THE USE OF INFORMATION TECHNOLOGIES WHILE STUDYING LAWS OF RECTILINEAR MOTION

Svetlana Sambueva, *Buryat State Academy of Agriculture, Russia*
ShulunTsydypov, Tatyana Mamunova, Nikolai Chekmarev, Vitalii Parfyonov, *Buryat State University, Russia*

Abstract
The development of education is in continuous progress all over the world and is connected with such innovations as intensification, intellectualization and individualization. Recently one has started solving the problem of creative skills on the new level – the competence approach to the meaning of education. The competence approach puts in the forefront not student's being kept informed, but his\her skills to solve problems. In order to realize the above-stated approach we have computerized the installation known as the Atwood's machine for studying rectilinear motion. To increase the accuracy of time measurements, linear and angular displacements we added photo gauges which register the change of black-and-white sectors put on the block. The signals form photo gauges move through the device of interface to the computer where the data of the system timer for each signal are being recorded into the file of variables. The instructions for managing the process of measurements are shown on the display in the interactive regime. As a result of the experiment the dependences of $\varphi, \omega, \varepsilon, s, v, a$ values on time are shown on the computer screen in the form of the tables. The students are offered themselves to construct the graphs of these values dependences on time with the help of tabular processor Excel where there is the opportunity to transfer initial data. Using opportunities of the tabular processor the students must receive the approximating equation and correlate its coefficients with the characteristics of the rectilinear motion. Thus, with the help of the given installation one can get average and more exact meanings of kinematics values by using student's self-constructed graphs of these values dependences on time. This installation also helps to check up the laws of rectilinear motion including the dynamic laws of rotational and translational motion.

The development of education is in continuous progress all over the world and is connected with such innovations as intensification, intellectualization and individualization. In the high school and school practice of teaching the elements of traditional explanatory-reproductive pedagogics are generally used where the basic kind of student's activity is to reproduce the given information. It is not sufficient for the development of creative, research skills connected with interpretative thinking, it is necessary to organize such kinds of activity as comparison, the analysis of different facts and phenomena (Bespalko 1995).
Recently one has started solving the problem of creative skills on the new level – the competence approach to the meaning of education (Abrosimov 2004). The competence approach puts in the forefront not student's being kept informed, but his\her skills to solve problems.
The teacher must manage not only storing texts from textbooks and lectures, but also creative actions of students aimed to the development of personal new knowledge and ways of activity. The actions carried out by the student in the beginning are estimated as creative, and in the process of their development they become reproductive for him\her.
In order to help the student to use the educational experiment as the tool for getting new kind of knowledge, it is necessary to have corresponding methodical support and to enlarge the structure of methods of tabular, graphic and statistical data processing (Starovikov 2007). It is obvious that only the use of new information technologies can be an adequate reply to all these requirements. In the process of teaching experimentation the computer can be used not only as a mean for presenting interactive instructions in the form of hypertext, but also as the measuring mean which obtains data directly from the gauges of physical values (Novikov 1998).
In order to realize the above-stated approach we have computerized the installation known as the Atwood's machine for studying rectilinear motion (fig. 1). To increase the accuracy of time measurements, linear and angular displacements we added photo gauges which register the change of black-and-white sectors put on the block. The signals form photo gauges move through the device of interface to the computer where the data of the system timer for each signal are being recorded into the file of variables. Using these data and known values of the sectors angles $d\varphi$ (Fig. 2) we can calculate the turning angle $\varphi = nd\varphi$, angular velocity $\omega = d\varphi/dt$ and angular acceleration of the block $\varepsilon = d\omega/dt$.

