Technologies in School

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Abstract. *The technologies of information and communication are tools that more and more should integrate our classrooms and, consequently, excellent options for science teaching. The continuous evolution of the society forces a constant looking for new information be the teachers, because in his classroom there are students familiarized with the new technologies and used to a constant use of theirs. Therefore, if they are in a school that presents classes in a perspective, essentially, "traditional" it will drive to a lack of motivation and interest in school, by the students. So, for the teacher to promote a motivate atmosphere and pleasant to teaching/learning inside the classroom, one of the ways of getting is the use of new technologies of information and communication.*

In this perspective, it's presented, here, a different approach, viewing a methodology, at the same time, inductive and constructive. Recognizing the importance of the experimental work in science teaching, concretely, in a class of Physics and Chemistry Sciences it was provided to an 11th grade, in the teaching/learning of contents concerning the uniform movement, the accomplishment of an experimental activity of investigative nature, having in mind the concepts learned until the moment. The developed activity took the students, wend confronted with a problem situation, they add to make there previews for a possible answer to the initial subject, plan out one or more experimental activities that allowed testing the hypotheses. Then, the students, executed those activities, analysed it and interpret the data collected with the purpose of finding the answer to the problem, which will be, or not, concordant with the initials forecasts (hypotheses), in other words, a investigative course.

The didactics materials available, to the students, were a computer simulation and a sensor of movement, CBR (Calculator Based Ranger), two examples of technologies of communication and information.

After the execution of the experimental activity the obtained results were analysed and interpreted by the students. They were able to verify that the data obtained by the sensor of movement, CBR, differ a lot of the obtained by a computer simulation.

This is part of an article developed during my last year of degree at the Azoren University follow up by Dr. Carlos Gomes.

With this new work, the aim is think of new things we can do in yours classrooms that will promote the interest and motivate even more the students. So why not use robots (constructed by the students) to study Classic Mechanics.

In this case, conclude that the speed, in this movement, is constant and the acceleration null. So that, the analytical expression of the law for the uniform movement consists in a 1st degree equation for the position order time ($x=x_0+vt$), in SI units.

Keywords. 1st degree equation, CBR, computer simulation, ICT, investigative experimental activity, problem situation.

1. Introduction

The information and communication technologies (ICT) began some years ago a revolution in the society whose end is still for pulling the curtain. The improvements and innovations in this field have been of such order, that every day opens up new evolution perspectives and discovery roads.

Therefore, it makes no sense that, these aren't tools of great use in the classrooms, or everyday of larger use. There's been verifying through several recent studies (Bulla et al., 2002; Ehmke & Wünscher, 2002; Kocijancic, 2002;

Mendonça et al., 2002; Vasylevska et al., 2002) that ICT are great tools for Science teaching. They have the advantage for allowing a direct exploration, for the students. The acquisition of data is accomplished in real time, it allows a graphic data storage, that's, the data are exhibited, to the students, in a graphic representation and consequently they can have a vision of the data in a way easily understood. Since, the data are collected and exhibited quickly, the students can examine the consequences of a great number of experimental variation conditions, in a small period of time.

Due to the small time interval for the data collection, it allows, the students, to spend more time in observation of the physical phenomenon, in study, to interpret, to discuss and to analyse data, the main objectivity wend we accomplishment an experimental work. It is also of mentioning, the fact, that different types of problems use the same hardware forms and software, allowing to the students to investigate varied physical aspects without the need of learning, again, to use the didactic material.

It is important to refer that the authors consider the present students, of our days, as much the primary level as secondary, are qualified to use a great fan of tools (technologies of information and communication) to investigate the physical world, and if they still didn't have any contact with this type of tools, they have sufficiently developed competences to learn quickly. A lot of times the teacher "gives" an excuse for not using ICT, the fact, students not knowing them. However, is usually the own teacher that is "afraid" of learning is handling, preferring to continue doing the "traditional" experiences with the "traditional" materials. However, it is essential to develop and substitute didactic materials for the accomplishment of the "traditional" experiences. The teacher that works like this will see immediately results, when looks at his classroom and sees motivated students in the accomplishment their works.

