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Project based learning: Civil Engineering Student's feedback (case study)

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Abstract

Project based learning is a challenging task, requiring expertise in the topic to be taught our learning is enhanced when the teacher is highly effective.
As Students our learning is optimal when we are engaged in the learning process. The development of engineering school is critical for the future of the profession. School should be expected to gain pedagogical training through Projects based learning and as civil engineering students we want to talk about our Project based learning experience and the best example is the "urban planning and sustainable development" project.
We will present a feedback as a first year of the Civil Engineering of the Private School of engineering and technologies (ESPRIT) students. We were able to participate throughout the first semester of the 2018-19 academic year in project that included workshops, tutorials, site visits, courses and in-situ work.
The "Urban planning and Sustainable Development" project, which was part of an "Architecture and Urbanism" teaching unit, aims to bring together the different modules around a common project in order to allow students to grasp the complexity of engineering practice by understanding it in its entirety, to concretise and assimilate the different knowledge and know-how to acquire the targeted skills, as well as working on the aspect of being-well-being through different situations and modes of evaluation.
Still in the framework of project-based learning, which adheres to the concept of active pedagogy deployed with the objective of targeting the skills required, the recourse to feedback to talk about the experience is necessary.

The reflection around this participation and the commitment of the students accentuate the wish to make of us active actors and co-constructors in the process of learning. While offering us the opportunity to take a look at the approach developed, the methods used, the productions produced, the role and level of involvement of the actors concerned, as well as the means used.

Our work traces the progress of the project "Urban Planning and Sustainable Development" from our point of view as students, we will present the pedagogy deployed in this project in our vision as students, we will discuss the innovative contributions of this project in terms of training and also on a personal and interpersonal level, we will also invoke the obstacles that we had to overtake. We will finally bring a critical look on the subject and propose the points that can be improved in this approach.
Keywords: Active pedagogy, student's feedback, project based learning, integrated projects, engineering education, skills.

1 Introduction

This paper describes our experience as students in the project based learning approach. Being aware about the importance of the operationalization in the training of engineers, in this context several questions arise:

What are the skills expected of the civil engineer? How will the expected skills be developed in the courses? What processes of build up with the actors (teachers, students)? What is active learning? What are its advantages and disadvantages? What is the impact on this approach on students?

The purpose of this paper is to provide student's answers and points of view practitioners in these issues, in the specific context of higher education. It will focus on reflection. The objective is to give a feedback of the pedagogy adopted in the project "Urban planning and Sustainable Development", to underline both the potential difficulties and its contributions.

According to Rogiers a competence is "the possibility for an individual to mobilize an integrated set of resources in order to solve a situation-problem that belongs to a family of situations "(Roegiers, 2000), and in a more specific way, for an engineering school we can use the definition of the competence of Guy Le Boterf, that leads to the following wording which details the ability to act effectively (Le Boterf 1999). It will be recognized that a person knows how to act competently if she can combine and mobilize a set of relevant resources (knowledge, know-how, qualities, etc.) in order to achieve in a particular context professional activities according to certain methods of exercise to produce results (services, products), meeting certain performance criteria to a recipient.

The specification of the context of the evaluation is important for the recognition by the entourage of the action carried out with competence. The expression of the competence can be done in the school or in a professional environment.

Civil engineering is at the forefront of the development of the world in general and in particular a country. The world population has doubled in the last two decades, in the face of this demographic explosion the area of civil engineering must ensure socio-cultural satisfaction of the population in terms of buildings (buildings), displacement (roads), energy (dam), etc.

The choice of the civil engineering leads us to be actors of this process of development and thus engineer, architect, etc., are in the forefront for the construction of new city and infrastructure by ensuring the future needs of the populations.

As an engineering school the “école Supérieure Privée d’Ingénierie et de Technologies” ESPRIT uses an active pedagogy placing the student at the center of the learning process. The goal of this school is to train directly operational engineers and the slogan of the school allows to guess directly this vision "se former autrement" which means “to get formed in a different way”. The figure 1 shows the components of pedagogy deployed in ESPRIT.



