Biology contexts to catch interest in physics of drop out university biology students

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Abstract. This paper presents partial results of a project that aims to make physics meaningful for university biology students. Many of these students believe that physics in not really relevant to their career and professional life. Attention is paid to students' interests, so the relationship with biology has been used to show the physics involved in many biological phenomena. It has been observed how student attitudes vary depending on the tasks and contexts used in class, even for those that previously failed in this subject. In this paper we present the results obtained in optics to illustrate the proposed approach.

1 Background

In the first semester of biology career there is a compulsory physics course. This population is particularly unmotivated towards the study of physics because they do not see the usefulness of it in their career and argue that they are not good in math; identifying physics and mathematics. This fact evidenced the way physics is usually taught at Mexico's high schools.

It is known that biology students need a different physics course than that taught to engineers and physicists, however, the approach of many courses for the two populations remain very similar. In July 2015 a course that placed great emphasis on biological contextualitation [1] for learning physics was designed. With this approach students make sense of theoretical concepts strengthening its usefulness and functionality outside the classroom, coming to recognize that they can learn a subject who say they have never understood before. One of the conditions necessary to achieve significant learning is that students want to learn, so they are important both the will and motivation, which are determined largely by the sense that students attributed to the learning situation.

It has been taught during 5 semesters, 3 semesters with students just arriving to the university, in which we have obtained very good results and 2 times with repeaters. In the five semesters the population has been constituted mainly by women (four fifths of the group), the number of students vary from 20 to 25.

2 Differences between the two populations

Classes for drop out students are not the same as the classes of the students who take physics for the first time at university. They have been for several semesters in the faculty, some of them are finishing their career, fear a new failure in physics, have a poor concept of their performance in it and they are sure that they have not needed physics to advance in the biology studies. For fear of failure and self-distrust, postponed students expect to be told how to act, especially during the lab sessions. In the other hand, some of these students are more concerned to understand how to answer the teacher or the test, than to learn in depth. This is shown in the final scores.

When we worked with the previous group of repeaters (February 2017) the disinterest towards physics was even greater than in the first-year students, but it was very important when they suddenly said "if I would have known this before I would have done better in molecular"; "animal physiology would have been different if I had known what is the meaning of potential difference";

"I already understand why I have to use different spectroscopes in the analyses". Then our students are feeding us back with the examples that should be used.

3 Adjustments of the proposal to the population of repeaters

One of the conditions necessary to achieve significant learning is that students want to learn, so they are important both the will and motivation, which are determined largely by the sense that students attributed to the learning situation [2]. The optics pre-test, in the first session, consisted of drawing how we see an object. What elements are essential so that we can see, for example, a book? At the end of the topic, as part of the exam, they were asked the same question and requested to comment on what had changed in their vision model.

This semester, emphasis was placed in that they in that they recognize which are the most important variables for the phenomenon. The first activity was that they would literally play with the magnifying glasses and realize that they could not only have an amplified image looking through the glass as it is commonly use, but that they could even project an image on the wall of a well Illuminated object. In this case the window of the laboratory was used. They were surprised that the magnifying glass could serve not only to amplify an object but to see an image that was reduced. They had to decide which variables to measure and which to keep constant.

Some sessions latte they are asked to make a diagram that shows the positions where two lenses should be placed, so that this arrangement works like a microscope and to build it latter in order to prove their hypothesis. As biology students, they are very interested in understanding how the microscope works. During the same sessions of the practical work, concepts and mathematical expressions are introduced. The phenomenon is analysed so that they develop a model of the operation of the lenses, which allows them to analyse whether the results obtained in a written exercise are correct or not. This is how they develop the routine of reviewing their results and monitoring themselves. This is a big change from simply making calculations with equations that have no meaning.

In this semester students were asked to build a simple telescope and compare the positions of the lenses and the object in a microscope and a telescope. there was a huge enthusiasm in the activity

Conclusion

The problems that are being solved with the current approach of the course are: to reduce disinterest and show students that they have the capacity to learn physics, to understand it. To achieve this, we must work from the concrete to the abstract and analyze the phenomena so that they begin to construct explanatory models that allow them to predict. They must be convinced that this approach to physics and this way of learning it is much more useful than just manipulating formulas and getting results without meaning.

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References

[1] C.H. Crouch and K. Heller, Introductory physics in biological context: An approach to improve introductory physics for life science students. *American Journal of Physics*, **82** (2014) 378-386.

[2] G. Hernández. *Paradigmas en psicología de la educación*, Paidós Educador, México, 2004.