

Reflection strategy for teaching construction projects in Civil Engineering

Estrategia de reflexión para enseñanza de proyectos de construcción en Ingeniería Civil

Albeiro Bejarano Castellanos is an Architect of Jaramillo Mora S.A. Cali (Colombia)
albeca34@hotmail.com) (<https://orcid.org/0000-0003-3903-3099>)

Dr. María Fernanda Serrano Guzmán is a professor at the Pontificia Universidad Javeriana Cali
(Colombia), (maria.serrano@javerianacali.edu.co) (<https://orcid.org/0000-0002-7366-6597>)

Dr. Diego Darío Pérez Ruiz is professor at the Pontificia Universidad Javeriana Cali (Colombia),
(ddperez@javerianacali.edu.co) (<https://orcid.org/0000-0002-9656-2803>)

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Abstract

The competitiveness of the educational programs on the universities requires an adjustment on the content of academic programs so that they can respond to the problems of their surroundings. For this reason, in regards to the profile of a civil engineer's occupational performance, particularly, it is useful for the student to identify administrative practices and processes that tend to reduce costs and time over the different works. In this work, it is presented a proposal of didactic strategies focused on the inside thought around concepts related to the administration of construction projects using reengineering and construction philosophy without losses (lean) concepts in different activities. For this, we started with information col-

lected in housing construction projects, in which the best practices for waste reduction were evaluated. The applicability of technical knowledge is combined with tools focused on reflection to strengthen concepts of resource management, both human and financial, using tools that use critical thinking, problem solving, social commitment, teamwork and communication skills, which, all together, contribute to strengthen ethical aspects and social responsibility of the engineering practice. It is concluded from the study that inside thought is a useful tool of the teaching-learning process, since it prepares the future professional to solve the problems surrounding it.

Keywords: Learning, construction, arrangement, skills development, fieldwork, working life.

Resumen

La competitividad de los programas educativos de las universidades exige que los contenidos de los programas académicos se ajusten de manera que puedan responder a las problemáticas del entorno. Por esta razón, en lo concerniente al perfil del desempeño ocupacional del ingeniero civil, en lo particular, resulta útil que el estudiante identifique prácticas y procesos administrativos que propendan por la reducción de costos y tiempos en las obras. En este artículo se presenta una propuesta de estrategias didácticas centradas en la reflexión alrededor de conceptos relacionados con administración de proyectos de construcción empleando reingeniería y la filosofía de construcción sin pérdidas (Lean) en diferentes actividades. Para ello, se parte de información recolectada en proyectos de construcción de vivienda en donde

se evaluaron las mejores prácticas para la disminución de desperdicios. Se conjuga los conocimientos técnicos con herramientas centradas en la reflexión para afianzar conceptos de administración de recursos, tanto humanos como financieros, mediante herramientas que emplean pensamiento crítico, solución de problemas, compromiso social, trabajo en equipo y habilidades comunicativas las cuales, en conjunto, contribuyen de manera transversal a fortalecer aspectos éticos y de la responsabilidad social del ejercicio de la ingeniería. Se concluye del estudio que la reflexión es una herramienta útil del proceso de enseñanza-aprendizaje, ya que prepara al futuro profesional a resolver problemáticas de su entorno.

Descriptores: Aprendizaje, construcción, organización, competencias, trabajo de campo, vida profesional.

1. Introduction

The curriculum of Civil Engineering in the universities include, in their academic offer, courses that, in their content, address topics related to the administration of works, construction projects and construction processes, among others, with which it is intended to provide skills to the future professional to perform in the construction sector. Commonly in the classroom, environment where different apprentices come together with different experiences and preconceptions (Ucol-Ganiron Jr. and Alaboodi, 2013), various educational strategies are employed that allow the formation of critical and reflective thinking for professionals (Arratia Figueroa, 2008) aimed at achieving the common good and towards a more just and democratic society (Palomer, L., Humeres, P., Sánchez, A., González, S., & Contreras, A. 2013). Usually, during the occupational performance, the engineer must use his knowledge to solve problems related to constructive processes.

Therefore, it is imperative to develop teaching strategies based on reflection on transversal skills that the student must acquire or develop on social commitment, critical thinking, problem solving and communication skills so

that the student faces preconceptions or prejudices and, at the same time, can anticipate possible contingencies (Montalva, Ponce, and Llorca, 2017; Erren, 2008) that may arise during the formulation or execution of a project. All under the premise that a good professional is not only the one who manages the theoretical or technical knowledge, but the one that demonstrates its competences to apply environmental problems with this knowledge (Sávio, D., Cândido Moraes, & Motta Barreto, 2017).