CBR is a sonar detector of movement that can be used together with the graphic calculators TI. This makes data collects and the analysis of concrete situations of the physical world, turning possible this study in the classroom. It is of easy use and doesn't need programming.

With CBR and a calculator, the students can collect, see and analyse data to any movements.

CBR allows exploring the mathematical and scientific relationships among distance, speed, acceleration and time of any data collection.

It allows to the students to explore contents, as for instance:

- Movement: distance; speed; acceleration; time.
- Graphic representation: axes of coordinates; dependent and independent variables.

The use of computer interactive simulations has an enormous didactic potential for the learning, in a constructive vision. In agreement with Jon & van Joolingen (1998 *apud* Ehmke, 2002) "the definition of a computer simulation consists of a program that copies a process or a dynamic system, with their certain parameters, and it allows to experience and to simulate procedures in an atmosphere of virtual learning."

According these authors, the use of computers to simulate a complex and dynamic nature phenomenon, were the devices are of high costs or inaccessible, haves a solution the use of multimedia material. Because the interactive simulation allows the exploration and manipulation of these types of atmospheres supporting the student's learning. And this strategy turns possible, for the student, to tie the new information with the knowledge existent, a constructive vision of the learning/teaching process. It's also understandable that a good use of the learning atmosphere is necessary to adapt the cognitive demands and give an effective and appropriate orientation. In other words, to plan out the practical work appropriately.

One of the main purposes of the Science teaching is to give explanation of the nature's phenomenon through mathematical models.

In many cases, students are trained to develop competences to solve problems manipulating, sometimes, mathematical equations.

According to Kocijancic (2002: 381) even for the students, that are not particularly interested in Science, such approach is difficult and causes certain "hate" or fears Science. Even for students, that easily work with equations, doesn't usually understand and notice that there is a relationship between mathematical models and everyday atmosphere.

According this author, "the purpose of computer simulated experiences is usually used to visualize mathematical models and turn the learning more interactive and attractive [...] Computers equipped with an interface for on-line measurements with a sensor, it's increasing at Sciences school laboratories. The computer is used to measure and to monitor physical phenomenon, such as, temperature, electric potential, pressure, etc."

Though, for a real learning, several tools and concepts have to be integrated and the applied methods must be chosen in agreement with learning aim.

2. Main text

In the extent of teaching/learning of contents concerning straight line uniform movement, in a 11th grade, in the of Physics and Chemistry Sciences class, an experimental work of investigative nature was developed.

The students, at that the moment, already characterized a particle movement, using the position, the speed and the acceleration. They, also, know that in uniform movement the sum forces are null.

Consequently, when the resulting forces, that act on a material particle of mass *m*, is null, be the inertial law (1st Newton law), the particle is in rest (v=0 *m/s*) or she moves with uniform movement. By the 2nd Newton Law, since the resulting forces are null the acquired acceleration is also null.

$$F_r = ma \quad (1)$$

$$ma = 0 \Leftrightarrow a = 0 (m/s^2) \quad (2)$$

Therefore, the speed is constant, there is no variation of the speed vector long time, because a straight line path is described be travelled the same space in the same time, that is, the position is directly proportional to time.

$$a = \frac{\Delta v}{\Delta t} \quad (3)$$

$$\frac{\Delta v}{\Delta t} = 0 \Leftrightarrow \Delta v = 0 \Leftrightarrow v = \text{constant}\,(m/s) \quad (4)$$

$$v = \frac{\Delta x}{\Delta t} \Leftrightarrow v = \frac{x - x_0}{t - t_0} \Leftrightarrow x - x_0 = v(t - t_0)\,(SI) \quad (5)$$

Considering t_0=0 *s*, in equation 5 the analytical expression for the uniform movement, in SI units:

$$x = x_0 + vt\,(SI) \quad (6)$$

The developed activity intends that the student's, starting with a problem situation, make a deduction of the analytical expression for the uniform movement.

