

## **The Use of System Thinking Concepts in Order to Assure Continuous Improvement of Project Based Learning Courses**

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### **ABSTRACT**

*This case study describes a continuous improvement experience, conducted from 2002 to 2014 in Sao Paulo, Brazil, within 47 Project-Based Learning MBA courses, involving approximately 1.400 students. The experience report will focus on four themes: (1) understanding the main dynamics present in MBA courses (2) planning a systemic intervention in order to improve the following courses (3) doing the intervention and analysing the results (4) assuring the continuous improvement.*

**Keywords:** Project-Based Learning, Systems Thinking, Community partners

### **DESCRIPTION OF THE CONTEXT**

In 2002, the first author was invited to teach a capstone course on “Project Simulation” to finalize a two-year long Project Management MBA offered by University of Sao Paulo, Brazil. The MBA program offered a number of Project Management related courses (Project Planning and Control, Risk Management, and so on). The “Project Simulation” course was conceived with the goal of giving students hands-on experience and the opportunity to apply what they had learned during their MBA studies. In designing the twelve-week long “Project Simulation” course, the professor decided to use Project-Based Learning (PBL) techniques.

Each class met for three hours. In the first half of the class the professor gave a lecture about system dynamics techniques applied to project management. The students worked in the projects on the second half of the class.

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The students worked in teams. The number of team members was related to the complexity of the project scope. We can say, that, in average, the number of team elements was five. They did several different kinds of projects, such as small buildings reforms (painting, windows replacement, renovation of bathrooms for the elderly), acquisition of equipments (computers, furnitures, refrigerators, air conditioners and many other equipments), purchase of food, blankets and clothes and organizing activities for children (Christmas and New Year's parties, gymkhana).

During the course period they intensively exchange information with Community Partners. Many of project activities involved fundraising. The students obtained the necessary resources in a variety of ways: by seeking donations from corporations, selling raffle tickets, organizing fundraising events (like workshops and parties), soliciting donations from people of their social networks, and so on.

### **THEORETICAL FRAMEWORK**

Project-based learning (PBL) is approach to learning gaining more and more attention in the later years. PBL can be understood as team activity that is carried out over a defined period of time, with the purpose of creating a product or service (Donnelly and Fitzmaurice, 2005). According to Savery (2006, p.16) "the learning process is oriented to follow correct procedures and teachers act as instructors and coaches". There are Universities where Problem and Project Based Learning pedagogies are becoming integrated to institutional objective (Barge, 2010, p. 9). However, in spite of all this development, we think that there are some gaps in available literature related to the practical issues of creating and sustaining effective PBL courses. In our point of view, the key questions is how to make the PBL an experience that bring benefits to all involved (schools, students and community)?

For the this question, Palmer (2010) discusses the concept of a learning space, where the groups of students can learn with each other and share experiences.

The purpose of this report is to discuss practical ways of assuring students and teacher engagement to PBL courses, to present ideas of creating and maintaining a reliable network of community partners and to discuss a method of managing effectively PBL courses.

We believe that four components contributed to the success of the experience. First, the understanding of the structure responsible for the course dynamics. Based on that, we took actions to reinforce the virtuous cycles and create additional ones. Second, the course followed a well-structured project-based learning approach. Third, we work closely with a reliable network of community partners. Fourth, the professor had support from his institution and was given the autonomy to change, redesign and improve the program, assuring a continuous course improvement.

### CONCRETE IMPLEMENTATION AND ACTIONS

In order to understand the course dynamics, we used concepts from System Dynamics Theory. We used causal loop diagrams (CLD) and followed the modelling process proposed by Sterman(2000). With CLD we create a model for the course dynamics, based on what we observed during the classes. Models are simplification of reality, but they can bring us insights of the main dynamics present. We created our model based on our experience as modellers and we think the model was a valid description of the problem that we were interested in.