This new form of education is characteristic of the current state of affairs and responds to the permanent adaptation to the processes of change of the environment (Luengo, Luzón, and Torres, 2008), it is a proposal of effective training within the processes of professional training, which includes the acquisition of knowledge with approximation of realities (González, Mieres, Denegri, and Sepúlveda, 2014).

Concepts such as re-engineering and construction without losses are widely used in construction projects. While it is true that re-engineering has been considered an administrative trend that began in the 1990s in the United States as a strategy for documenting information that fell into disuse between 1997 and 2007 due to organizational failures (Vergara-Schmalbach,



Fontalvo, and Morelos, 2013, p.214), in recent years it has taken effect because, precisely, it is based on the lessons learned for the development of projects. In essence, re-engineering seeks fundamental revision and radical redesign of productive processes to achieve improvements in performance (Bustos, 2005, p.3). Therefore, from the premise of seeking competitiveness in construction companies, the recognition of the successes and failures of the past can help improve the production process in a work.

As for the Lean philosophy, what is intended is to achieve increased productivity, cost reduction, greater flexibility, greater added value to the final product and an increase in results using a reasonable cash flow with the necessary materials to provide a quality product (Raposo and Cardoso Viera Machado, 2013), eliminating overproduction, waiting times and unnecessary transport (Giroto and Rodrigues, 2013). According to this, Lean focuses on the raw material, the product, the process, the market and the way to manage it all (Flamarion, Petter, and Valle Antunes Jr., 2008), all these concepts closely related to the final product of a work civil.

In order to respond to the new challenges arising from the knowledge society (Luengo, Luzón, and Torres, 2008), this proposal of didactic activities is developed with the aim of consolidating concepts related to project management, basing the exercise on strategies of reflection around reengineering focused on the improvement in equipment and tools of construction and Lean applied for the analysis of waste in the masonry activity, management concepts that can influence the quality of the product to be delivered in a work. Although the methodological approach focuses on Works Administration, its applicability extends to the courses of Construction Methods and Construction Projects. In addition, although this approach is focused on pedagogical applications for Civil Engineering and Architecture, the methodological structure that supports it can be oriented towards other professions. The approach of reflection on different

stages of constructive processes aims that the future professionals analyze significant aspects of these concepts and find application in their work environment (Arratia, 2008) projecting their occupational performance in spaces where they should use their knowledge and skills in real situations in everyday life (Iglesias and Beltrán, 2012), but can also develop values and attitudes (Palomer *et al.*, 2013).

2. Methodology

The proposed reflection strategies combine the curricular and extracurricular activities and the contents of the Construction Projects course and incorporate questions that place the future professional in their occupational performance with positions in different situations. The design of the activities was oriented to respond to the difficulties encountered in teaching certain subjects in this course in three cohorts (consecutive semesters).

3. The pedagogical strategies of reflection as support to the tests of the state in Colombia

For the National Accreditation Council in Colombia, the concept of quality in higher education is associated with the fulfillment of characteristics that the educational institution possesses and under which an educational service in optimum quality is offered (Ministry of National Education, 1998). The approach of the pedagogical strategies based on reflection presented is designed to ensure that future professionals effectively acquire the required quality standards based on expected performance competencies. These competences are evaluated in the State Examinations of Higher Education in Colombia, now known as Pruebas Saber Pro (Ministry of National Education, 2010), exams that are mandatory since 2009 (Ministry of National Education, 2018).

In the results workshop conducted by the Ministry of National Education presented



the results of these tests that contain questions aimed at assessing general and specific skills using strategies of critical thinking, written communication, social responsibility among other modalities (Ministry of National Education, 2017). While it is true, traditional strategies continue to be used, the reality is that they do not meet the expectations that 21st century education requires (Sávio *et al.*, 2017).

This confirms the need to generate pedagogical actions within the classroom that allow the future professional to develop good communication skills to relate to the other in a healthy and productive organizational environment (Erren, 2008) (Bermúdez and González, 2011) (Serrano Guzmán *et al.*, 2017) that respects the contributions of the other and that learns to work as a team to achieve the goals (Ibarra and Rodríguez, 2011). At the same time, that he/she makes use of its intellectual autonomy to understand his/her context (Vélez, 2012) (Serrano Guzmán *et al.*, 2017) and responds responsibly in the formulation of technical solutions that respect the solidarity duties of the city (Muñoz, 2011).

