Video's Resources to support Conceptual Physics Learning

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Introduction

The understanding of conceptual physics in the classroom is a difficult cognitive process for inexperienced students when they can not connect the real world of physics phenomena with science models. Commonly, physics students have their own perceptions of the world that surround them, however when they are asking to explain their daily experience with scientific arguments learning in physics classes, they use their own intuitive models. For example, mechanical phenomena are tightly linked with the world where the students live, but as the mechanical concepts understanding are so difficult to them they prefer to use simple ideas to explain the phenomena instead of applying correctly Newton´s Laws.

How can we help our students to have a better understanding of conceptual physics?

We are experimenting with video as a resource to help the comprehension of our students in class. The purpose to include video resources in a class is to create a learning cycle where the students can be involved in a discussion of a simple experience which they need to explain through of recording and analyzing a video. They are encouraged to build a complete physics model about the phenomenon they are studying by their own. The next step to the cycle is to begin with a more complex situation which is not really well known by students, but they can analysis it under a conceptual point of view and try to predict what will happen if they prepare a real experiment. Then they will have the opportunity to confront their ideas directly by making an experimental activity, analyzing the corresponding video recording and proving their own predictions.

In brief words, we can conclude, that: what you see, you can think, but the most important think is what you think you can see.

Conceptual Learning Cycle.

The Conceptual Learning Cycle (CLC) is a way of learning concepts that it can be used in physics learning as a strategy where the students are confronted with a conceptual physics situation which they need to understand step by step. The students follow the next trajectory of mental and practical activities:

1. CONCEPTS. Students are confronted with a theme that it involves an important body of conceptual physics.
2. DISCUSSION of a physics phenomenon. A physics phenomenon is used to focus the concepts that are included in it. Groups of students discuss the phenomenon under study.

3. Intuitive EXPLANATIONS. Students try to give an explanation of the phenomenon with their own words. That explanation is taking as a first model, possible naïve model but that it discover the thought of students.

4. EXPERIMENTAL ACTIVITY. The students proceed to carry out an experiment that illustrates the studied phenomenon. They make very careful observations and confront their ideas with the things observed.

5. VIDEO RECORDING. If the students find differences between their ideas and the observed phenomenon they proceed to record a video clip (small video) of the phenomenon.

6. VIDEO ANALYSIS. Students study the video clip frame by frame using different techniques.

7. More FORMAL MODEL. Students give new explanations of the phenomenon. They express them by applying conceptual physics as it is possible, for example laws and principles.

8. New COMPLEX PHENOMENON. Students study a new phenomenon more difficult than the previous studied phenomenon but inside of the same conceptual body that contains the first phenomenon.

