Problem-Based Learning: An Instructional Model in Teaching Training Courses

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1. Introduction

In this moment of change and renovation at the University it is very important the use of alternative didactic methodologies in class. From this new framework the focus is on learning, the students must acquire advanced learning strategies and the teaching methodologies are to be active. The problem-based learning (PBL) is a methodology based on learning, reflection and investigation for solving a problem by students [1].

This concept was born in medical education programs [2]. But this influence has gone to others subjects and it had demonstrated that this model could be effective in all disciplines [3, 4]. In the Grades of Primary Education and Early Childhood Education Courses we believe that PBL is really beneficial to future teachers because they need obtain the specific competences and abilities necessaries for developing their educative practice in a real and an effective way.

In different education programs, students learn to solve different problems. Learners have to use diversity of skills for solving each type of problem. It is possible represent different categories of problems [5]: policy problems, strategic performance problems, troubleshooting problems, decision-making problems, design problems, dilemmas, rule-using problems and story problems. This requires different instructional methodologies and students need adapt their own learning methods.

In our study we have used several types of problems: decision-making problems, study of case, dilemmas and learning based on an activity [6]. In all cases we have followed the eight phases to develop the PBL propose by [7]:
- Learn and analyse about environment of the problem.
- Carry out a brainstorming
- List things which are knew
- List things that are need to solve the problem
- Define the problem
- Look for information
- Present the results

For this reason we chose PBL as the best framework for working with our students. The PBL helps to the students to achieve abilities and capacities connected with teams work, motivation, communication skills, critical thinking, problem solving, investigation [8]….In our study we aimed to use the Problem-Based Learning (PBL) methodology for developing and promoting general and specific competences.

2. Methodology

In order to enhance the personal and professional competences of future teachers, we used PBL methodology in the three years of the Grades of Primary Education and Early Childhood Education.

A group of 127 students from the first course, one of 66 students from the second Course and a third group of 69 students from the third Course participated voluntarily in the study.

To collect the data we used "The Self Assessment Scale about abilities developed in BPL". This scale was adapted from the proposal presented by the Instituto Tecnológico y de Estudios Superiores de Monterrey [9] to determine the specific abilities the students consider they improved with the PBL methodology

This scale is composed of 21 questions concerning to 4 different dimensions. These dimensions, described by Fernandez et al [10] are related to: Emotional Competences (EC), Practice Execution (PE), Learning Effects (LE) and Generalization (G).(Table 1). All of the questions were designed as Likert-type ranging from 1 (strongly disagree) to 4 (strongly agree).

| Variables and dimension		
V1. To have a deep and clear motivation about necessity of learning (EC y G)	V8. Intellectual ability improves (LE)	V15. Imaginative thinking abilities (PE)
V2. To be more tolerant for facing ambiguous situations. (EC)	V9. Problem solving ability (EC)	V16. Sensory thinking abilities (PE)
V3. To be more able for working in groups (EC y G)	V10. Writing communication abilities (PE)	V17. Auto-criticism abilities (EC)
V4. Abilities for personal interaction (EC)	V11. Oral communication abilities (PE)	V18. Ethic compromise ability (EC y G)
V5. Creativity Improve (LE)	V12. To have the possibility of observed our field of expertise in a wide perspective (G)	V19. Research abilities (PE)
V6. Analysis ability (LE)	V13. Critical thinking abilities (PE)	V20. Autonomous working abilities (LE)

V7. Synthesis ability (LE)	V14. Reflexive thinking abilities (PE)	V21. Design and management of working projects (LE y G)

Table 1. Dimensions and variables

3. Results and discussion

Figure 1 shows the perception of the different courses in all the variables measured in our work. As can be observed the students from the 3rd course rated BPL as a good tool for improving abilities and competences.

Figure 1. Mean values of each item's responses as a function of the course
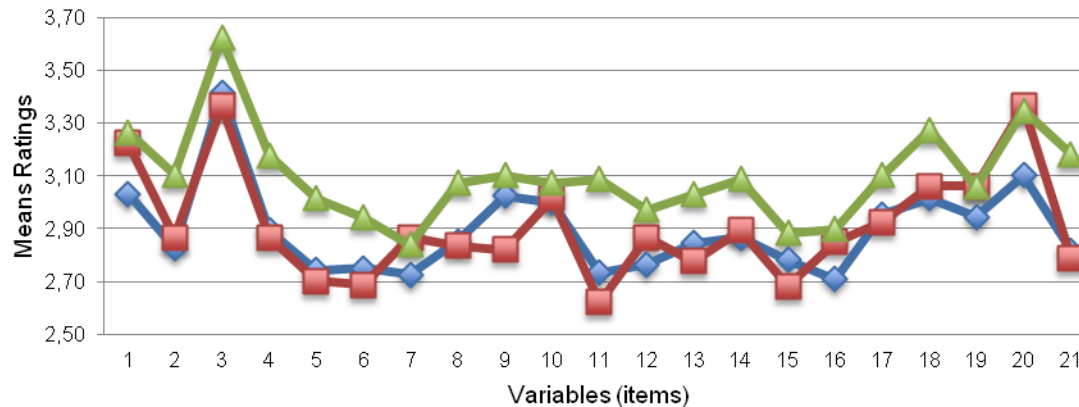
In order to check for group differences we performed analyses of variance (ANOVA) on the responses to each variable (items). The variables that showed significant differences are detailed below:

The analysis for the variable **To have a deep and clear motivation about necessity of learning** showed significant differences between the groups. Specifically, the students of second and third year, who did not differ, tended to report higher levels of motivation. A different pattern emerged in relation to the variable 2 **To be more tolerant for facing ambiguous situations**. In this case, it was the 3rd course group who differed from the other two in describing themselves as being more tolerant, $F_{(2, 259)}$: 6.44, p= .002. The same pattern appeared in the variables 3 (**To be more able for working in groups**), 4 (**Abilities for the personal interaction. Intellectual and emotional),** 5 (**Creativity Improvement),** 6 (**Analysis ability)** and 8 **(Intellectual ability improvement).**

Concerning the variable 9 (**Problem solving ability),** the analysis revealed significant differences between groups. The first and third year students judged PBL to be important to develop problem-solving capacities.

