Innovative teaching and learning technologies
used in pre-university system

Liliana Violeta Constantin¹, Livia Dinica²
(1) National College “Elena Cuza”, Bucharest, ROMANIA
E-mail: liliana2009constantin@yahoo.com
(2) School Inspectorate of Bucharest, ROMANIA

Abstract

The future of a society which is in progress and development is represented by the use of the
information technology and of communication in the didactic process. In this way, learning becomes
interactive, in correspondence with the individual needs and the performances of the students. Using
the modern technologies in the learning process is a more difficult action to achieve with the miss of
quality software, the high costs, and the miss of specialized personnel, the resistance at the change of
the students, the professors and the parents. Although the advantages of using the TIC in education are
numerous, the student must achieve when it is possible, real experiments because the nature offered the
possibility of researching and the direct learning. The laboratory experiment is a good method for
developing the scientific way of thinking and the practical abilities. The student must perceive the
learning process as a progressive transformation achieved after the interaction with the objects of
knowledge, with the situations of life. This is why, the most efficient approaching of the practical and
theoretical physics is to be achieved joining the traditional methods with the modern ones. This work
presents a laboratory lesson: “The study of the uniform straight movement”. The students had at their
disposition laboratory equipment and a simulation with Macromedia Flash MX Professional. Also,
they had at disposition a laboratory paper which must be completed by the students. In this way is
creating an adequate climate for learning and for a permanent competition.

Keywords: Modern technology, TIC, Real and virtual experiments

1. Introduction

To experiment means to provoke with conscience some phenomena in determined conditions for their
study and of the laws which govern them? In the scene of the physics hours the students observe the
conditions in which a precise phenomenon appears, they stabilize the cause reports, they discover the
factors which influence the experiment, and they record the phenomenon. In this way, when they realize
and experiment, the students are in a permanent activity of observation, of searching, trying,
interpretation, appreciating the results obtained in the experiment way.

The experiment represents in this way a source of direct information but also a modality of developing
the spirit of observation, of inductive investigation, of causal thinking. He develops at students’
actionable abilities, the objectivity, the analytic spirit in reworking and interpretation process of the dates,
cultures the patience, the attention, the perseverance, the order, the discipline and creativity.

We can say that in the study of physics achieving experiments is extremely useful because the
development of the theory is made by starting from some experimental observations which determine the
introduction of some notions and physical measures, the construction of some logical theories, complete
and coherent. As a Chinese proverb said: “an image replaces 1000 words”.

The endowment inadequate with equipments of the laboratories determines the effectuation of some
demonstrative experiments or even their replacement with some summary explanations. In this way the
interest of students for the study of physics is reduced considerably!
This is why there must be made efforts for buying computers which can allow the realizing of virtual experiments but also the presentation of some sequences filmed during the effectuation of the real experiment. These aspects offer the students the possibility to familiarize with the laboratory equipment, with the work methods. In this way the virtual and classic experiment complete each other!

This work presents a laboratory lesson in which is effectuated not only the real experiment but the virtual one in the purpose of creating an adequate climate for learning and for a permanent competition. At the study of the uniform straight movement the students had at their disposition laboratory equipment (instruments) and a simulation with Macromedia Flash MX Professional. Also, they had at disposition a laboratory paper which must be completed by the students. This work paper has the following structure:

2. The experimental study of the uniform straight movement

2.1. The Purpose of the work:

The determination of the speed of an ink drop which moves through oil and the drawing of the $\Delta x = f(\Delta t)$ graphic;

The demonstration of the fact that in the uniform straight movement the line on which the material point moves is practically a straight one and the speed in constant in time;

2.2. The Principle of this work:

The uniform straight movement is the movement in which the trajectory is a straight line and the speed has constant value (the acceleration equals zero).

The law of acceleration: $a=0$;

The law of speed: $v=\text{constant}$;

The law of space: $x=x_0+v(t-t_0)$;

Particular cases:

$x_0=0$ result $x=v(t-t_0)$

$t_0=0$ result $x=x_0+vt$

$x_0=0$ and $t_0=0$ result $x=vt$
2.3. The used didactic materials:

Graded cylinder, oil, ink, chronometers, millimeter paper, ruler, pen, calculator, and pipette.