At the end of the first course taught, in order to gain further insight, we drew a casual loop diagram (CLD) for the feedback processes in the course. Figure 1 shows that students' motivation to work would lead to higher quality team work and better overall project results. Over time, students would be motivated to work on projects that led to high quality results. We named this first reinforcing feedback the "*students' morale*" loop. In turn, high quality projects would motivate and engage the professor himself, who would then be more motivated to improve the quality of educational resources. A high quality faculty involvement would increase students' motivation and encourage better quality work. This reinforcing feedback we named the "*professor's morale*" loop.

There are also two negative feedback loops related to fatigue. Both professor and students become more tired during the course development. The fatigue would impact negatively on the motivation of professor and students. We named these negative feedback loops as "Students fatigue" and "Professor's fatigue".

This initial model (Figure 1) shows the dynamics of the first course taught; we created this model to have a better understanding of which variables needed intervention in order to make the subsequent courses successful.

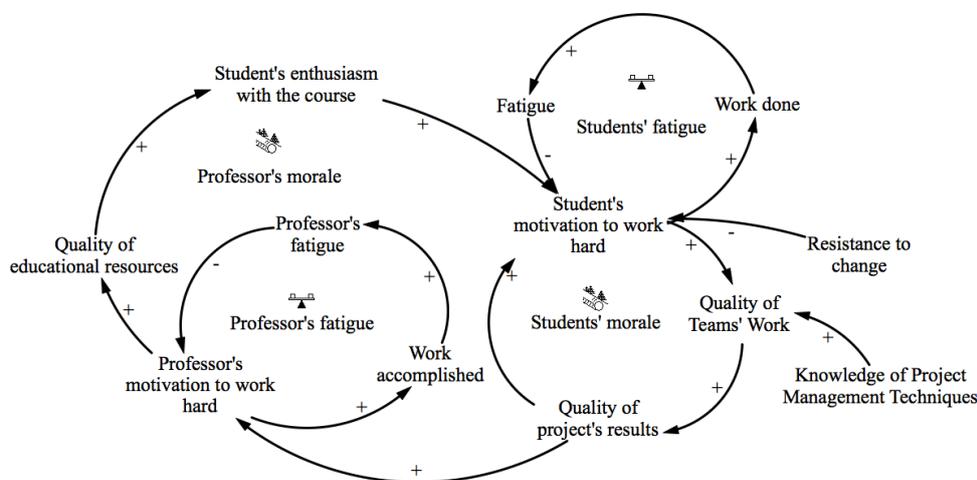


Figure 1. Causal Loop Diagram shows the main feedback loops

## PLANNING THE INTERVENTION FOR THE FOLLOWING COURSES

It was clear to us that we could boost students' enthusiasm and commitment by improving the quality of educational resources and the teaching methodology. By improving both the students' and the professor's morale, we could let the reinforcing loops driving the dynamics operate in a virtuous way.

To change students' perception of and attitude toward the course, we considered the options available for improving the quality of educational resources (e.g., lectures, class notes, etc.) and the teaching methodology (using PBL concepts).

We saw that if the professor's motivation increased, he would devote time and effort to improve the quality of educational resources (e.g., write a course related book, create a course's website). The improved educational resources would then raise students' enthusiasm and close the reinforcing feedback loop, that of "*Professor's morale*".

We consider to develop partnerships with NGOs engaged in humanitarian works. We anticipated that the development of partnerships would bring exciting project's themes to the students, increasing their feelings of participating in something valuable. In parallel, we expected that if quality of projects' results grow, the number of successful projects would increase leading the strengthening of the partnerships. Those actions would create a new reinforcing feedback loop, named "Building Partnerships".

The growth in the number of successful projects would also reduce students' resistance to change. If students saw a high number of projects completed successfully, their resistance to change would disappear. The reinforcing loop associated with these dynamics is captured in the "*Breaking resistance*" loop.

Finally, if the quality of project's results increased, the community partners' motivation would also increase, leading to a higher interaction between the students and partners, increasing the student's enthusiasm with the course. This last reinforcing loop was named "*Partner's morale*".



