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Assessing Students' Attitudes In A College Physics Course In Mexico

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Abstract

Considering the benefits of modeling instruction in improving conceptual learning while students work more like scientists, an implementation was made in an introductory Physics course in a Mexican University. Recently Brewe, Kramer and O'Brien have observed positive attitudinal shifts using modeling instruction in a course with a reduced number of students. These results are contrary to previous observations on other methodologies that promote active learning. Inspired in those results, the Colorado Learning Attitudes about Science Survey (CLASS) was applied as pre and post tests in two mechanics courses with modeling. In comparing the different categories of the CLASS, we have determined significantly positive shifts in Overall, Sophistication in Problem Solving and Applied Conceptual Understanding for a sample of 44 students.

Introduction

Understanding of what is important in a classroom has changed dramatically since that formal research in Physics Education began. Today, the emphasis in the study of the hidden curriculum is as relevant as those in conceptual understanding or in problem solving skills. One example of this hidden curriculum is student's beliefs. The importance of students' beliefs and expectations has been increasing in last years, since these were found to be one of the points to improve in the students. For instance, previous studies have shown that traditional courses only diminish students' motivation [1].

Now days the Colorado Learning Attitudes about Science Survey (CLASS) [1] is a complete and accurate test to asses students' beliefs about physics and its learning. This test has also been modified for other subjects as Chemistry [2]. It has been translated to many languages, which provides a standard test to be applied to all students without taking in consideration problems involved in foreign language implementations.

In this article we present the results obtained in the second implementation of modeling instruction in a Mexican institution. Given the characteristics of the sample is necessary the use of non-parametric statistics to determine the significance of the positive shifts observed.

The course

The course was taught with the methodology based on modeling theory [4]. The students worked in collaborative groups, in which they developed models of physical situations on whiteboards. Later they could share their models with the rest of the class, and so establish a discussion about the different proposals. The working groups were formed randomly. Each group was made of four or five students and was changed three times in the semester. The professor made sure the students had the necessary tools to build the models through activities previously made outside the classroom. That was the second time that the professor taught with this methodology, so he is considered an early-adopter teacher. The course was held without the support of a textbook and the lecture time given by the professor never took more than 10 minutes in a 50-minute class.

Methodology

For this study, two groups with modeling instruction were considered, both with the same professor and 38 students each. The students that took both the pre and post tests (CLASS) gave a total sample of 44 students for this experiment. The pre test was taken in the first week of the semester and the post one was taken a week before the end of course.

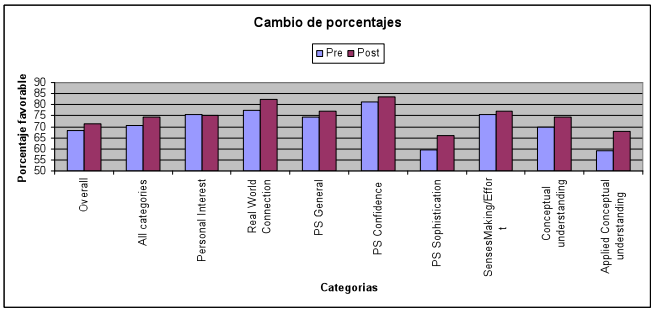
For the initial processing of the information the CLASS template [9] was used. The pre and post test percentages of likehood to experts was in this template calculated.

In a preliminary analysis of the data, it was observed not have the normality property, which is needed in order to use parametric methods in statistics. Therefore it was used the Mann-Whitney test to found the statistical significance in the differences of the pre and post results for all the categories (shifts). The computed shifts were obtained subtracting the individual pre and post results and then getting the average. The idea behind this is to be able to use the program SPSS to find the significance of our findings, since the difference in pre-post is very small; there was no way to ensure the findings were significant without statistical procedure

Results and discussion

The most significant result found in this study is in the category Applied Conceptual Understanding. This result is also the most important found in the study made by Brewe, Kramer and O'Brien [6] in the Florida International University. Even though both modeling implementations had no relationship between them, other than following the literature about how to make modeling implementations [4, 5], the results are quite similar. Modeling instruction seems to improve the scores in Overall and Applied Conceptual Understanding being independent of the specific implementation. It is important to remember that one of the objectives or premises behind modeling instruction is to bring students to the being of scientists. Looks like a better understanding of the knowledge they get comes together with the methodology and activities of modeling instruction

Firstly, the results obtained in the pre test were between 59.20 and 81.25 percent of responses as the experts, while in the post test were from 65.91 to 83.52 average response as an expert. Hence the minimum value has increased, while the difference between the maximum and minimum values has decreased. The highest shifts found were in Applied Conceptual Understanding, being of 8.77, and in Problem Solving Sophistication with 6.29.



All the favorable shifts found in CLASS were positive with exception of Personal Interest, which had a negligible negative shift. The positive shifts ranged from .08 to 8.77 and the negative did it from 0 to 3.90. The directions of both kinds of shifts are in the same way. The significant positive shifts were found to be in Overall 3.05 (p = .056) and in Applied Conceptual Understanding with a shift of 8.766 (p = .009). In the All and Problem Solving Sophistication categories were found shifts of 3.78 (p = .097) and 6.287 (p = .085) respectively.

TABLE 1. CLASS test results. * p = 0.1, ** p = 0.05

Class category	Pre-post	Positive shift	Negative shift	Positive significance	Negative significance
Overall**	68.35-71.40	3.05	-1.87	.056	.186
All*	70.60-74.39	3.78	-1.36	.097	.290
Personal Interest	75.39-75.30	.08	-1.06	.730	.954
Real World connection	77.30 -82.20	4.92	-1.70	.206	.776
Problem solving general	74.27-77.19	2.92	-2.03	.359	.577
Problem solving confidence	81.25-83.52	2.27	-1.70	.683	.825
Problem solving sophistication*	59.62-65.91	6.29	0	.085	.838
Sense making	75.65 - 76.95	1.30	-.16	.900	1.000
Conceptual understanding	70.00-74.55	4.45	-1.74	.406	.395
Applied conceptual understanding**	59.20-67.97	8.77	-3.90	.009	.108

Conclusions

- The improvements of beliefs and attitudes toward Physics have to be considered in the curriculum development in order to get, at the end of the course, more motivated students with the understanding of the roll that play the scientists in the society. The CLASS survey is a useful tool to assess the success in an implementation in terms of the improvements of beliefs and attitudes toward Physics. In this study, significant positive shifts were found in two of the categories that the CLASS test assesses. The positive shifts found in this study together with those found in Florida International University show that modeling instruction is able not only to improve conceptual learning, as previous studies amply show, but is also capable of changing students' beliefs about physics.
- Bigger changes could be reached if the intention to improve beliefs in the students was part of the curriculum development and not only consequence of the course methodology.

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