The proposed pedagogical strategies have been implemented in the course of Construction Projects in the Civil Engineering program of the Pontificia Universidad Javeriana Cali and are aimed at concepts of construction without loss and re-engineering whose appropriation provides future graduates skills for occupational performance in the works in which he/she has the opportunity to work. However, the proposal presented can be implemented in different educational programs at the undergraduate level and at a graduate level in other disciplines.

4. Results

Reflection offers a bridge between theory and practice under the understanding that “an ounce of experience is better than a ton of theory” (Bringle and Hatcher, 1999). The reflection strategies were designed for the Construction Projects course starting from the guidelines provided in the Course Learning + Service of the

Pontifical Catholic University of Chile. These reflection strategies allow evaluating the learning of concepts, developing transversal skills/abilities as well as attitudes and values (Montalva, Ponce, and Llorca, 2017), covering critical thinking skills, problem solving, social commitment, teamwork and communicative skills. Precisely, if the future professional develops these strategies, it will be possible to offer the industry and the working environment creative professionals with a leadership spirit (Serrano Guzmán *et al.*, 2017, Shin *et al.*, 2013: Oehrtman *et al.*, 2010). Aptitudes and skills that will allow them to defend their positions in a critical and interpretive manner (Good and McIntyre, 2015) within the framework of an ethical environment (Vellurattil *et al.*, 2014) and social responsibility (Pérez de Maldonado, Bustamante, and Maldonado, 2009). In the particular case of the Construction Projects course, each activity is designed considering that it should allow for continuity, be related to the topic addressed, be a challenge for the student and contextualized to the reality of the group that approaches it (Montalva, Ponce, and Llorca, 2017). The fundamental parts of the reflection strategy include the objective of the course, the objective to be achieved with the activity, necessary resources, duration, description of the activity and annexes if applicable. These strategies are in line with the structuring of activities in the Learning + Service methodology (Jouannet, Salas, and Contreras, 2013) where, in some cases, community partners or beneficiaries are involved. It should also be noted that similar thinking strategies have been proposed in the Undergraduate Design I and Polluter Transport courses at the graduate level. Next, the proposed strategies are presented.

4.1. Proposal for reflection in critical thinking

Objective of the course: Identify the contemporary concepts of administration, organization and definition of a construction project.



Objective of the reflection strategy: Identify situations of the civil engineer's occupational practice supported by the custom and the social implication that this has in the development of a community.

Resources: Reading material, computer, pencil and paper

Modality of work: individual and group

Duration: 30 min

Description: The media constantly reports on the negative repercussions for the communities in the event of non-execution of infrastructure works required for the satisfaction of basic needs with the consequent deterioration of the quality of life of the inhabitants.

With this activity, personal criteria are identified to change this dynamic in the world. Students are asked to read the fragment extracted from (Vega, 2015) "The Legend of the Ring of Gyges" in 5 minutes, with the following content transcribed in verbatim:

Gyges was a shepherd in the service of the ruler of Lydia. One day there was a violent thunderstorm, and an earthquake broke open the ground and created a crater at the place where Gyges was tending his sheep. Seeing the big hole, Gyges was filled with amazement and went down into it. And there, in addition to many other wonders of which we are not told, he saw a hollow bronze horse. There were window-like openings in it, and peeping in, he saw a corpse, which seemed to be of more than human size, wearing nothing but a gold ring on its finger. He took the ring and came out of the crater. Gyges discovers that the ring confers him the power of invisibility and due to the power it offers, he gets to be named the shepherd responsible for going to report to the king. After much thought, he devised a sinister plan: go to the palace, seduce the queen, kill the king and seize the throne. Using the privilege of his ring, he manages to materialize his plan, becoming king, but not any king, a tyrant... He could have used the ring to discover, for example, the criminals, to make a more just society, but he decides that it is more interesting to grow by acquiring wealth and

power. Plato explains in this way the tyranny and corruption of the leaders, feeling superior, with power and impunity, and questions what each of us would have done if we had found the magic ring, distinguishing between expressing an opinion if we were asked and to really own the power of the ring (Vega, 2015).

