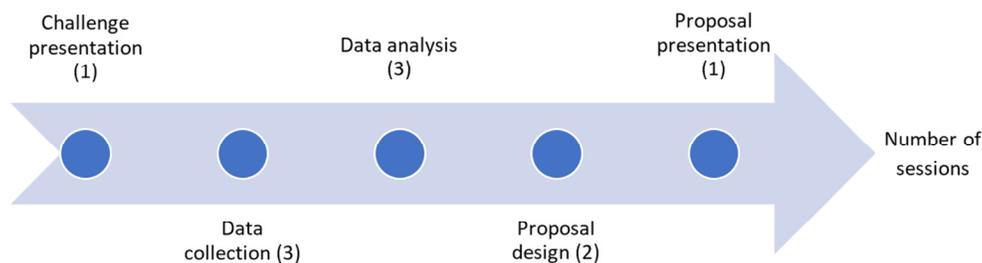
Initially, the selection focused in three categories: fit of the venture in terms of size, availability, or willingness to contribute, and finally, diversity of productive heading. The second and the third were key to discriminate several entrepreneurship; first, most of those did not contain the readiness to receive the groups of students due the seasonality demand peak, and second, many of the ventures were dedicated to clothing production, which did not bring enough diversity to the groups.

Furthermore, a third challenge was found once the selected companies were assigned to the groups. It was discovered that many of those who declared themselves as production centers did not comply with it, and just declared themselves as such to benefit from the foundation's training programs.

### 3.2. Challenge design

Challenge-based learning is the main method implemented in the Industrial and Systems Engineering career from a Bolivian university, with the main goal to improve the interaction with the industry and achieve the application of theoretical concepts and knowledge.

Every challenge designed and presented to the students answer to an objective and certain competences that should be completed during the module. During class, the method to collect data about the objectives achievement, the development of skills by students was the observation of the interactions between the students and the industry, and between the students inside every team. The process followed for this challenge can be found in Figure 2.



**Figure 2:** Micro companies challenge process flow.

Open interviews were also held between the professor and the students, to identify difficulties collecting data or defining the proposals from every team to the companies.

There is a global evaluation phase during the final presentation of proposals answering to the challenge. In this phase, the evaluators team is compound by the class professor, other representatives from the academia and finally, representatives from the industry, enterprises or interested parts in the problematic raised.

The way that the Challenge-based learning methodology was designed, while working with micro companies varies from the challenges executed with bigger companies, where usually the problem is very specific, there is information available as a starting point and more resources to dispose. The work with micro and small companies require to understand that the training partner (company) may not have a lot of time, information, and resources to give, also that the problems may seem basic, but the impact of the solution is more noticeable and relevant to the company's performance.

## 4. EXPERIMENTAL/ NUMERICAL SETTING

The implementation of Challenge-based learning took place as explained before in a specific course of higher education in Bolivia. This course was taken at the same time in two parallels, where each author of this paper oversaw one of the classes.

There were in total 54 students divided into 10 groups, and each group was assigned one company randomly, referred to in this document as "training partners". Among the assigned companies, we worked with carpentry, water bottling, textile, aquatic plants, among others, shown in Table 2.

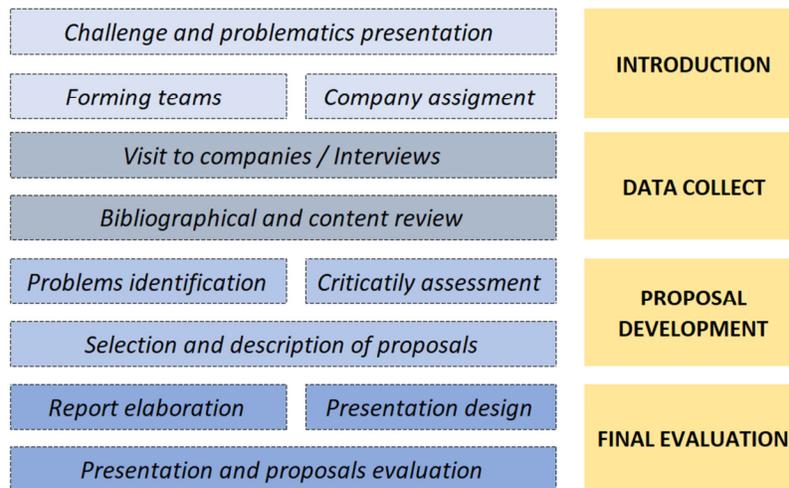
**TABLE 2 - TRAINING PARTNER’S DESCRIPTION**

