

# THE IMPROVEMENT OF FACULTY COMPETENCE AND COLLABORATION BETWEEN ACADEMIA AND INDUSTRY: A CASE STUDY IN THE ENGINEERING COURSES OF A BRAZILIAN UNIVERSITY CENTER.

Sergio Ricardo Mazini, Wesley Pontes, Pedro Sergio Hortolani Rodrigues, Lucas Mendes Scarpin

Department of Industrial Engineering, Electrical Engineering, Civil Engineering, Mechanical Engineering  
University Center Toledo Araçatuba

## ABSTRACT

The search for the training of professionals increasingly integrated into the industrial environment is a constant challenge for higher education and requires the involvement of several actors in this process. The speed of the technological changes and the need for the differentiated profile of the new professionals motivate more and more the search for new partnerships that allow the full development of the students. In this context, the integration among various actors such as industries, class entities, government and academia can help in the development of faculty competence and collaborate in the development of future professionals.

The objective of this work is to report the experience in the development of partnerships between the engineering courses of a University Center in Brazil and several industries, class entities and government that contribute to the development and improvement of the faculty and the resolution of real cases by students through Problem Based Learning. The main motivation for the choice of Problem Based Learning was the application of a methodology that could develop in the students the critical sense, analytical capacity in problem solving and teamwork.

The case study presents an overview of the framework developed for the development of partnerships and the application of Problem Based Learning through real cases from the industry. Throughout the case study the integration of some CDIO Standards is also presented.

The development of partnerships that allow the application of real situations makes the interest and engagement of students increase, enabling the full development of students. The alignment of the curricular guidelines of the courses with the expectations and real situations of the labor market is of paramount importance and the educational institution must provide mechanisms that contribute to the creation of strategies and actions in this sense.

## KEYWORDS

problem-based learning, skills development, collaboration, engineering teaching, CDIO Standards: 5, 7, 8, 9, 10

## INTRODUCTION

One of the major challenges of higher education is the development of full and prepared professionals for the job market. The practical activities carried out throughout the course should reflect the reality that the students will encounter when joining the companies, thus meeting the expectations of the labor market.

In this context, the realization of partnerships with companies, class entities and government can provide effective actions that will contribute to the formation of this future professional. Among these actions is the resolution of real cases experienced by companies using the Problem Based Learning methodology that puts the student in contact with real problems faced by companies (Lima et al., 2014).

The application of interdisciplinary projects in undergraduate courses allows for greater commitment on the part of the students, as well as greater motivation for the studies (Koch et al., 2016). The principles of the CDIO framework, as reported by Edström & Kolmos (2014), present guidelines for integrating with stakeholders both for the development and training of faculty and students.

The objective of this work is to report the experiences of partnerships between the engineering courses of a University Center in Brazil and companies and other agents, which allowed the development of practical cases for students, in addition to the approach to the labor market.

## PARTNERSHIP EXPERIENCES

The Engineering courses of the University Center of Toledo Araçatuba - UNITOLEDO, located in the city of Araçatuba, state of São Paulo - Brazil, have always had an approach with the industries of the region because many professors have acted or are working in these companies. In addition many of the students of these courses work in these companies which ends up facilitating an initial contact for eventual experiences of partnerships.

In relation to related partnerships and class entities that represent the interests of industries, the Production Engineering course has been holding events in partnership with the São Paulo State Industries Center - CIESP, which has a regional office in the city.

Table 1 below presents two events and where it was possible to integrate the professionals of the industries with the teachers and students of the course.

Table 1. Events of the Production Engineering course in partnership with CIESP.

EVENT	GOALS	DATE
Optimization of Production Systems: a practical approach to the simulation of productive systems and their results in industry.	Present the partnership between CIESP and UNITOLEDO, demonstrate basic concepts of simulation and optimization and presentation of a case of success applied in an industry of the region.	October 27, 2016

Lean Board Game - Lean Production	Enable the use of tools and techniques of continuous improvement in the industrial production process.	June 20, 2017
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Figure 1 presents the two events organized in partnership of the Production Engineering course with CIESP.



