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ADAPTATION OF THE PBL+ METHODOLOGY TO B-LEARNING AND ONLINE TEACHING

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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+?

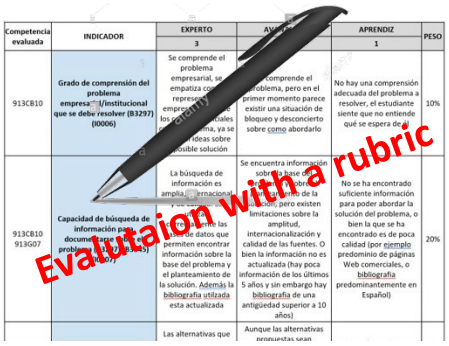
Solve a real problem from a Company

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

To assess the suitability of the learning-teaching system PBL+ to the new scenarios imposed by the pandemic

- Higher presence of blended learning (mixed learning face-to-face and online)
- Entirely online teaching in extreme situations.

Methodology

A survey to the teaches that use PBL+ in their classes.

The survey included the following items:

- The suitability of the different components of PBL+ to teaching in mixed systems (face-to-face and online simultaneously) in the one hand and entirely online in the other (Likert scale, 1 lowest, 5 highest)

- The degree of achievement of the different competences covered by the PBL+ in the same two cases indicated in the previous point (Likert scale, 1 lowest, 5 highest)

Methodology

Subjects included and classification according to type of subject

Subject	Degree/Master	Type of subject
Ornamental crops	Degree in Agrarian Engineer	Process engineering
Biotechnological processes	Degree in Biotechnology	Process engineering
Crops systems	Master in Agronomic Engineering	Process engineering
Innovation in the pharmaceutical industry	Master in Production in Pharmaceutical Industry	Management and economy
Business administration and agri-food marketing	Master in Agronomic Engineering – University of Valladolid	Management and economy
Agricultural and rural development	Master in International Cooperation for Development	Management and economy
Processes in carbochemical and petrochemical industry	Master in Mining and Energy Resources Engineering	Process engineering
Environmental technology	Degree in Electrical Engineering	Environmental engineering
Energetic resources management	Degree in Environmental Science	Environmental engineering
Aerospace sustainability	Degree in Aerospace Engineering	Management and economy
Chemical reactors and fermenters	Master in Production in Pharmaceutical Industry	Process engineering

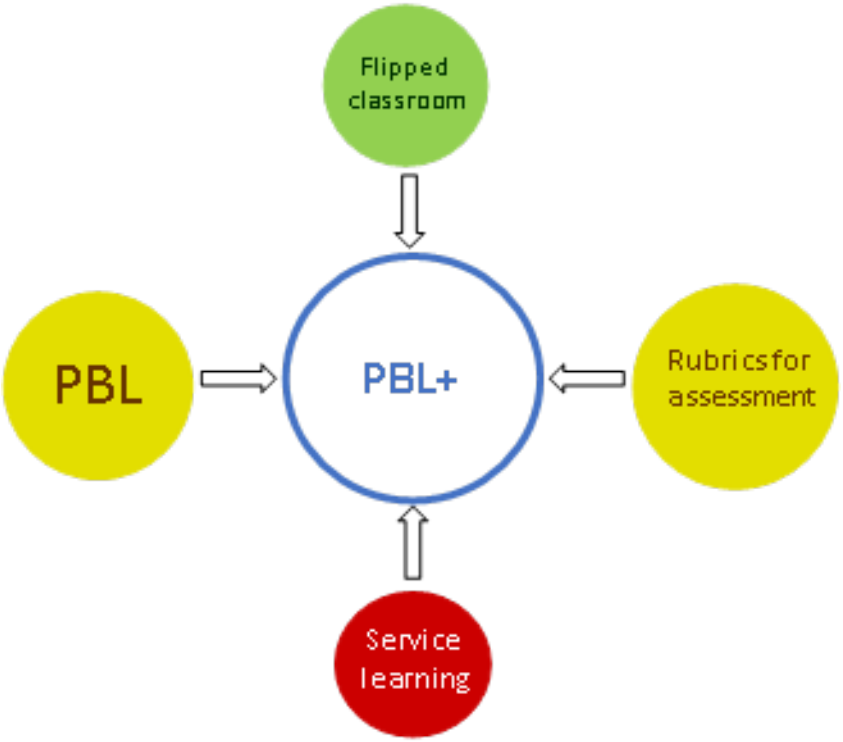
Results

Suitability of the different components of PBL+ for teaching in (i) mixed systems and (ii) entirely online systems (1 lowest – 5 highest)

Components of PBL+	Type of subject						Average for all the subject's types	
	Process engineering		Management and economy		Environmental engineering			
	Mixed system	Entirely online	Mixed system	Entirely online	Mixed system	Entirely online	Mixed system	Entirely online
PBL	3	2	4	4	2	2	**3.0**	**2.7**
Flipped classroom	5	4	5	4	4	3	**4.7**	**3.7**
Service learning	2	1	3	2	3	1	**2.7**	**1.3**
Rubric for assessment	3	2	4	2	3	2	**3.3**	**2.0**
Average	3.3	2.3	4.0	3.0	3.0	2.0		

Results

Suitability of the different components of PBL+ to teaching in mixed systems and entirely online systems (Green suitable; yellow partially suitable; red unsuitable)



Results

Degree of achievement of the different competences covered by the PBL+ in mixed systems and entirely online systems (in red the achievement is severely affected, in yellow moderately affected, in green not-affected)

Competence	Type of subject						Average for all the subject's types	
	Process engineering		Management and economy		Environmental engineering			
	Mixed	Entirely online	Mixed	Entirely online	Mixed	Entirely online	Mixed	Entirely online
Technical knowledge and skills	3	2	4	3	3	2	**3.3**	**2.3**
Synthesis capability	4	2	4	3	4	3	**4.0**	**2.7**
Critical thinking	3	2	3	2	3	2	**3.0**	**2.0**
Written communication skills	5	5	5	5	5	5	**5.0**	**5.0**
Oral communication skills	2	1	2	1	2	1	**2.0**	**1.0**
Average	3.4	2.4	3.6	2.8	3.4	2.6		

Discussion

The PBL+ has been designed to be used in face-to-face teaching systems, because the interaction between the students and the companies is a key aspect of the system.

The results obtained in the survey indicate that:

- For technical and engineering disciplines, the visio-conferences cannot replace the in-person exploration of the processes in which the problems to be solved are born
- But not even in most of the management and economical subjects, the face-to-face interaction to understand the companies' problems can be fully replaced by a virtual communication, although they adapt better than the pure engineering disciplines

Conclusions

1. Out of the four components of the PBL+, the service learning was the worst adapted to mixed or entirely online systems, whereas the flipped classroom showed the better adaptation, with a suitability score for mixed learning of more than 4.5 and for entirely online of almost 4.
2. The rubrics results outdated as a consequence of the changes imposed by modification in the percentage of face-to-face or the shift to an entirely online model as a consequence of the pandemic evolution, and the option to solve this problem is the use of flexible rubrics.
3. The mixed and online systems fail to achieve the competences related to the oral communication skill, critical thinking and neither the technical knowledge and skills.
4. As a result of the assessment carried out, the training process of engineers cannot be based on online learning-teaching systems. Moreover, the mixed systems should be kept to a minimum, and the PBL+ activity should be part of the face-to-face activity in mixed systems.

Acknowledgements

The Teaching Innovation Group (TIG) INGENIAQ from the University of León, is supported by the “Escuela de Formación” from the University of León (Spain), who grants the activities of the group.

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