Based initially on Thomas (1999) and later on Larmer & Mergendoller (2010), we created an environment that allowed the students to develop project management skills, giving to them the opportunity to work in real-life projects, with real clients.

We established processes of revision and critique of the projects, at the second part of each class. We also brought questions to our students that led them to in depth studies. In our environment, the students had freedom to chose the client, the project theme, the team members. They were also free to decide their roles and responsibilities. They were free to chose the fundraising strategies, to contact and establish partnerships with corporation and local community.

### **ESTABLISHING RELATIONSHIPS WITH COMMUNITY PARTNERS IN ORDER TO OFFER EXCITING PROJECT THEMES**

We contacted a number of NGOs in São Paulo, through COMAS, the City Council for Social Welfare, an entity that works with NGOs. From this action we got our first partner, a NGO that worked with children and teenagers of poor neighbourhood. The NGO provided several professional courses to them, helping in the development of their skills. The MBA students worked with enthusiasm, accomplishing projects that brought all kind of resources to that NGO. The success of the students' projects led to strengthen of this partnership. The NGO learned to trust in the initiative, bringing new project themes for the following courses. Moreover, the NGO invited other NGOs to participated. The word-of-mouth process began. Along the years, the process repeated itself and the new NGOs became partners.

The students had a important role in this process. In each class of students, sometimes we had ones that worked as voluntary in NGOs that were not our partner.

The students asked us permission to invite that NGO to participate in the next course, as a new partner. We always welcome new community partners. In this way, the students contribute to the ampliation of the virtuous cycle. The whole process of creation a network of reliable partners took several years, it was a slow process. In addition to NGOs, we have worked with Public Institutions (City Counties, Public Schools, Public Hospitals and Community Centers). Our advice to PBL community is that, more difficult than to create a partnership, is to chose the right partner, to keep the partnership and to educate the partner to work with students.

### **IMPROVING THE QUALITY OF EDUCATIONAL RESOURCES**

The quality of lectures and support material improved dramatically. Each lecture was carefully planned and improved, term by term, year by year. The idea was to create motivating lectures that would awake the interest of students for the subjects covered.

We replaced the handouts given to students with books specifically designed to be used in this course. This process was done in an incremental way, every couple of years a new book was released, with revised content and new topics. We also created a website to support the course, with video recorded lectures. The course website provided information about previous years' projects, allowing students to have access to extensive information (eg. project management plans, reports, lessons learned catalogue, videos and so on) of all previous projects.

### RESULTS AND REFLECTIONS

From 2002 to 2007 the number of projects undertaken was relatively small, 19 projects. Until 2006, students worked together on a single project. By the end of 2007, we changed it. The projects started to be done by small teams of students (five students at maximum). Adding to that, in 2007, the Project Simulation course was also offered to another very similar MBA course, taught by the same professor, following the same method. This other MBA course had equal structure, but was designed to IT professionals. Both changes caused the number of projects per year to increase (Figure 3).