In Book II of the Republic is the well-known myth of the ring of Gyges which shows the notion of human injustice and identifies the energetic resurgence of justice (Higuera, 2016). The history of the ring of Gyges reveals that carrying the ring confers confidence and freedom to the shepherd, with which it transforms and allows it to be part of a different social group (Higuera, 2016).

Then, they are asked to read fragments taken from the text "The human being, corruption and politics" by Gerardo Berthin Siles in volume 5 of the magazine *Ciencia y Cultura* (Berthin, 1999) and which deals with the topic of ethics in politics.

... [...] in politics there is an ethics different from ethics. And it is proven that with the passage of time, progress in economic terms and in other terms has turned out to be more important than the spiritual development of the human being, showing that there is a great gap between what man wants to be and what he really is, then there would be two spaces, that of power and that of not power, the first, the scope of the political, the place where man lies, deceives, distorts, betrays, in this way wars would be justified, as an example. Finally, it tells us that political success is measured if one can maintain, increase or demonstrate power over others, while moral success is measured if it can be demonstrated in relation to others that these are objectives in themselves (Berthin, 1999, p.1).

Then, the teacher guides the group by saying that a discussion space is open for the students to answer the questions in plenary: 1) what do you think of the attitude of Gyges? 2) In what situations can civil engineers behave like him? 3) What coincidences can be found between the



attitude of Gyges and those who have the “ring” of state funds and are in charge of managing the funds of the municipalities in each country? 4) in what way can one be an active participant in politics while remaining within the framework of ethics and morals? For this, 20 minutes are allocated. The results of student participation are recorded on the board.

Reflection for the closing of the activity: It is finalized emphasizing that the custom of “a life of corruption” must be uprooted from the civil engineer’s occupational exercise.

Evidence of application of this strategy of reflection in other courses: critical thinking is a reflexive action-oriented activity (Zelaieta and Camino Ortiz de Barrón, 2018) and can be applied in different areas since it allows analyzing problems of all kinds (France, de la Garza, Slade, Lafortune, Pallascio, and Mongeau, 2003).

These types of exercises have been implemented in the Design I prerequisite course of the Design II course (Serrano *et al.*, 2018), leading to a degree at the undergraduate level in Civil Engineering and postgraduate courses at the level of the master’s degree in Pollutant Transport. At all times, for the development of this activity, an adequate environment is sought in which participants can present their arguments generating a practice committed to transformation and social improvement (Zelaieta and Camino Ortiz de Barrón, 2018).

4.2. Proposal for reflection on communication skills competence

Objectives: Develop written communication skills; strengthen strategies for the preparation of summaries.

Resources: Article on the web, computer with Word or word processor.

Modality: Group, minimum 2 and maximum 3 participants.

Duration: 20 to 30 minutes.

Description: Considering that the individual uses different processes and knowledge of different linguistic-sociolinguistic types to

communicate, strategies for the strengthening of discursive management should be encouraged (Viera, 2010). In the course of Construction Projects, the teacher can rely on the construction of definitions as the concept of the Lean philosophy applied to construction projects. The working groups are organized, and the following invitation is made: “in a dialogue, discuss what you know about Lean Manufacturing and, depending on what you know, prepare a paragraph that has between 30 and 35 words”. 10 minutes are granted.

Subsequently, each group is asked to read the definition that was structured, and the best definition is selected by vote. As recommended by the Teaching Development Center of the Pontifical Catholic University of Chile in the A + S Reflection Activities window: “no group can vote for its own definition” (Teaching Development Center, 2017a). In this activity, 5 minutes are allocated.

Once the best definition has been selected, the group is asked to read the textual quotation of the following paragraph of the article “The industrial engineer impacting the environment” by Ángela Patricia Anaya and Mario Fernando Acosta in the Journal of Engineering Education (Anaya y Acosta, 2010):

[...] Lean has the basics of identifying value activities, understanding the flow of products, services and information through the value chain and between the links of the supply chain, and, finally, the characterization of waste in the activities of the company. [...] in the areas of production and manufacturing the waste is easily identifiable, while, in the case of information, the waste is less visible. The information is what allows measuring the development of the activities to compare with the expected standards or the goals set and then then understand if the operation of the area, process or industry is appropriate (Anaya and Acosta, 2010, p.182).

And, to continue: read the definition of Lean taken and adapted from (Raposo Rosa and Cardoso Viera Machado, 2013):



Lean is a multidimensional approach that extends to groups for a variety of administrative practices that include just-in-time, quality system, teamwork, production by departments and administration of inputs in an integrated system. When the synergy between these factors is achieved, high quality with low waste is achieved (Raposo and Cardoso Viera, 2013, p. 887).