Figure 1: Active pedagogy learning situations adopted in ESPRIT

2 Project-Based Learning Approach

The manner in which civil engineering is taught must change. That change is necessitated by different causes like globalization, sustainability requirements, emerging technology, and increased complexity with the corresponding need to identify, define, and solve problems of traditional disciplines. As always within the civil engineering profession, change must be accomplished mindful of the profession’s primary concern for protecting public safety, health, and welfare.

As part of the training process the project based learning approach is used in order to make improve the teaching methods.

2.1 The general definition of PBL

Project-based learning (PBL) is a comprehensive approach to classroom teaching and learning that is designed to engage students in investigation of authentic problems, it is a model that organizes learning around projects.

According to the definitions found in PBL handbooks for teachers, projects are complex tasks, based on challenging questions, that involve students in design, problem-solving, decision making, or investigative activities; give students the opportunity to work relatively autonomously over extended periods of time; and culminate in realistic products or presentations (Jones, Rasmussen, & Moffitt, 1997; Thomas, Mergendoller, & Michaelson, 1999). According to other defining features found in the literature include authentic content, authentic assessment, teacher facilitation but not direction, explicit educational goals, (Moursund, 1999), cooperative learning, reflection, and incorporation of adult skills (Diehl, Grobe, Lopez, & Cabral, 1999).

2.2 PBL according to us as students

Project-based learning is a teaching method used by some teachers in order to group students to better study modules with learning outcomes in common or aiming for the same skills.

This method groups together several modules by placing the focus on the learner and introduces an interactive dynamic in teaching. Students have the opportunity to build their own knowledge and are placed in problem solving situations, so they make unexpected discoveries. The individual takes a central place because competence is seen as a "combinatorial knowledge" (Le Boterf 1999), and the individual is "builder of his skills" (Le Boterf 1999).
More simply formulated, the teacher becomes a guide and a counselor when students make decisions for the realization of the project.

The renewed interest for this pedagogy is based on the possibilities it offers in the acquisition of skills.

2.2.1 What are the PBL impacts on students?

Project-based pedagogy develops several student skills such as self-confidence, responsibility, and the argumentation that leads students to justify and make choices; the spirit of initiative, organization, and oral expression allow him to express his ideas in public.

This pedagogy also develops the ability of mutual listening, the spirit of mutual aid, the solidarity and other's opinion respect.

In most cases, project-based learning can be done in four steps: first we start by defining the project clearly, second we organize and plan the work process, in the third position comes the realization of the project and finally its evaluation.

The way in which these steps are carried out is not often respected since it depends on the teacher in question who has several factors to manage, such as the duration of the project, the learning tools at his disposal and sometimes the number of students.

2.2.2 What is the teacher's role?

The teacher is also at the heart of the learning process.

He coordinates the work and provides the student with what he needs in carrying out the project, more precisely, it takes into account the needs and interests of students; explicitly defines the skills to be attained, plans and organizes the various phases leading to the realization of the project,

He must coordinate the tasks performed to help students and guide and encourage them.

2.3 PBL in the Civil Engineering training at ESPRIT

As a first year students we participated throughout the first semester of the 2018-19 academic year in project that included workshops, tutorials, site visits, courses and in-situ work.
That was for us the opportunity to know the concept of PBL with the "Urban planning and Sustainable Development" project, which was part of an "Architecture and Urbanism" teaching unit.

We could through this project of concretising and assimilating the different knowledge and know-how to acquire the targeted skills, as well as working on personal and interpersonal skills through different situations and assessment methods.

3 "Urban planning and Sustainable Development" project

A complete engineer must have other skills than technical, he works as a team, manages groups, takes into account human factors and above all be able to inspire others.

We chose to work on the project UPSD (Urban Planning and Sustainable Development) a project that lasted almost a semester, in which we learned about the technical aspect, it was a prerequisite for the other modules and led us to achieve it by acquiring the expected learning outcomes.

3.1 Project description

The initial idea of this project was the willingness of teachers to break with theoretical and abstract projects. For this, they proposed that we work on the rehabilitation of an existing building, to do this they suggested the building of ESPRIT as a study corpus.