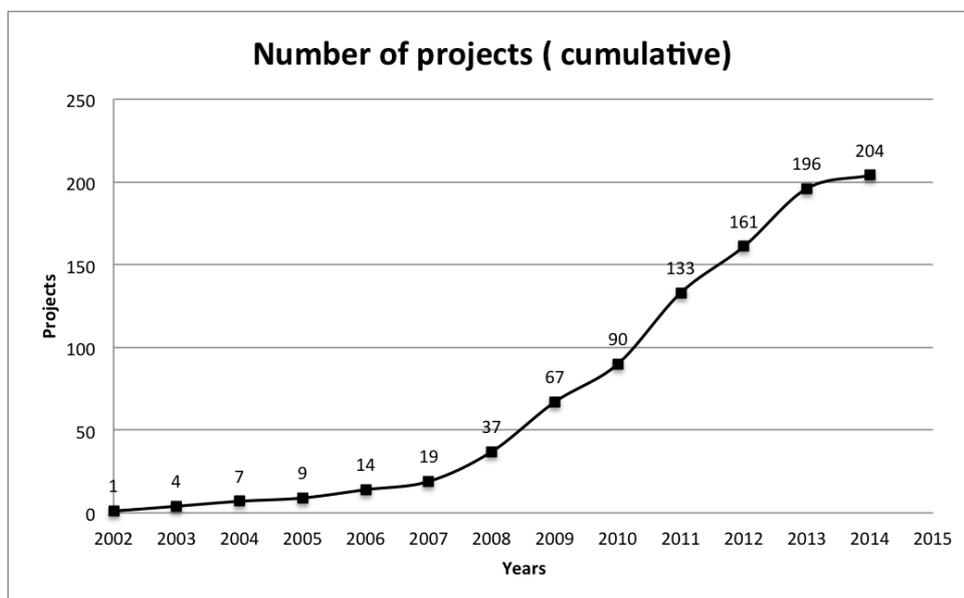


Figure 3. The cumulative number of projects, from 2002 to 2014

Figure 4 shows that almost half of projects (47, 5%) involved goods acquisition (equipment, books, food, toys etc.). Another half involved the sum of activities as reforms, product creation, systems development, marketing actions, service creation and trip support.

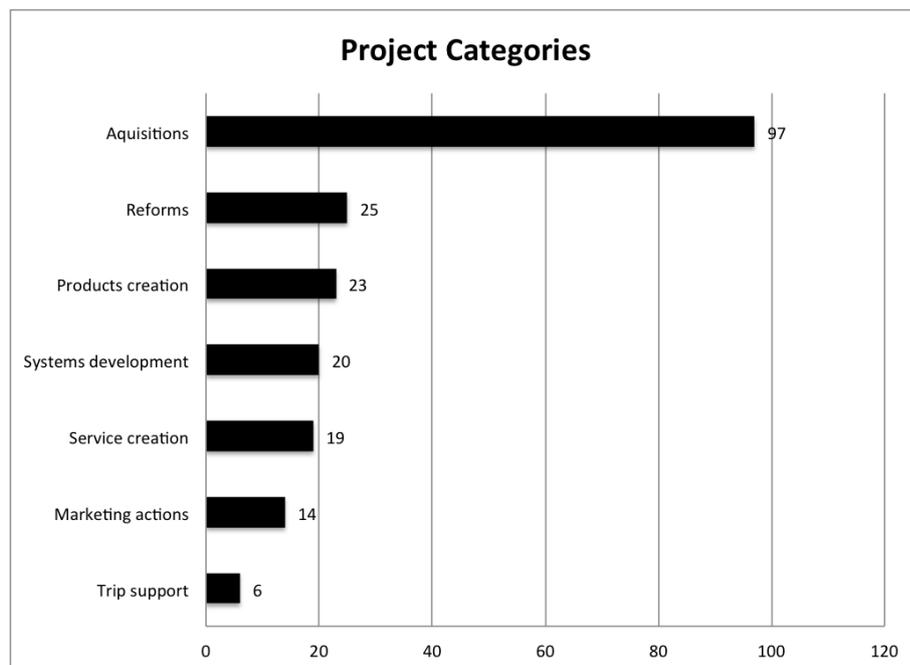


Figure 4. Project Categories

Sixty eight percent of the projects involved fundraising activities, thirty two percent didn't.

The students obtained resources they need from raffles in 37% of the projects, from corporation's donations in 33%, from individual donations in 25% and from fundraising events in 5% of projects. We can say that one hundred and fifty five projects accomplished (76%) had medium complexity, twenty one (10%) were complex and twenty eight (14%) had low complexity. In terms of the quality of the project documents, 57% of the projects were very well documented (blogs organized, with all plans and documents created during the project), 13% of the project were fairly documented and 30% of projects were poorly documented. From the 204 projects accomplished, one hundred and sixty five (81%) can be considered successful. Twenty projects (10%) had partial success (the project failed to achieve the requirements or the schedule). Nineteen projects (9%) can be considered failures.