Subsequently, the group is instructed to supplement the definition that was selected with the definition provided by Anaya and Acosta (2010) and Raposo and Cardoso Viera (2013) and, finally, to write a paragraph that contains at least two sentences that summarize what could be the definition of the Lean Philosophy applied to construction. It is also requested that the new definition does not exceed 60 words and that it must have at least 55 words.

Reflection for the closing of the activity: The exercise ends inviting the participants to point out the difficulties encountered in preparing the definition.

Evidence of application of this reflection strategy in other courses: This activity was carried out with students of the Design I course,

using the concept of rural social interest housing. The exercise allowed to include in the definition of housing the concept of sustainability which was not initially considered.

4.3 Reflection proposal on competition problem solving

Objectives: Identify causes of waste in masonry activity; propose alternatives for the increase of the productivity in masonry.

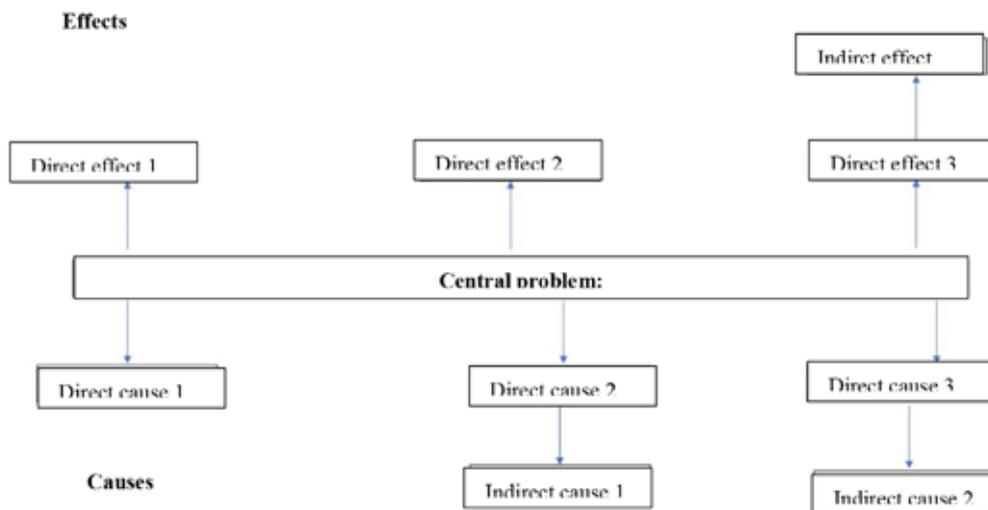
Resources: Field visit and reading of manuals for the completion of projects with the Adjusted General Matrix (MGA) of the National Planning Department.

Modality: Group, between 2 and 3 members.

Duration: 40 minutes.

Description: This activity is carried out after the field trip. The teacher guides students on the importance of observation to identify factors that affect performance in the masonry activity. In the field visit, the working group must record the causes of the loss of materials and time in the masonry activity in a construction company. The map of causes and effects is elaborated in an infographic like Figure 1.