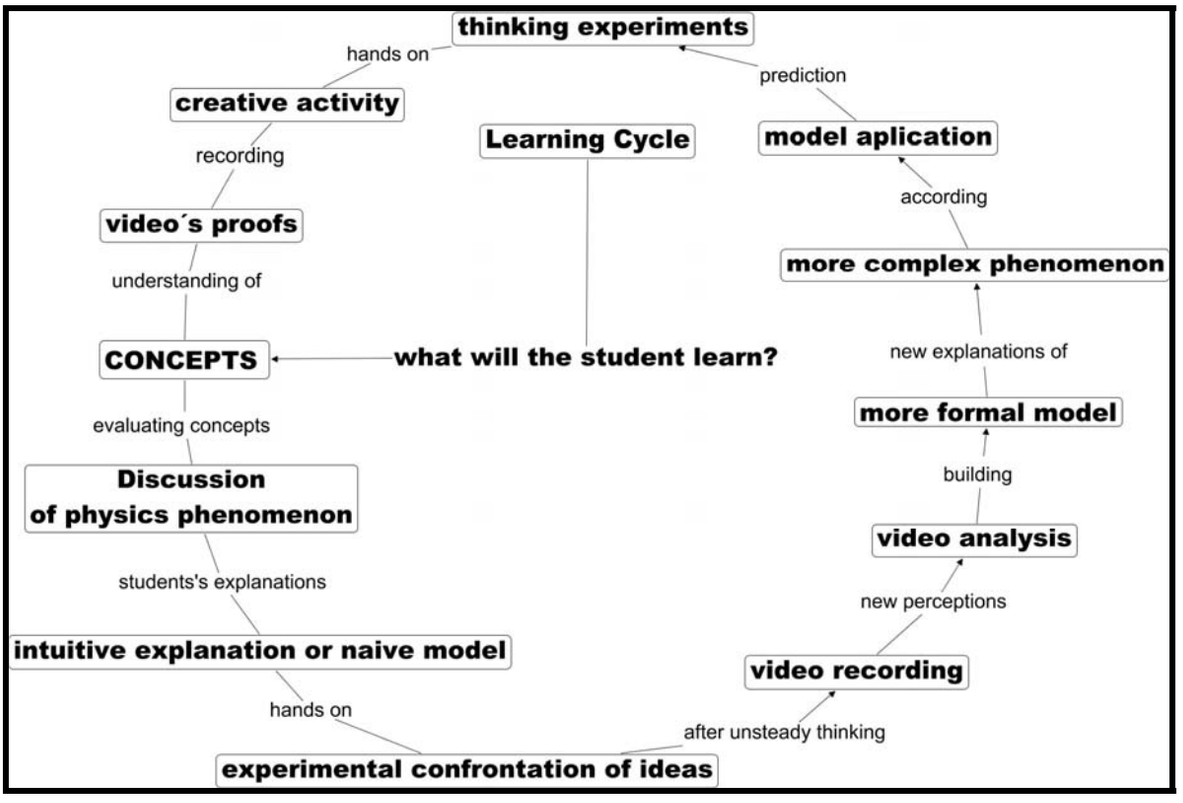
9. MODEL APPLICATION. Students must apply the formal model that they found previously to the new situation.

10. THINKING EXPERIMENT. Students are encouraged to make predictions and to think an experiment that can be used as the proof of their predictions. It is possible to think an imaginary experiment that it is difficult to make in the laboratory.

11. CREATIVE ACTIVITY. Student plan and make an experiment which simulate the general conditions of the thinking experiment.

12. VIDEO's TEST. Students record a video to prove their prediction. They need to establish the conditions under it will be made the experiment.

13. CONCEPTUAL RETURN. Students come back to the beginning, with the original conceptual ideas but with a more enrichment thinking. They summarize the founded ideas by themselves in a scientific language and end the cycle.



EXAMPLE.

1. Concepts: FREE FALL
2. Discussion of a physics phenomenon. Galileo´s experiment of Pisa Tower.
3. Intuitive explanations. Aristotelian explanation.
4. Experimental activity. Dropping two bodies of different mass.
5. Video recording. Recording the falling of the two objects from the rest at the same time without any conditions of the height to those that are released.
6. Video analysis. The edition frame by frame of the video is analyzed by students.
7. More formal model. Students approach to the Galileo's explanation.
8. New complex phenomenon. Inside an elevator in free fall is a person that drops two bodies of different masses at the same time from the same height.
9. Model application. All the objects are falling at the same acceleration, and when the person leaves free the balls they continue falling like the person and the elevator. But in relation of the person they are in rest respecting him, that is, the acceleration of the balls respecting the person and the elevator is zero (The consequences of this fact direct us to the Equivalence Principle, but this discussion is taking apart for the moment).
10. Thinking experiment. If we are in a g-accelerated spaceship we don´t know if we are freely falling to the Earth or we are in the free space with g-acceleration.
11. Creative activity. A wood box is assembled with a video recording camera (Web camera) inside and two balls of different masses attached to the roof of the box by means of two external electromagnets. All the system is hanging meanwhile the electromagnets are turn on, but when they are turn out all the things of the system fall to the ground.
12. Video's test. The video record inside the box shows that the balls are in rest respecting to the camera (only during the fall).
13. Conceptual return. All objects fall to the Earth with the same acceleration, but if it is true all the objects are falling together to the ground when they are dropped from the same height at the same time from the rest. For this reason the two

objects fall together to the floor, without caring if they are inside or outside of a box.

Bibliography.

Teaching and Learning Physics with Interactive Video

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http://perg.phys.ksu.edu/dvi/pt/intvideo.html