### COMMUNITY PARTNERS

From 2002 to 2014 we have worked with 39 institutions (Figure 5). The community partners needed a variety of help: food, school materials, clothes, medicines, equipment, toys, books, computers, assistance repairing their buildings, and so on. They presented their needs in a format of themes of projects. Consequently the project scopes ranged from simple to complex. Nine of the community partners were responsible for 65% of all projects.

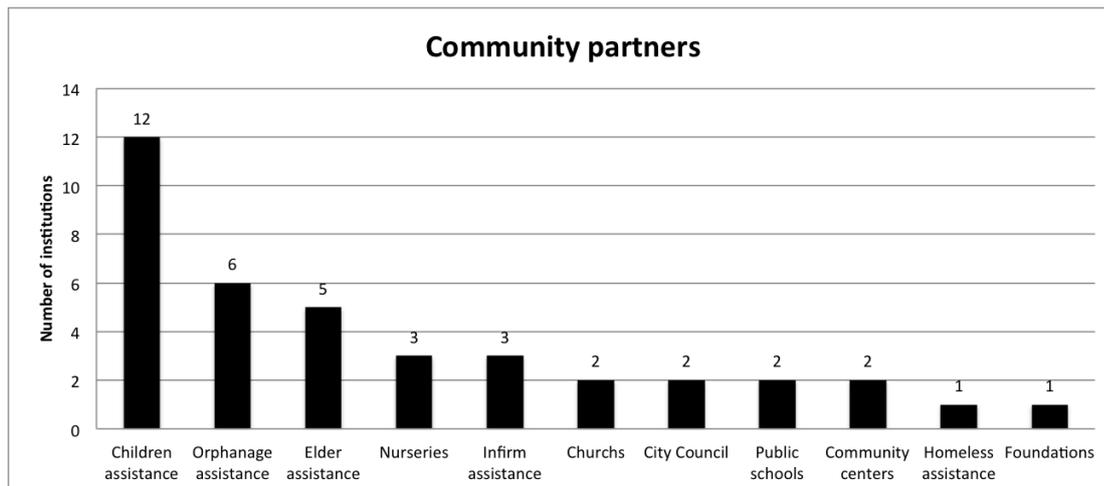


Figure 5. Community partners' main activities

## ANALYSIS AND DISCUSSION

Due to our efforts to systematically building partnerships (Figure 2, Loop “Building Partnerships”) there was a steady growth in the the number of community partners (Figure 5). The diversity of project’s themes offered to the students (Figure 4), reflects the diversity of social work accomplished by our partners. In authors’ opinion, it seems that the use of PBL techniques in addition to the improvement of educational resourses lead to the increase of student’s enthusiasm with the course (Figure 2, loops “Professor’s morale and “Students’ morale”).

Our findings suggest the students enthusiasm has relationship with the complexity of projects chosen. The students had freedom to choose the project themes. They could choose projects of complex, medium or easy scope. It was clear to us that highly motivated students tend to choose complex projects. That as the case in 10,5% of the projects. The majority of students chose projects of medium complexity (77,5%), a project adequate to the amount of time they have to work on it. Few students chose the easiest way, simple projects that didn’t require a lot of effort. That happened in 12% of the projects. The previous theoretical knowledgement of project management techniques certainly was one of the factors responsible for the high success rate (82,5%).

## CONCLUSIONS

The use of Project Based Learning supported by System Thinking proved to be a very useful course management method. The sum of the three systemic interventions we did brought the desired results. The relationships with community partners brought exciting project themes to the students. We think this contributed to increase of their motivation.

The choice of challenging the students to work with Community Partners that help poor and disadvantaged people brought additional benefits. Students became more aware about social responsibility and became more interested in making a contribution to the people that need it most. As we reflect on our efforts for well over a decade in more than 47 courses, we hope that our insights can serve a much broader audience.

For further information about the academic projects, there is a short documentary available in [www.projectbasedlearning.com.br](http://www.projectbasedlearning.com.br)

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