<b>Item</b>	<b>Number of workers</b>	<b>Type of company</b>
Pastry cookies	1	Single owner
Clothing	1	Single owner
Carpentry	2	Family business
Handmade fabrics	5	Family business
Carpentry	2	Family business
Aquatic plants	2	Family business
Handmade soaps	2	Single owner
Carpentry	3	Family business
Bottled water	3	Family business
Frozen vegan burgers	1	Single owner

The challenge proposed to the students, was to identify the main operational problems facing the assigned companies and from the collection of data, interviews, bibliographic review, and others. In addition to the application of the theory revised during the course, they could design and elaborate improvement proposals to companies.

These improvements could be related to process improvement, implementation of new tools or distribution methods, development of tools for information management among others. The evaluation of the proposals would be carried out as described before, during the development of the challenge and at the end of it by different internal and external parts of the university. Those teams that responded in a more creative, feasible and efficient way to the problems of the assigned companies won the challenge.

The experiment, in this case, taking as a basis the guidelines from Challenge-based Learning, was planned, and executed according to the following diagram, presented at Figure 3.



**Figure 3:** Experimental model for the micro company challenge.

**Source:** Adapted from [16].

For this version of Challenge-based Learning, both professors modify the course design and planning. At this point it is important to clarify that those courses last approximately six weeks. The first four weeks were devoted to the presentation and explanation of theoretical concepts, reinforced with case studies, exercises and partial applications in the assigned companies. At this stage the interaction with the companies was small, in relation to the time dedicated to the advancement of traditional content.

The last two weeks of the course were dedicated only to the challenge. All students, in their teams, had to plan visits to the companies, prepare questions for the owners to help them identify the main operations problems and after an analysis and evaluation of the situation process carried on by the students with support from the professor, each team had to identify one or more possible solutions.

In this phase, every team had to evaluate the feasibility, need of resources and availability of those to select one or more solutions to describe and expose to companies and evaluators.

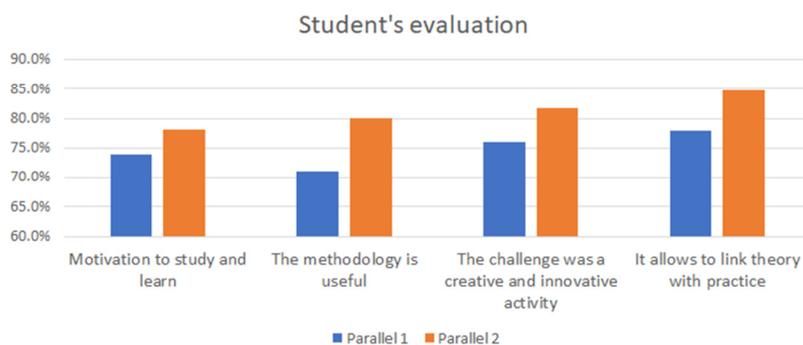
Among the most recurring problems for the micro companies that were worked with, some were identified as flaws in the lay-out of the facilities, low or no use of tools such as social networks and others that allow interaction with customers for the taking of orders, product design and distribution of the same, disorder in the facilities generating losses of product, inefficient use of time and inefficient processes.

## 5. RESULTS AND DISCUSSION

In an overall result, it was noticeable that the type of problems faced by micro companies was by far more trivial than issues commonly found in the industry. Many of those did not have a cost structure, an operation designed, and appropriate layout, or even a control of the handwork or other resources usage. In some cases, the analysis made by students showed that some companies were not sustainable, and their costs were higher than their income, even considering that most of the workers did not charge for a salary, being those parts of the family.

By the end of the course, there were noticeable impacts in the results of the implementation of the challenge. Firstly, the overall evaluation of the class in one parallel raised around 8% in comparison to the previous semester, reaching an increment of 11% in evaluations from 92 to 100 percent of approval. The second parallel did not have any previous data to compare, however, around 65% of the class evaluated the experience above 80 points overall.