For the problem resolution, the students had a computer simulation and a movement sensor, CBR (Calculator Based Ranger).

After an activity application, the class has divide in three work groups. Later, it was read a small text about Nature regularities, where contains the problem question. The subject problem was: Walk is an activity that you do everyday. Could this common situation be represented by a mathematic law? Study the simplest case, when we walk in straight line, travel the same space in the same time.

The students had to plan, accomplish, explore and discuss in group an experimental activity that allowed the resolution of this problem situation and, in the end, construct one Gowin V. In first place, the several work groups, confronted with the problem question, they launch several hypotheses, as for instance:

- When we walk, in straight line, same space in same times, it's a uniform movement.
- The total forces are null.
- The position is proportional to time.
- We have constant speed.
- Acceleration is null.
- When we stood back of the sensor the position increases, in time proportion.
- When we approached the sensor the position decreases, in the same time proportion.

For elaboration of the work the students possessed a system that allows collects and analysis data, CBR, as well as, an interactive simulation. CBR bases in the use of a linked graphic calculator to a movement sensor, through an interface.

Figure 1. CBR.

The function beginning of this device is the technical acquaintance of sonar for the detection of aquatic systems as, for instance, fish shoals. Sound waves are emitted than reflected in two the system again. Through the time round trip time and the propagation speed, it's possible to detect what depth is the system. The ultra-sonic movement detector that accompanies the CBR system bases on a similar beginning sends hundreds of electronic pulses that knock in the object and return to the detector.

After the hypotheses emission, the groups planned out and executed an experimental procedure.

Than the interpretation of the data, below some examples are presented, of the possible obtained data.

We can observe, from the graph, Fig. 2, that initially the object was in rest, reason for which in the first instants the graph presents a straight line. The small presented flotation can be due to oscillations happened in the beginning of the movement, since the sensor is an extremely sensitive detector. After, we have a straight line with a certain inclination. Some oscillations appear and can be due the student's arms movement, or any swinging by is body.

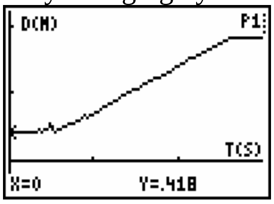

Figure 2. Position *versus* time.

The Fig. 3 resents another position graph order time. It's again verified that object is in rest initially and at the end. However, it presents an appreciable difference in the inclination, because the student walked faster.

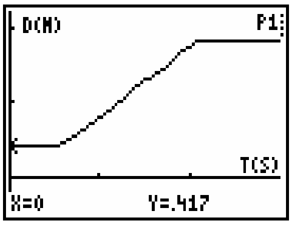

Figure 3. Position *versus* time.

Fig. 4 presents a graphic, when the object approaches the sensor. Initially it's in rest, as well as, the end. A significant difference is that the inclination is negative, because the position in relation to CBR, decreases along the time.

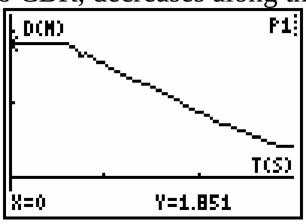

Figure 4. Position *versus* time.

The graph, Fig. 5 presents the speed order time, it would be of waiting a constant value, however that's not revealed by the obtained graph. These discrepancies mean that perfect uniform movements don't exist in Nature, but good approaches. However, if a lineal regression had been accomplished, it would probably be obtained a constant value.

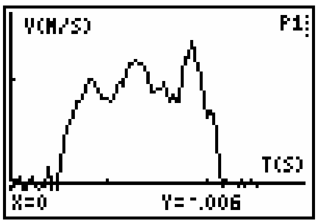

Figure 5. Velocity *versus* time.

Obviously, as a consequence speed isn't constant along time, the acceleration doesn't present null value. In a similar way, to the case of the speed graphic, doing a lineal regression maybe we obtained a null acceleration, for this movement.