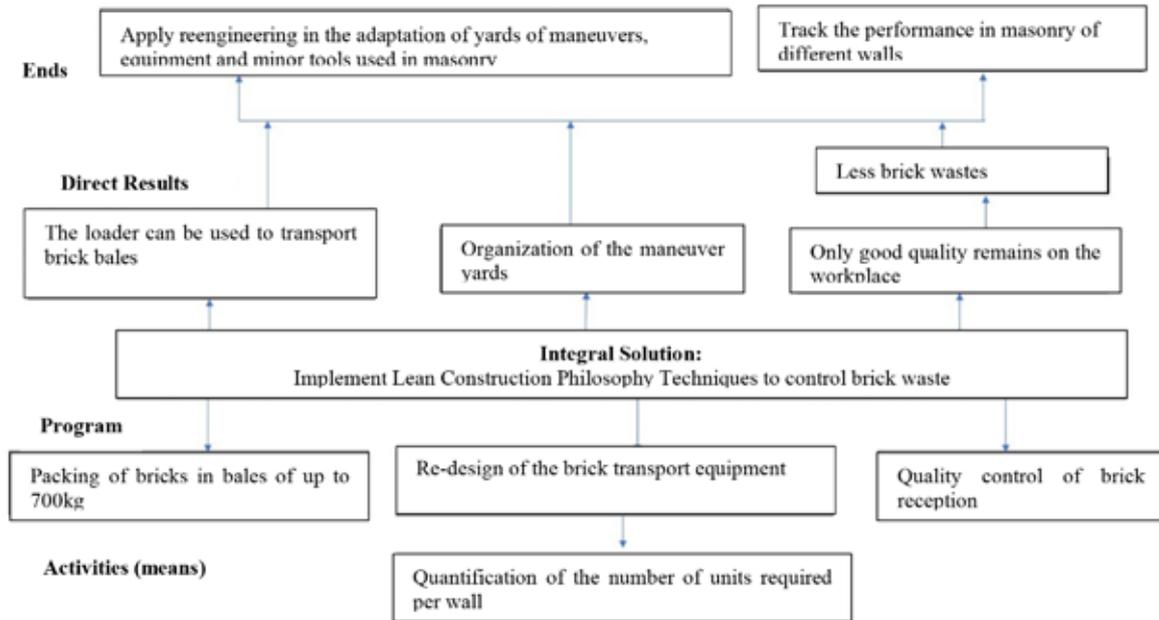
Figure 1. Problem map



Source: Authors with information adapted from Territorial Sub-directorate and Public Investments of the National Planning Department, 2013.



Figure 2. Map of problems identified during the visit

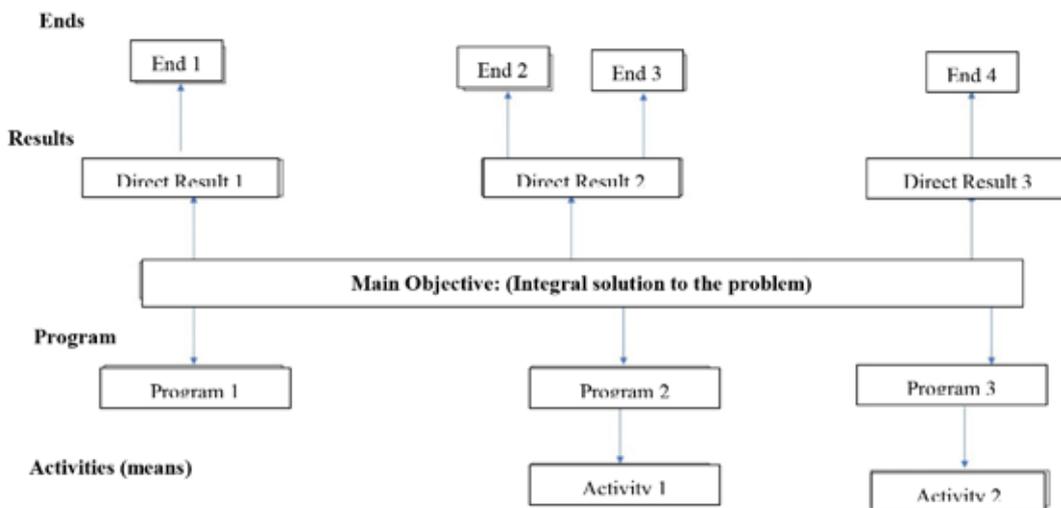


Source: Authors with information adapted from Bejarano (2017).

In each working group, the objective map is set up, with its corresponding purposes and means as established by the MGA methodology. Dedication time: 30 min.

The Objective Map is proactive to the problem map and allows to conceptually close the project in analysis (Figure 3).

