Tracker

Study of the Free Fall and Vertical Launch

Contextualization

In the ambit of an Erasmus project (Science Connection), students from the 11th grade developed a learning scenario to study the free fall and vertical lunch using Tracker as a computer-based learning tool. Their work was presented in a peer-to-peer system, in the first blended mobility for school learners that took place in Granada, Spain.

Figure 1: Students of the 11th grade(Author`s collection)

Figure 2: Erasmus Team in Granada (Author`s collection)

Introduction

In recent years there are a lot of day-to-day cases where our project fits in.
In 1971, David Scott, an Apollo 15 astronaut, made an experiment where he dropped a hammer (1.32kg) and a feather (0.03kg) at the same time. In the video we can see Scott holding the hammer and the feather at the same height when he, later, dropped them simultaneously. We can see that the two objects fall side by side and arrive at the ground at the same time.
In our planet it is very difficult to study a free fall movement due to the friction made by the athmosphere, one example is the vertical fall of a skydiver. The friction plays a major role in decelerating the skydiver during the fall allowing him to reach the ground in a safe speed (±20Km/h).

Objectives and Methodology

The objective of our project was to calculate the gravitational acceleration of a ball, with the help of a tracker and the equations of motion.
We start off by setting a contrasting background (usually white or black), so we can track the ball using the application. After that we set the camera so we can record the movement of the ball after we throw it. The ball must be shaped and have a certain weight that minimizes the friction on the fall and it shall have a vertical and rectilinear movement. The next step is to study the movement with "Tracker" with the equations of motion.

Materials

* Different balls
* Contrasting Background
* Computer with Tracker
* Mobile Phone/ Camera
* Ruler

Procedures

Launch vertically a ball, using a contrasting background.

Figure 3: Students performing the experiment (Author`s collection)

Video record the launch. Use Tracker to analyse the Data.

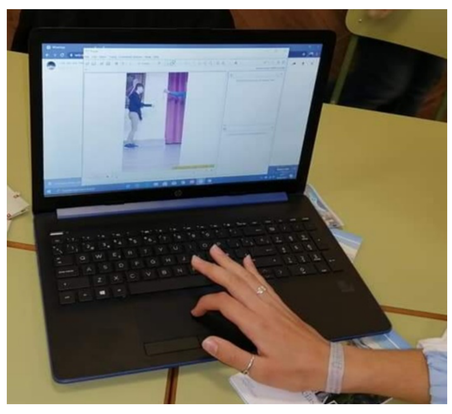

Figure 4: Students using Tracker to analyse Data (Author`s collection)

Results

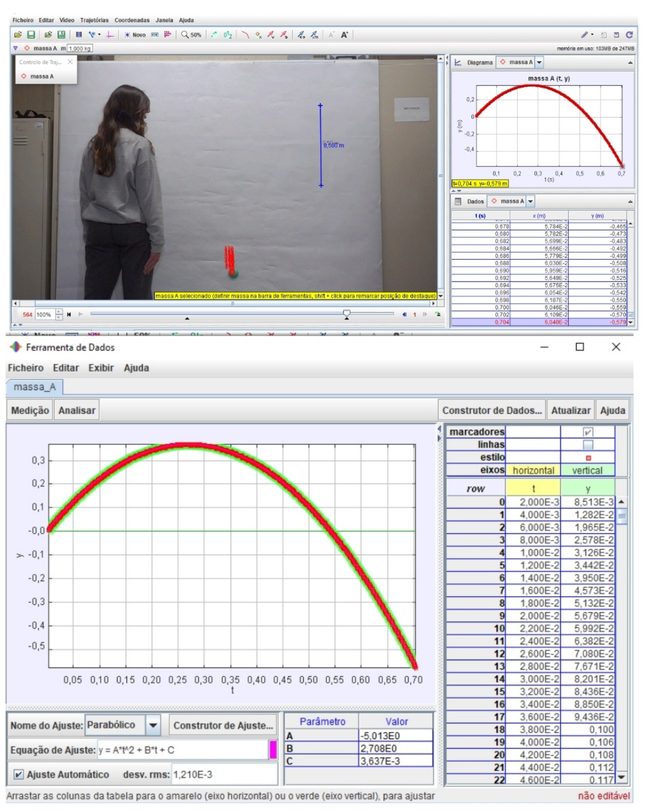

Figure 5: The y (position) vs. t (time) graph. The parabola fit an equation of $y = At^2 + Bt + C$ with parameters **A = –5.013, B = 2.708 and C = 0.003637**. By comparing with equation $y = y_o + v_{oy}t - \frac{1}{2} gt^2$ it is determine g= 10,03 ms^{-2} and v_{oy}**= 2,708** ms^{-1} (Author`s collection).

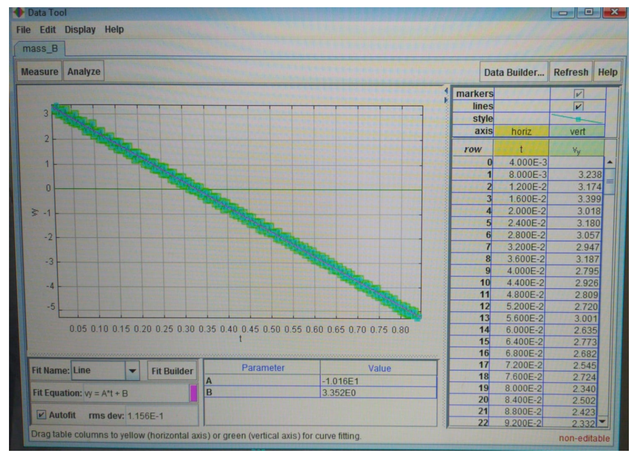

Figure 6: The vy (velocity) vs. t (time) graph. The line fit an equation of $v_y = At + B$ with parameters **A = -10,16** and **B = 3,352**. By comparing with equation $v_y = v_{0y} - gt$, it is determine that **g = 10,16** ms^{-2} and v_{0y} **= 3,352** ms^{-1}. (Author`s collection)

Conclusions

This activity allowed students to: 1. analyse the graph of position as a function of time through video analysis, obtain the acceleration of gravity using physical-mathematical modelling, and compare the value obtained with the theoretical standard value (9,81 m/s^2); 2. study the magnitude of the velocity in the vertical and horizontal directions; 3. classify the different types of rectilinear motion. It also contributed to the change of attitude of students for the study of science and increased student`s understanding and involvement in the study of Physics. Students acquired knowledge and skills for a scientific field based on the use of technology, strengthened cooperation skills, developed critical skills and abilities to explore and decide on issues related to their experience.

Acknowledgements

This work was financially supported by the project "SCICON – Science Connect " (ref. 2019-1-RO01-KA201063169) funded by the Erasmus+ of the European Union. We want to thank the company GEFCO - Groupages express de Franche-Comté for having sponsored our work.

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