SUCCESSFUL CASES AND LEARNED LESSON AFTER TWO COURSES USING PBL+ FOR PRACTICAL TRAINING OF ENGINEERING STUDENTS

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What is PBL+?

Practical activity
"To solve a real problem from a Company in contact with a representative from the Company"

It is a methodology created by the Teaching Innovation Group INGENIAQ that gathers several learning-teaching techniques

What is PBL+?

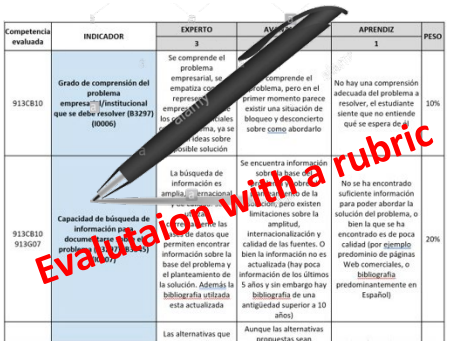
Solve a real problem from a Company

Project Based Learning
PBL

Direct contact with a comissoned person from the Company

FLIPPED CLASSROOM

Service learning when the Company is a public institution or a micro-company



Objective

GENERAL: To analyse the application of the PBL+ during 2 academic courses in 3 different subjects representing the different knowledge areas included in the curricula of an Engineer.

SPECIFIC: To analyse the application of PBL+ in one subject related with processes engineering in agro-environmental studies; one related with production engineering in bioprocesses; one about socioeconomical aspects of engineering. For the analysis internal and external conditioning factors were considered.

Methodology

Subjects selected:

- Processes engineering in the agro-environmental studies: “Cropping systems”.
- Socio-economical aspects in engineering: “Business administration and agri-food marketing”.
- Processes engineering in the bio-processes: “Biotechnological processes”.

Gathering of positive aspects and learned lessons by the responsible teacher using the following tools:

- Survey to the teachers participating in the subject
- Survey to the students to know their opinion about the activity
- Survey to the company representative about the activity
- Comparison between the auto-evaluation of the students and the teachers’ evaluation using the specific rubric

A SWOT was issued

Results

SWOT PBL+ in the subject “Cropping systems” Master in Agricultural Engineering

Strengths	Weaknesses	Opportunities	Threats
The involvement of a company in the learning-teaching process	PBL + is not well adapted to online distance learning	The possibility of improving the subjects’ programming with the information obtained from the company	The limited number of local companies could deplete the available topics
The students feel positive to get in touch with the professional activity	Each student become an expert in the cropping system analysed but has very reduced contact with the rest of the cropping systems	It may improve the employability as some students can be contracted by the company where they performed the activity	the companies can get wearied from the repetition of the activity year after year and they can decline collaboration
The PBL+ activity is an effective simulation of what is “real professional life”	The activity has partially failed in achieving the “critical thinking” competence	This activity can improve the collaboration univerisy-companies	The differences in the difficulty of the different problems can affect to the equality of opportunities

Results

SWOT for PBL+ in the subject “Business administration and agri-food marketing” Master in Agricultural Engineering

Strengths	Weaknesses	Opportunities	Threats
The rubrics allows the teacher evaluation within the students' self-evaluation and co-evaluation.	The competence less achieved both students and teachers was students´ critical thinking.	The students declared that they enjoyed interacting with companies communicating with them, reading comments about the company and obtaining their own conclusions.	It was found a significant difference in the assessment, males gave significant higher marks than females. This result could be explained due to the gender bias in technological contexts proved by, where females were presented with less technology skills than males.
The teachers expressed that rubric is capable to measure the progress, evolution and acquisition of competences by the students according to the European Higher Education Area (EHEA) learning process	The students granted higher importance in practical solutions to theproblems than to formal aspects	The students eulogise their colleagues’ work, which help them to learn and progress while seeing the ways to improve their own work	The teachers noticed the students´ lack of self-evaluation ability.
This project contributed to the alignment of the evaluation with the competences, the student's follow up of his own activity.		This project favours their responsibility of the learning and the self-evaluation of the quality of their work and the ways in which it could be improved	The assumption of students’ responsibilities in the teaching-learning process using rubrics is a challenge for them

Results

SWOT for PBL+ in the subject “Biotechnological processes”
Science Degree in Biotechnology.

Strengths	Weaknesses	Opportunities	Threats
The rubrics allows students to perform self-evaluation and discern the main aspects having impact on the final grade.	The competence less achieved both students and teachers was students´ critical thinking.	The students were more enthusiastic regarding the search of information with an applied focus.	The general application of this practice to the whole course is not feasible.
The teachers expressed that rubrics are a useful methodology for achieving the learning objectives of the subjects	Students showed difficulties in assimilating new concepts that were not previously explained by the teacher due to the tendency of the learning system to wait for approval.	Searching for information allowed contact with their partners and colleagues. Communication and cooperative work was fruitful	Self-evaluation and the excessive use of rubrics may become tiresome if extensively applied to all learning tasks
The application of this experimental exercise helps in closing the gap between theoretical knowledge and practical information.	There are still great difficulties in language skills. Scientific information and technical knowledge is mainly published in this language, thus understanding some concepts is more difficult for students with low English level	This project sets a great expectation of applicability and opens the door to changes in the way theoretical concepts are introduced	Implementing this methodology during COVID-19 pandemic has a high risks of for students not performing all tasks and low capacity of detecting these cases.

Conclusions

1. The PBL+ has proven to be a useful methodology for Engineering studies because it helps the students to connect the theoretical knowledge with business and entrepreneurial real situations.
2. PBL+ may be considered a revolution in the way of introducing the theoretical concepts, and it makes more attractive the teaching-learning process.
3. PBL+ has been useful for the different knowledge areas that make up the training of an engineer, i.e. production engineering and economical aspects.
4. The students showed problems in distinguishing the scientific information that is useful for the industry from the pure theoretical musings, and to select the useful information.
5. PBL+ is an optimal activity to improve the competences related with critical thinking, but the students fail in this competence more than in the rest of them.

Conclusions

6. The industrial/biotechnological sector is reluctant share information with the students, unlike what happens in the agricultural sector. Thus, in the industrial companies PBL+ must be adapted, and the teacher needs to act as an intermediate between the company and the student.
7. The use of rubrics for evaluation is a key aspect for the success of the PBL+, but the abuse of rubrics may become tiresome.
8. The distance learning was not adequate for the application of the PBL+ methodology in the subjects related with the processes engineering

Acknowledgements

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