Figure 1. Events carried out in partnership of the course of Production Engineering and CIESP.

## FRAMEWORK FOR THE DEVELOPMENT OF PARTNERSHIPS WITH INDUSTRY

For the development of partnerships with industries, the main concern has always been the realization of effective actions that generate a return to both the industries and the students of the institution. In this sense, a framework was developed to assist in the planning of actions in search of increasingly effective partnerships. Table 2 presents the steps of this framework, which was elaborated by the teachers involved in the actions.

Table 2. Framework for the development of partnerships.

STAGE PARTNERSHIP	MAIN ACTIONS AND DELIVERIES
1 – Technical Visit	In this first stage a technical visit to the industry is held so that teachers and students can learn about the processes, difficulties and challenges faced by the industry.
2 – Experience Report	In this second step, an industry manager visits the educational institution and reports their experience on some subject related to the subjects that the students are studying.
3 - Presentation of the Challenge	At this stage, the company manager presents the challenge proposed to the students, who should help throughout the semester.
4 – Work meetings	At this stage, always supervised by a teacher, students divided into teams discuss and seek a solution to the challenge presented.
5 – Challenge Resolution	In this stage, the students together with the tutor teacher, meets again with the industry manager for the presentation of the proposed solutions to the challenge.

These stages of the framework are cyclical and can be resumed according to the needs established during the resolution of the challenge, as shown in Figure 2 below.



Figure 2. Framework for the development of partnerships.

## REAL CASES THROUGH PROBLEM BASED LEARNING

A practical example of partnership with the industry occurred between the course of Production Engineering and a concrete pre-casting industry where two challenges were proposed to two classes of the course. Table 3 presents the real cases to which the students were challenged.

Table 3. Real cases presented in the challenge to the students.

PRESENTATION OF THE PROBLEM SITUATION	IDENTIFICATION OF THE CHALLENGE
<ul style="list-style-type: none"><li>Concrete pre-casting company, located in the city of Araçatuba state of São Paulo, required by regulations of Brazilian law to allocate a part of its area that until then was being used to deposit finished products for demarcation of legal reserve. The products destined to the stock of finished product come from 3 lines of products that the company produces.</li></ul>	<ul style="list-style-type: none"><li>Develop the new layout for the finished products stock due to the demarcation of the legal reserve area.</li></ul>
<ul style="list-style-type: none"><li>Concrete pre-casting company, located in the city of Araçatuba state of São Paulo, needs to improve the quality of concrete pipes for sanitary sewage. The product in question is part of one of the three product lines that the company produces.</li></ul>	<ul style="list-style-type: none"><li>To achieve the perfect quality standard in the manufacture of concrete pipes for sanitary sewage, according to NBR 8890: 2007.</li></ul>

The challenge of developing the new layout for the finished products inventory was made by the group of the 5 semester of Production Engineering that used the following disciplines as a basis for the proposed solution to the problem: Layout Design and Industrial Localization, Planning, Programming and Production Control I.

The challenge of achieving the perfect quality standard in the manufacture of concrete pipes was carried out by the 7th semester of Engenharia de Produção, who used the following disciplines as a basis for the proposed solution to the problem: Management Quality and Production Planning, Programming and Control II. In both cases, the groups were organized by the professors responsible for the disciplines who assisted in the elaboration of the proposed solution to the problem, taking into account the diversification of students with different profiles for the development of the work.

Figure 3 demonstrates some of the steps taken in the technical visit to the company and the presentation of the challenges for the students of the 5 and 7 semesters of Production Engineering and some moments during the resolution of the challenges by the students in the teaching institution.



Figure 3. Challenges proposed by the industry to two classes of the Production Engineering course.

Table 4 demonstrates the CDIO Standards worked through the projects that involved two classes of the Production Engineering course and a concrete precast industry.