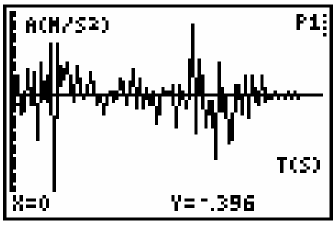

Figure 6. Acceleration *versus* time.

A computer simulation in computer used, it can be found in the Internet, it consists in a object that moves I a straight line. Where he can manipulate speed values. When the movement is simulated, in simultaneous, the graphs position-time and speed-time are drawn. Examples of the data are presented below.

It is verified easily that the graphic representation collected by the simulation doesn't present any type discrepancy. From the graph, Fig. 7, it is perceptible that the object occupies same space in same times, for that the graphic representation is a straight line.

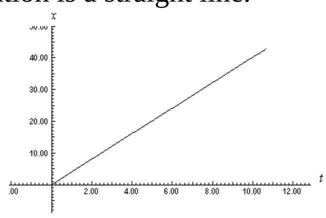

Figure 7. Position *versus* time.

Wend we select a negative speed value, the straight line inclination is also negative.

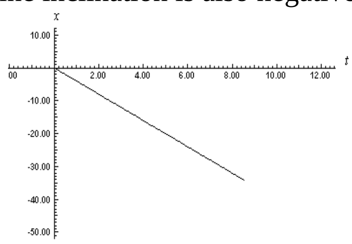

Figure 8. Position *versus* time.

Relatively to the graphic of the speed *versus* time is obtained a constant function, as was waited, since it's a uniform movement uniform.

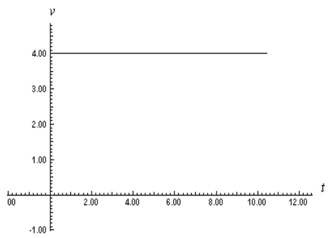

Figure 9. Velocity *versus* time.

Finally the graph acceleration *versus* time is a null function.

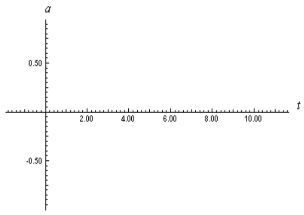

Figure 10. Acceleration *versus* time.

From the analysis of the graphics obtained with the use CBR and interactive simulation, the students could verify that position is proportional to time. As well as, the speed is constant and the acceleration null. That's easily observed by the graphic obtained by the computer simulation, however, the graphs obtained by the sensor CBR, already present some discrepancy. Such happens, because perfect uniform movements don't exist in Nature, only good approaches.

With some problems, work groups associated that the position $x=f(t)$ it represented by an 1st degree equation.

The general equation $y=mx+b$, where y is the dependent variable, m inclination, x the independent variable and b the origin coordinate.

Therefore the independent variable is time (t), the dependent variable is position (x), the origin coordinate consists in the initial position (x_0) and inclination, as observed from the graphs of Figs. 2 and 3, is velocity. Then, analytical expression for uniform movement is the equation 6.

It's of pointing out, that this is a sensor extremely sensitive, but we can resolve this by using robots and for instance, to the movement of the subject's arms that accomplishes the movement is here solved.

It's also verified that the students snow a big interest wend using the ICT, so the construction of robots to accomplish the study of uniform movement will promote more interest and motivation, the main objective of a teacher.

It's also important to mention that this investigation, from the physical world, allows the students to notice that the contents learned in the classroom, are situations that happens daily in their life.

3. References

[1] Bulla M, . Computer aided experiments in science teaching. An integration of possible approaches in web environment. 2002.

[2] Ehmke T, Chow Y-C, Anger FD, Lee C-Y. Learning with animations and simulations in a computer-based learning environment about torques. 2002.

[3] Kocijancic S, editor. Computerised laboratory in science and technology teaching. Integrating various aspects of using ICT. 2002.

[4] Mendonça A, . Environments for teaching and learning of physics allowing an exploratory methodlogy. 2002.

[5] Vasylevska Y. Computers in physics education: In situ simulation. 2002.