Figure 3. Map of objectives or ends and means



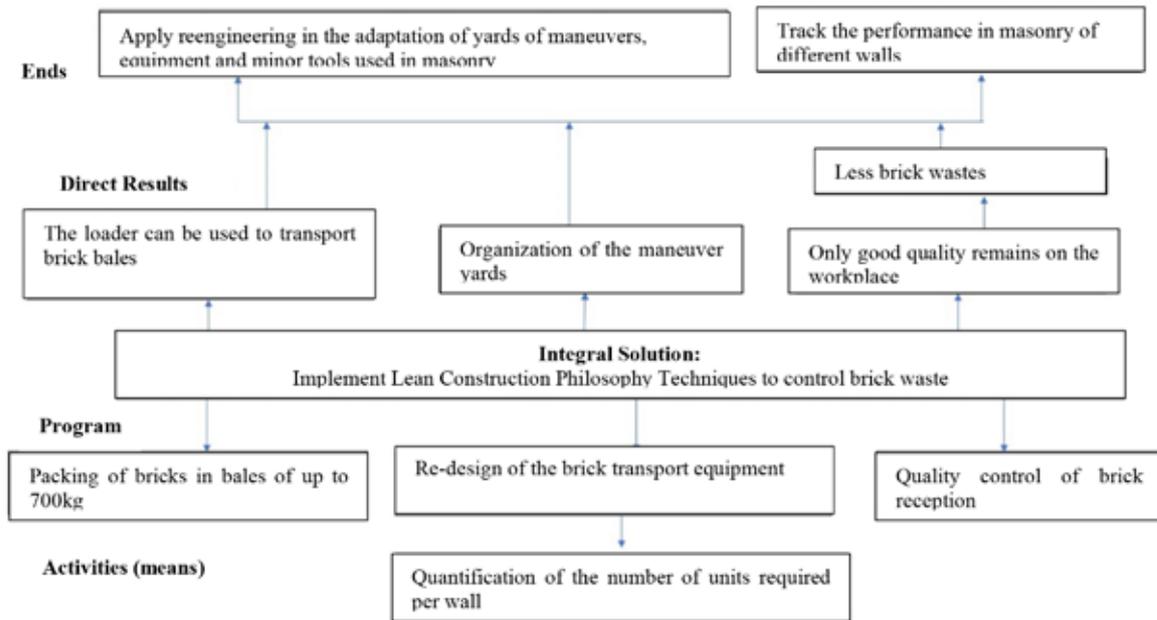
Source: Authors with information adapted from Bejarano (2017).



The student is expected to generate a map of objectives similar to that indicated in Figure 4.

The time allocated to this stage is 15 min.

Figure 4. Middle-end map



Source: Authors with information adapted from Bejarano (2017).

Reflection for the closing of the activity: The exercise is finalized by asking the group of students to evaluate the benefits of implementing a construction program without losses in other activities of a project. And, to point out the technical difficulties and human resources that could be faced by the work team that undertakes these activities. In this regard, this reflection activity allows the student to learn through social and practical interaction that collects the experiences of a work which allows him to perceive and transform reality (González, *et al.*, 2014) and adapt what he observes for an improvement of construction processes.

Evidence of application of this reflection strategy in other courses: This activity has been implemented in the Design I course where the student finally learns to prioritize investments (Serrano *et al.*, 2018). The experience advanced in the second semester of 2017 involved four groups of students who started from an existing

information of communities in the country and identified the projects that could meet the needs of the inhabitants.

4.4. Proposal for reflection on competence: social commitment

Objectives: To promote spaces for reflection on the importance of modification or radical changes in tools and construction equipment with a view to the implementation of the Lean philosophy in construction activities; sensitize students about the social responsibility of the engineer in relation to human resources.

Resources: tool images and equipment used in construction projects.

Modality: Group, between 2 and 3 people

Duration: 40 minutes

Description: The activity consists in deepening on the concept of re-engineering applied in equipment and construction materials used



in different processes in a work. It is based on a reading of a fragment quoted verbatim from (Vergara-Schmalbach, Fontalvo Herrera, and Morelos Gómez, 2013, p. 224), where they define the concept of reengineering:

... Re-engineering is the radical improvement of processes with high impact results, unlike other approaches that are characterized by seeking incremental and continuous results ... (Bustos, 2005, p.3). [...] ... As an administrative trend, reengineering is currently focusing on new project developments based on the study of errors and past successes (Vergara-Schmalbach, Fontalvo, and Morelos, 2013, p.224).

Afterwards, the students are invited to review the images in Chart 1 and to identify the radical changes that occurred to arrive at the adjustments in the constructive elements.

Reflection for the closing of the activity: The professor urges the group to elaborate the analysis of unit prices of each one of the executed changes and to estimate the useful life of the constructive elements presented and the possible risks of the workers.

Evidence of application of this strategy of reflection in other courses: This strategy has been adapted for new students who are asked to identify propitious conditions for the hazards within the work. The above because it is considered that the engineer must be committed to defend occupational health and provide conditions to mitigate occupational risks, although they are individual actions that concern the worker, the effect for the normal development of the works involves actions of all and each one of the members of an institution, in this case of a project (Guarro, 2005).

