Implications of PBL on learning heat and thermal energy concepts through situations of traditional ceramics

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Abstract. Traditional ceramics is related with the manufacture from an artisanal perspective; however, a huge part of this activity involves physics knowledge. The High School Technological Program oriented to Ceramics (BTC in Spanish) rises because of the need for individuals with knowledge in science and technology applied to ceramics. So, is necessary to have a teaching-learning method that guarantees the apprehension of heat and thermal energy concepts. The Project Based Learning (PBL) offers the opportunity to do that through situations of the ceramic context. The responses analysis of a multiple-choice test shows a gain in the low zone of Hake's factor.

1 Introduction

To produce ceramic pieces implies the articulation of knowledge, not necessarily formal, about physics, chemistry and aesthetics. The main objective of this work is to assess the gain of the learning of heat and thermal energy concepts based on situations of traditional ceramics, in the students of The High School Technological Program oriented to Ceramics (BTC in Spanish), reached by the use of the PBL. By this way, teachers can count with another methodological option to ease the learning of physics concepts in high school students.

A ceramic technologist, grade obtained with BTC, must to consider the application of physics on ceramics, the definition of this activity, formulated by Morales Güeto [1], «a ceramic product is any manufactured, essentially compound by solid, inorganic, non-metallic matter, cold conformed and heat consolidated», shows this need. So, any student has to understand this relationship to develop inside the ceramic field. To do that, any physics teacher has to use a methodology oriented to develop the scientific skills by the use of situations of traditional ceramics. As mentioned previously, PBL implies that.

2 Methodology

Due to entry mechanisms to the program was used an intentional sample inside the quantitative paradigm. By the number of students, research's category is pre-experimental with a pre-test – post-test design [2]. The study group was compound by 45 students (16 women and 29 men), whose age range is around 16 and 17 years old. All of them members of the *Ceramic Kiln's Thermodynamics* course. The assessment of learning of concepts was made applying a test compound by 20 multiple-choice questions. The students had 40 minutes to solve the test.

The data analysis includes calculation of Hake's factor as shown in [3] and Concentration factor as shown in [4]. Concentration factor (C) can take the value of zero, when students choices have made randomly, and 1 when all students chose the same answer option. In a determined answer, the use of C with the score S, informs about the evolution of the concept comprehension. This combination can be classified as low (L), medium (M), and high (H). Different combinations result in a response pattern which can be identified the preference for one, two or no one model as can be viewed in Table 1.

Table 1 Codification of response patterns

Model	S-C Pattern	Implications
One	**HH**	One correct model

	LH	One dominant correct model
Two	**LM**	Two posible incorrect models
	MM	Two popular models
None	**LL**	Towards a random situation

3 Results

It was the first time that students worked with this methodology. The number of students whose answered the test was 31. As a result of the concentration analysis can be identified a positive incidence of the instruction due to a general movement from LM-LH to MH. This situation implies the possibility of a correct model election. Table 2, shows items with a pattern movement.

Table 2 Items with a movementbetween LH-LM and MH

Pre-test				Post-Test			
Ítem	S	C	Patrón	Ítem	S	C	Patrón
1	0.161	0.424	LM	1	0.194	0.485	LM
2	0.419	0.538	MH	3	0.387	0.488	LM
5	0.290	0.565	LH	6	0.387	0.506	LH
10	0.194	0.618	LH	16	0.419	0.548	MH
12	0.548	0.640	MH	19	0.645	0.775	MH
17	0.548	0.692	MH	26	0.516	0.611	MH
19	0.452	0.683	MH	29	0.355	0.513	LH
20	0.323	0.412	LM	30	0.516	0.608	MH

Combining what is shown in both tables, can be appreciated movement between zones with one model. In MH case, it indicates an increase in correct answers, rest of the items are in LH zone in both Pre, and Post-test. However, Hake's factor analysis result is $G = 0.11$, into the low gain zone. Comparing it with the obtained one of a group with a traditional method ($G = -0.037$), can be noted an advantage of the PBL method. Between pre and post-test was observed a lack of discipline, by the students, with the activities realized.

4 Conclusion

The use of PBL centred in traditional ceramic situations brings offers encouraging results in comparison with other methodologies. The low gain can be a result: (a) of a deficient adaptation, by the students, to the methodology; and (b) the lack of discipline during the activities between pre and post-test. It is recommended to obtain data for more groups to know more accurately the incidence of the PBL in the learning of concepts of heat and thermal energy.

References

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