Subsequently, it was up to us to choose the space to work on (cafeteria, classroom, amphitheatre ...). From the start, we were involved in the decision making.

We had to work in groups, during the formation of groups, teachers strongly recommended us to form heterogeneous groups composed of Tunisian and African sub saharan students.

So, for one semester, it was up to us to propose a new sustainable layout for the selected site. Initially, each group completed a diagnostic report of the selected areas. An exercise that familiarized us with the techniques of in-situ work (taking measurements, drawing sketches, doing surveys, interviews ...) which are basic techniques for an engineer.

From that moment, each course session becomes a correction and supervision one. To better accompany us and distribute the tasks within the groups, we were called to fill in weekly specifications which explains the involvement of each member of the group. One of the methods of monitoring for teachers is as shown in Table 2 to define WHO does WHAT, WHEN and HOW?

Table 1: The WHO does WHAT WHEN and HOW description

Who	What	When	How
Persons in charge of the task	The description of task	The time allocated in this task and the deadline	The way it will be done

The project was not limited to lectures or coaching sessions. To better optimize the process, we also visited construction sites, in order to discover the professional environment and learn about companies and the practical life of civil engineers.

One of the highlights during this project was the workshop settled to understand the techniques of producing mock-up. Students from the ENAU (National School of Architecture and Urbanism) in 3rd and 4th year animated a workshop on the techniques of producing a mock-up. The figure 2 shows the students in action during the workshop.

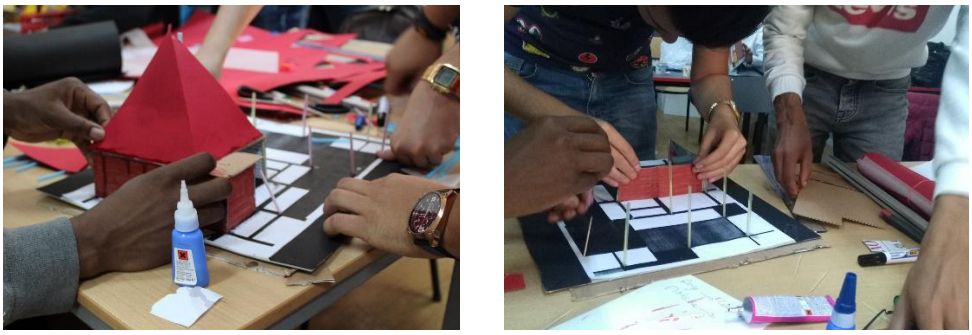


Figure 2: Students producing mock-ups

The alternation between practical and theoretical aspects in the project was a climax. Thus, at any time when a need for a knowledge or a theoretical concept is required, teachers do not hesitate to make it according to the pedagogical means that seems most appropriate.

In addition to technical knowledge and group work methods, oral presentation techniques are one of the objectives of the "Urban planning and Sustainable Development" project. In every session, the groups had to present orally and with adequate tools the progress of their work.

The investigations, the verbal exchanges, the emission of hypotheses, the observations, the explanations, the arguments, the documentary researches and the experiments are always done on two levels: at the level of the group first, then at the level of the class, with possible feedback.

This alternation between individual and collective work allows the gradual construction of scientific knowledge by students.

3.2 Matching learning outcomes and Learning situations

The link between competence and situation is vital. Competence is defined in particular with reference to the situation it makes it possible to master. Although it is conceivable that competence is 'transversal' (in making it possible to master several situations), in contrast, there is no sense in discussing competence without referring to at least one situation that the said competence makes it possible to master because otherwise it would suggest that the individual with the competence could master any situation. In this sense, Le Boterf (1994) uses such phrases as 'competence put into action' and 'situational competence'.

The table 1 illustrates the learning situations adapted to each learning outcome.