4.5. Proposal for reflection on competence: team work

Objective: To consolidate the knowledge of the working group on the organization on site for the implementation of the Lean Construction philosophy in the masonry activity.

Resources: Paper and computer

Modality: Group, minimum 2 and 3.

Duration: 50 min.

Description: This reflection seeks to be a mechanism for the group to review the learning achieved as a group (Teaching Development Center, 2017b) and should be carried out after the visit to the work. You can count on the presence of an official of the work visited.

We proceed to read the following facts found in three projects. Project 3 was executed after completion of 2 and 2 was executed once project 1 was completed.

Project 1 (522 housing units): The brick was initially delivered in bales of 1000 kg. Currently, it is stowed in bales of 700 kg. We proceeded to generate the practice of collection of broken brick, cracked or with some imperfection, to be used as media cuts, special cuts, cylinder heads or modified according to the modulation in usable parts. Modulations were made in brick cuts and ensured the leveling of the area on which the material was delivered. The masons were classified according to their level of expertise in certain walls.

Project 2 (968 housing units): With the learning of the previous work, the same strategies were applied, with the following improvements:

- Two people were assigned who were constantly in charge of the collection of left-overs and waste.
- Penalties for waste generation were implemented.
- The leveling of the brick collection sites was planned from the beginning of the ground movement.
- The brickyard accepted to receive the material with imperfections.

The previous actions had as consequence that the percentage of waste of the average structural brick was reduced from 5% to 2%.



Project 3 (565 housing units): in addition to the work carried out in 1 and 2, the following adjustments were made:

- The structural brick with vertical perforation was implemented instead of the dry pressed bricks.
- The maneuver yards were conditioned so that the beam-block brick was close to the cutter.
- The delivery of brick was scheduled according to the work schedule.

Chart 1. Reengineering in improvement of electrical panels

Element	Characteristics		Changes between the elements
	Costs	Number of uses	
1 			Between 1 & 2
2 			Between 2 & 3
3 			Between 1 & 3

Source: Authors with information adapted from Bejarano (2017).

In Chart 2 there are different activities associated with masonry. The work team must organize the activities in a way that guarantees compliance with aspects of Lean that were imple-

mented in the three projects for the masonry process.

Reflection for the closing of the activity: This activity is accompanied by a rubric of



evaluation that includes the co-evaluation of the work team.

The teacher can take advantage of the space to reflect on the relevance of the distribution of functions in a group for the good achievement of the objectives and the importance of defining the functions (roles) in a project.

Evidence of application of this strategy of reflection in other courses: This strategy has

been used in Design I, a prerequisite course of Design II and this in turn, a requirement for the completion of the civil engineering program. During the development of the program, complementarity was observed in the work teams, compliance with the schedule of activities for the execution of the projects of 98% and three of the four groups carried out the peer evaluation of their peers in an equitable manner.

Chart 2. Activities executed for the masonry work

<p>a. Internal transport with cart designed for transport of brick</p>	<p>b. In rainy season you must protect the brick with polyethylene type plastics</p>	<p>c. Ease of transportation with the loader, it must be available</p>
		
<p>d. Workplace storage</p>	<p>e. Storage in pallets of transportable dimensions</p>	<p>f. The material is separated (brick to be used)</p>
		
<p>g. Bales of 700 kg instead of 1000 kg</p>	<p>List the activities in the proper order so that the masonry process follows the guidelines of the Lean Philosophy in construction processes:</p>	
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Source: Authors with information adapted from Bejarano (2017).



5. Conclusions

The understanding of the constructive processes and the implications it has on the quality of the final product to be delivered in a construction project are key factors for the client or the end user to feel that the product, good or service delivered fully meets their expectations. The reflection strategies presented are adaptable for the teaching of human resource management and materials under the modalities of reengineering application and the implementation of Lean understanding, in addition, that this philosophy of construction without losses brings benefits to the builder, but mainly to the environment because material waste is diminished. The proposed reflection strategies are used to develop skills such as problem solving, communication skills, social commitment, critical thinking and teamwork, which together enable the future professional to use their knowledge of management aspects to solve problems that may arise during a project. The design of the strategies and their application to the teaching of civil engineering, specifically to contents on construction projects, promotes the implementation of reflective practices that consider the solid, ethical and solidary training of the future professional and the responsibility of the exercise during its performance occupational in the construction of a just and democratic society. It is expected that these strategies respond to the demands of globalized competitiveness that insistently demands changes to higher education institutions during the training of future professionals.

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