Table 4. CDIO Standards developed in the projects.

CDIO Standards	Description	Note
5.Design-Implement Experiences	A curriculum that includes two or more design-implement experiences, including one at a basic level and one at an advanced level	The disciplines allow each semester to elaborate integrative projects with the theme of development of new products, processes or systems.
7. Integrated Learning Experiences	Integrated learning experiences that lead to the acquisition of disciplinary knowledge, as well as personal and interpersonal skills, and product, process, and system building skills	The integration with another course of the institution throughout the integrating project made possible the exchange of information and experiences that contributed to the development of established competencies.
8.Active Learning	Teaching and learning based on active experiential learning methods	The use of Project Based Learning enabled the use of active learning methodologies including students at the center of the teaching and learning process.
9. Enhancement of Faculty Competence	Faculty competency enhancement actions on personal / professional and interpersonal skills, and products, processes, and skills in system building	The realization of projects in partnership with companies allows a continuous training to the faculty in relation to the practices used in the company.
10. Enhancement of Faculty Teaching Competence	Teaching competency actions providing integrated learning experience, the use of empirical methods of active learning, and assessment of student learning	The realization of projects in partnership with companies allows an improvement in the development of empirical methods to be applied in the classroom.

## DISCUSSIONS AND CONCLUSIONS

With the application of problem based learning through the challenges presented to the students of the course of Production Engineering, it is possible to validate the partnership with an industry in the region. For the realization of the partnership, a framework was

elaborated by the participating professors and presented the proposal to the company in question.

Regarding the evaluation of the educational process that was discussed among teachers, industry and students, the application of problem based learning made it possible to integrate the contents of several of the course subjects, taking the subject of multidisciplinary into the discussions of the student groups.

The case presented in this article demonstrates the contribution that active learning methodologies can provide to the improvement of the teaching and learning process and also the importance of partnerships that bring students closer to the reality of the labor market. A very important factor that has been the subject of doubts in higher education, particularly in engineering courses, is precisely the way to apply the practice along with the theory exposed in the classroom. Another issue is the development of behavioral skills such as leadership, teamwork and conflict resolution, which are just as important as technical skills and the use of active learning methodologies provide support for this development, generating better results in the teaching and learning process .

The application of new teaching and learning methods should be widely discussed with teachers and course coordinators in order to identify first what skills they intend to develop and how to identify which methodology is best applied. Alignment and training of all faculty for the use of new methodologies in the classroom is extremely important and the educational institution should provide actions that contribute to the implementation of new methodologies and resources in the teaching and learning process. The experience acquired in the application of project-based learning brought satisfactory results, which allowed several discussions between teachers and course coordinator in the methodology for application in the next semesters and also for its application in other engineering courses of the institution. Additional research should be done to identify the profile of the student entering higher education in order to assess the paradigm shift and the problem of drop-out and how the use of active learning methodologies can contribute positively to these issues.

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## BIOGRAPHICAL INFORMATION

**Sergio Ricardo Mazini** is a coordinator and professor of the course of production engineering, holds a master's degree in production engineering. He participates in the Nucleus of Innovation and Academic Formation of the institution that is responsible for the continued formation of the teachers.

**Wesley Pontes** is a coordinator and professor of the course of electrical engineering, holds a PhD degree in electrical engineering.

**Pedro Sergio Hortolani Rodrigues** is a coordinator and professor of the course of civil engineering, holds a master's degree in civil engineering.

**Lucas Mendes Scarpin** is a coordinator and professor of the course of mechanical engineering, holds a master's degree in mechanical engineering.

### **Corresponding author**

Sergio Ricardo Mazini  
University Center Toledo Araçatuba  
Rua Antônio Afonso de Toledo, 595  
Araçatuba, São Paulo, Brazil  
CEP: 16.015-270  
55-18-36367083  
[mazini.prof@toledo.br](mailto:mazini.prof@toledo.br)



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