Four specific factors are considered from those evaluated in the final survey of the course, carried out on students to analyze the impact of the CBL methodology. The results are shown in Figure 4.



**Figure 4:** Student's class evaluation.

From these results, it can be confirmed that there is a general acceptance of the students to the methodology. Students perceive experience as an important benefit of applying the methodology.

As part of the survey, specific comments from the students were also collected, both positive and others that represent opportunities for improvement for future applications of the CBL methodology. Several students affirm that the challenge was very interesting, it allowed them to connect the theory with the practice, and in general, they would like to return to carry out challenges in other subjects. Among the comments that allow improvements to be made, reference is made to better time planning, since although the objective of covering all the content of the class was met, the intensity and demand of work required by the students was identified as high.

As part of the competences found in students, it was noticeable how the "soft skills" were developed through the experience. First, students showed high levels of resilience and critical thinking when issues with the training partners raised. Due the lack of structure of many of the firms, students had to be creative to find feasible solutions to the everyday issues presented, with very short options of resources.

This application of the CBL methodology in a modular education modality, that is, daily classes of 2 hours for approximately 6 weeks, account for the existence of some restrictions, in the sense that it is difficult to adapt the methodology during application by the short space of time that exists. They also deepen the need for detailed time planning, reorganization of activities in each session to balance the demand for attention, as well as advance planning of the role of the training partner. At the same time, it was shown that it is possible to apply this methodology in different modalities of university education effectively.

In an overall result, it was noticeable that the type of problems faced by micro companies was by far more trivial than issues commonly found in the industry. Many of those did not have a cost structure, an operation designed, and appropriate layout, or even a control of the handwork or other resources usage. In some cases, the analysis made by

students showed that some companies were not sustainable, and their costs were higher than their income, even considering that most of the workers did not charge for a salary, being those part of the family.

After completing the challenge, the researchers spoke with the training partners to gather information about their experience. Several of them accepted to be part of new challenges to deal with specific problems in other classes and in subsequent semesters. There is a general opinion about the importance of the involvement of students, coming from a "privileged" environment in a latent reality of the Bolivian economy. Likewise, several claimed to have learned a lot in the process and valued the solutions and tools obtained to solve their specific problems.

## 6. CONCLUSIONS

As previously stated, around 80% of Bolivian companies overall are of a sole owner, usually with less than five employees. Most of their operations are empirical, and that leads to a very high index of failure in the short term. Being this a reality of our industry, it is important to utilize tools such as the CBL methodology to approach our students to the market reality and needs. The researchers believe that the contributions they can receive to substantially improve their processes can have a direct impact on the survival of organizations.

Challenge-based learning, when well planned and executed, can become an important and helpful methodology generating tangible and intangible benefits for all parties involved in the challenge development process. It proved to improve student's engagement and motivation, along with the generation of experience, which is a critical factor that generates a gap between what companies demand from new professional and they usually find.

The application of this methodology contributes at important levels to the companies involved, since it allows them to give creative and feasible answers to daily problems they face in their processes, reducing the resources they would have allocated, if they had solved the problems alone. It also serves to capture talents with interesting potential to contribute to their industries.

This study helped prove the applicability to a modular educational system and promote the methodology among other professors, careers and also other training partners, which lead to the execution of new challenges in subsequent semesters. There exist great opportunities for future research, combining both, the problems micro and small enterprises face and the implementation of innovative educational tools, such as Challenge-based learning.

On the one hand, through this methodology, students can experience theoretical concepts and tools in real and relevant situations, as well as promoting the development of important soft skills in the current and dynamic work world for which they prepare, such as teamwork, thinking critical, decision-making, self-management, emotional intelligence, ethical and citizen commitment. This methodology also contributes at important levels to the companies involved, since it allows them to give creative and feasible answers to daily problems they face in their processes, reducing the resources they would have allocated, if they had solved the problems alone. It also serves to capture talents with interesting potentials to contribute to their industries.

Finally, it is believed that the long-term outreach of the projects applied are important to ensure that the proposals are realistic and valuable to the training partners. Unfortunately, due the short time of the courses, the evaluation of impacts is limited. Therefore, it is advisable to follow up the results obtained and the sustainability of proposals through time, reinforcing the alliances with these firms.

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