Table 2: Match between learning outcomes and learning situations

	Produce mock-up	Real case Study	Understand the notion of spatial quality (comfort and atmosphere).	Elaborate plans with annotations, quotations and mass properties with materials
Theoretical course				x
Tutorials		x	x	
Group Workshops	x	x	x	
Visits				x
PBL	x	x		x

4 Feedback and criticism

Our first year in ESPRIT was marked by this Project Based learning approach at both scientific and academic acknowledges level, it also allowed us to develop our skills, our teamwork abilities and our way of interacting within our school and revealed many advantages:

- As first-year students, we had an interesting experience. As presented by the teachers at the beginning of the year, the objective of the module is to make us discover the engineering profession in Civil Engineering field, to introduce us to different missions and tasks and simulate the different conditions of collaborative work with other stakeholders of the profession.
- At this stage, we can attest our satisfaction for attending the objectives fixed in the beginning of the module through an adapted process.
- Indeed, one of the assets of this active pedagogy is to gather students and teachers around a common project, allowing a better understanding of teamwork. The transmission of knowledge between teacher-students or student-students is done in a more fluid and direct way.
- Throughout our academic curriculum, we studied theoretical courses without knowing how to make the link between the applications of the formulas, methodological approaches. We were glad to discover this module associating practice to theory, based on concrete projects where the theoretical notions are used when the need arises. Thus, all the courses were at the service of the project, allowing us to make a direct link between theory and practice.
- We found that the method adopted has a considerable impact on the level of learning and the quality of reception of information, the diversity of these pedagogical methods was at the base of acquisition of learning outcomes.
- In the classical teaching methods, students are essentially passive receivers, so by enhancing the layout of the class into a participative one, we moved to a more flexible and interactive workshop space configuration, allowing us to simulate the working conditions of the an operational engineer within his office. Teachers become coaches or supervisors who supervise and guide us during the different phases of the project. This availability and proximity to teachers allowed us to improve our abilities.
- The autonomy that we had throughout the project, allowed us to put ourselves in various situations and develop our sense of curiosity to solve the difficulties.
- The error is a learning engine. During some sessions, as students during this project we were allowed to experiment and make mistakes. We were aware that the error is not a fault, it is necessary, it is inherent to the learning process. It is about moving from a common thinking to a scientific thinking. It is a permanent intellectual gymnastics that should be done to rectify one's natural point of view based on everyday experience.

However, like any new method, some points need to get improved in order to optimize the effectiveness of the result of the experiment for students and teachers:

- Time was a handicap in the realization of our project, or even in teacher's monitoring and supervision.
- The important number of students made decision-making within a group difficult and sometimes impossible.
- The divergence of opinions, the problems within the groups, the allocated time for the project "Urban planning and Sustainable Development» slowed down our progress and affected our productivity.
- The assessment by peers; a technique that we have appreciated and tested once during a formative assessment was not reproduced and generalized in all the reports as well as in the final evaluation.

5 Conclusion

This paper has attempted to answer several questions: how does the teaching method impacts the acquisition of competence? What's the role of students and teachers in learning process? How the PBL

affects the students learning? After a review and analysis of the available work, it emerges that the developing teaching methods is always beneficial for optimal learning.

How to help students without solving problems in their place and teach them that a problem can have multiple solutions? Scientific education is not learning by heart facts, knowing phenomena and their interpretation, it is also understanding how scientific knowledge has been established.

Critical thinking requires constant questioning. Students must learn to ask the relevant questions and always think of proposing answers.

The transition from a traditional question to an operational one requires work of reformulation and reflection. This work requires a search for information, by researching the available means leading to the correct answer. It is necessary to learn to think in a scientific way, to learn not to be content with dogmatic answers but to search for the logical response.

It is not surprising that this type of project takes a more important place in our training process which, by vocation, wish to offer a professional training linked to standards of competence and bathed in a performance culture. The thoughtful development of the skills of our engineers is a strategic issue.

The skills that we learned to deploy were experimented along the project and even when writing this article we had to experiment again teamwork, we had to manage our differences of opinion and find a middle ground to reach a result we would as a team agree on.

We are aware that as students the relevance of our judgment could be mistaken by our lack of experience. Our goal is to share our experience in this module in total transparency hoping that it would be beneficial in the process of continuous improvement.

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