![Image of didactic materials](image_url)

*Figure 1. The used didactic materials*

2.4. The way of work:

There are drawn different marks on the graded cylinder and it is measured the distance between the marks. It is introduced oil in the graded cylinder. With the help of the pipette it is introduced in the oil a drop of ink. It is easily pushed the ink drop for detaching from the superficial area and for the oil fall. On the drop actions its own weight, the Archimedes force and the resistance force at the advance through the oil (this force is in a direct proportion with the drop’s speed). The movement can be considered as a uniform straight one. It is time in which the ink drop gets down from the zero mark at the other ones. There are used other chronometers manipulated by more students. Each student chooses a mark. All students start their chronometers when the ink drop reaches at the zero mark. Each student stops its chronometer when the ink drop reaches the fixed (chosen) mark. It is recorded in a table the distance made by the ink drop and the time in which is realized this distance. It is calculated the speed of the drop

\[ v = \frac{\Delta x}{\Delta t} = \frac{x - x_0}{t - t_0} \]

using the relation:
2.5. The experimental results:

<table>
<thead>
<tr>
<th>Nr. of the determination</th>
<th>X (cm)</th>
<th>Δt (s)</th>
<th>v (cm/s)</th>
<th>vt(m/s)</th>
<th>Δv(cm/s)</th>
<th>Δvm(cm/s)</th>
</tr>
</thead>
<tbody>
<tr>
<td>The drop 1</td>
<td>5</td>
<td>3,82</td>
<td>1,30</td>
<td>1,325</td>
<td>0,0225</td>
<td>0,0175</td>
</tr>
<tr>
<td></td>
<td>10</td>
<td>7,60</td>
<td>1,31</td>
<td></td>
<td>0,0125</td>
<td></td>
</tr>
<tr>
<td></td>
<td>15</td>
<td>11,14</td>
<td>1,34</td>
<td></td>
<td>0,0175</td>
<td></td>
</tr>
<tr>
<td></td>
<td>20</td>
<td>14,88</td>
<td>1,34</td>
<td></td>
<td>0,0175</td>
<td></td>
</tr>
<tr>
<td>The drop 2</td>
<td>5</td>
<td>5,06</td>
<td>0,98</td>
<td>0,9625</td>
<td>0,0175</td>
<td>0,070625</td>
</tr>
<tr>
<td></td>
<td>10</td>
<td>10,37</td>
<td>0,96</td>
<td></td>
<td>0,0025</td>
<td></td>
</tr>
<tr>
<td></td>
<td>15</td>
<td>15,64</td>
<td>0,95</td>
<td></td>
<td>0,0125</td>
<td></td>
</tr>
</tbody>
</table>
\[ v = (v_m + \Delta v_m) \text{ cm/s} \]

2.6. The graphical representation:

![Picatura 1](image1)

![Picatura 2](image2)

*Figure 4. The graphical representations achieved in Excel*

2.7. The causes of the measurement mistakes:

The inattention of the student which makes the determinations, the imprecision of the measurement instruments, the impossibility of forming identical drops, the incorrect read of the indications of the used measurement instruments, the conditions in which it is realized the experiment.

2.8. Conclusions:

In the limit of the experimental errors it can be said that the trajectory of the ink drop is a straight line and the speed is approximately constant.

The laboratory work was realized on groups of students, in a way in which each student had a well defined responsibility. In this way it is developed the spirit of team work, the competitively and value appreciation character, the ability of using the modern technologies and of the laboratory equipment. The laboratory work papers were presented and discussed with the entire class. Also, the students elaborated different projects in which they presented the applications of the uniform straight movement. The students have created numerous problems, indicating the methods of solving them; they created rebuses and
numerous applications on the computer. For achieved the projects they used the CD-ROM encyclopedias, the search engines. In this way they have completed and diversified their knowledge. Using the electronic mail they changed opinions, thoughts with students from other parts of the Globe. They analyzed the similarities and the differences between the Romanian teaching system and the foreign teaching system. The communication through the internet allowed the professor to reply at the student’s questions and to guide them in achieving the projects even when they weren’t at school. This method of communication cannot be used by all the students because of the fact that they don’t posses an internet connected computer or don’t know enough how to use the computer. The materials realized by the students who used modern technologies were much more interesting then the ones worked by the students who used only the books found in the library.

Fixing the knowledge is realized with the help of some supplementary work tasks and with the help of a rebus realized in Excel which synthesizes the theoretical and practical learned notions. The atmosphere is relaxed and so the fear of mistaking is taken away from the students. Alex F. Osborn said: “The fear paralyzes the ideas, the creativity.” Many discoveries and good ideas were lost in time because of the fear of not mistaking.

The Rebus

1. Is formed from: reference body; moment of time of reference; instrument for measuring the distance; instrument for measuring the time;
2. The movement in which the speed of the object decreases;
3. The statement in which an object which occupies the same position in front of the reference object in any moment from the analyzed time interval;
4. CD-The movement in which the trajectory of the material point is actually a straight line;
5. The physical measure defined by the mathematical expression:
\[ v = \frac{\Delta x}{\Delta t} = \frac{x - x_0}{t - t_0} \]
6. The curve described by an object during the movement or the group of points which represents the successive positions of the object;
7. The movement in which the speed of the object increases;
EF-The movement in which the speed of the object remains constant in time;
AB-The statement, in which an object exists, object which occupies different positions in front of the reference object at different moments from the analyzed time interval.
Conclusions
Such a treatment of the experimental works in school allows the attraction of students towards the study activity, towards the understanding of the matter in a short and efficient time and forming the necessary competences for the personal development and of the society in which they live!

References