Differences were also observed for the variable 11 (**Oral communication abilities),** with the 3rd year students showing higher ratings. A similar pattern emerged for the variables related to thinking abilities (**Critical thinking abilities** and **Reflexive thinking abilities**), and the variables 18 (**Ethic compromise ability)** and 21 (**Design and management of working projects showed**).

As for the variable 20 (**Autonomous working),** however, on average second and third year students showed similar rating but higher ones than first year students.

Table 1: Variables for the PBL competences

Variable	1st Course		2nd Course		3rd Course		p
	Mean	SD	Mean	SD	Mean	SD	
1. To have a deep and clear motivation about the necessity of learning.	3.03	0.38	3.22	0,60	3.26	0,54	.0012*
2. To be more tolerant for facing ambiguous situations.	2.83	0,47	3.87	0,60	3.20	0,68	.0018*
3. To be more tolerant for facing ambiguous situations.	3.41	0,61	3.36	0,65	3.62	0,62	.0305*
4. Abilities for the personal interaction	2.89	0,49	2.87	0,52	3.18	0,57	.0010*
5. Creativity Improve	2.74	0,63	2.70	0,74	3.01	0,68	.0112*
6. Analysis ability	2.75	0,53	2.69	0,53	2.94	0,51	.0070*
7. Synthesis ability	2.73	0,54	2.87	0,63	2.84	0,63	.1750
8. Intellectual ability improves	2.85	0,47	2.84	0,54	3.07	0,49	.0022*
9. Problem solving ability	3.02	0,51	2.82	0,60	3.10	0,60	.0099*
10. Writing communication abilities.	3.00	0,58	3.01	0,66	3.07	0,65	.7205
11. Oral communication abilities.	2.73	0,65	2.62	0,72	3.09	0,72	.0004*
12. To have the possibility of observed our field of expertise in a wide perspective	2.77	0,58	2.87	0,60	2.97	0,59	.1289
13. Critical thinking abilities.	2.84	0,54	2.78	0,57	3.03	0,64	.0221*

14. Reflexive thinking abilities	2.87	0,51	2.89	0,56	3.09	0,59	.0220*
15. Imaginative thinking abilities	2.78	0,55	2.68	0,61	2.88	0,68	.1625
16. Sensory thinking abilities.	2.71	0,58	2.85	0,59	2.90	0,60	.0830
17. Auto-criticism abilities	2.95	0,53	2.93	0,68	3.10	0,73	.1884
18. Ethic compromise ability.	3.02	0,49	3.06	0,69	3.28	0,59	.0157*
19. Research abilities	2.94	0,58	3.06	0,65	3.06	0,68	.4393
20. Autonomous working abilities	3.10	0,69	3.36	0,60	3.35	0,61	.0106*
21. Design and management of working projects	2.82	0,48	2.79	0,54	3.18	0,58	.0000*

After focusing individually on the 21 variables of the questionnaire, we looked at the four dimensions described above (Table 1). To do so the whole set of variables included in the each dimension were collapsed. The corresponding ANOVA on mean ratings confirmed significant differences between students of 3rd year and the other two groups of students, who did not differ one from the other (Figure 2)

Figure 2: Mean Ratings as a function of the dimensions proposed by Fernandez et al (2006)

4. Conclusion

In our study, we aimed at exploring the effect of the PBL methodology in the perceived development of competences in a sample of students of two Degrees in Teaching training. The data determined a relation between the course level of the students and the relevance the students attributed to the PBL methodology. Specifically we studied 21 variables that assessed the extent to which students thought PBL helped them to acquire the competences we aimed to train..

We used a self-assessment scale in which the student expressed their perceptions about the PBL as a methodology to improve abilities and competences.

Whereas we find no effect of the on 7 out of the 21 variables (related to **synthesis ability**, **writing communication abilities**, **imaginative and sensory thinking, self-criticism abilities, research abilities and the possibility of observed field of expertise in a wide perspective**.

In general terms, the 3rd year students tended to though that PBL methodology helps them to improve their abilities in all the dimensions evaluated.

2nd and 1st year students had a similar perception concerning the abilities they learned, although were 2nd and 3rd year students who showed to have similar feeling on variables such as **motivation** and **ability to design and manage working projects** the students from 2nd and 3rd course had a similar perception.

Importantly, the abilities which students perceived to be improved the most through the PBL methodology were those related to **disposition for team working**, **Ethic compromise** and **Autonomous working.**

The participants in the PBL project judged this methodology to be useful to increase that they were more able for working in groups. They had a personal implication in their own learning process that offers them the opportunity for acquire ethics compromises. This effect was bigger when we talk about the 3rd and 2nd courses students who transfer their learning to new work projects.

Our results encourage further exploration of the role of PBL as a strategy/tool to optimize the learning of future teacher students. This methodology can help this students develop some of the skills they need to become effective teachers.

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