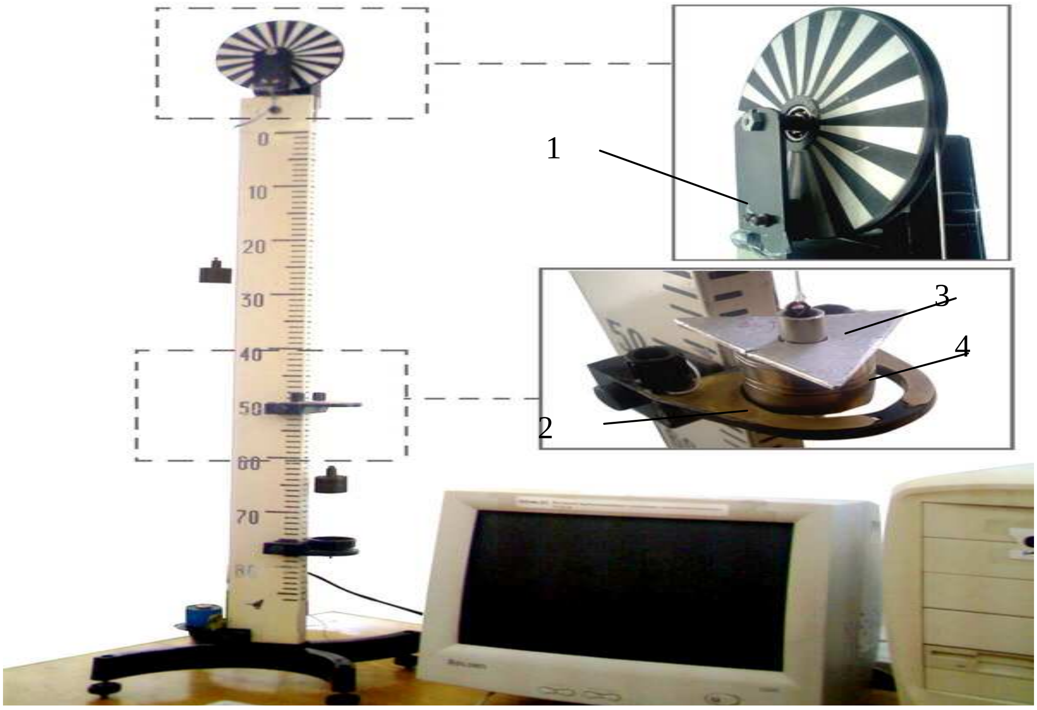

Figure 1: Atvud's machine with photo gauges connected to the computer (1 – photo gauges, 2 - a basic ring, 3 - overloads, 4 – weight)

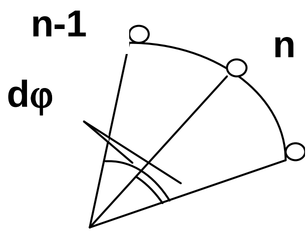

Figure 2

The velocity of cargoes motion on the string thrown through the block may be considered with the linear velocity of the points of the rotating block rim $v = \omega r$, where r is the radius of the block. The way passed by cargoes is equal to $S=\varphi r$, their acceleration is calculated as $a = \varepsilon r$. The instructions for managing the process of measurements are shown on the display in the interactive regime. As a result of the experiment the dependences of values φ, ω, ε, s, v, a on time are shown on the computer screen in the form of the tables.

The students are offered themselves to construct the graphs of these values dependence on time with the help of tabular processor Excel where there is the opportunity to transfer initial data. Using opportunities of the tabular processor the students must receive the approximating equation and to correlate its coefficients with the characteristics of the rectilinear motion. In figure 3 you can see the dependence of the block turning angle on time and the equation of the trend line which are given out with the help of the tabular processor and it is corresponding to the equation

$$\varphi = \varphi_0 + \omega_0 t + \frac{\varepsilon t^2}{2} . \qquad (1)$$

In figure 4 one can find the dependence of ω block angular velocity on time t, there you can see well the transition from uniformly accelerated motion to the motion with constant velocity after overload 3 removing with the basic ring 2 (Fig.1).

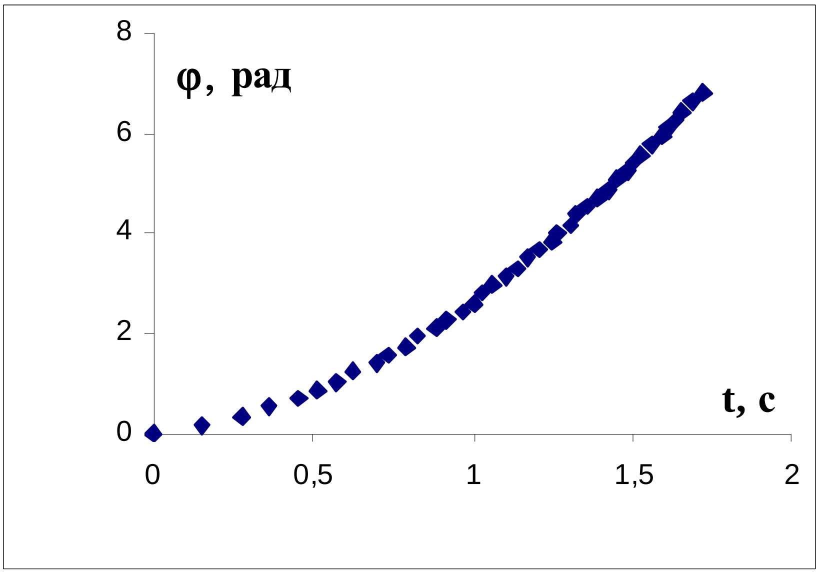

Figure 3: The dependence of a turn corner φ on time t

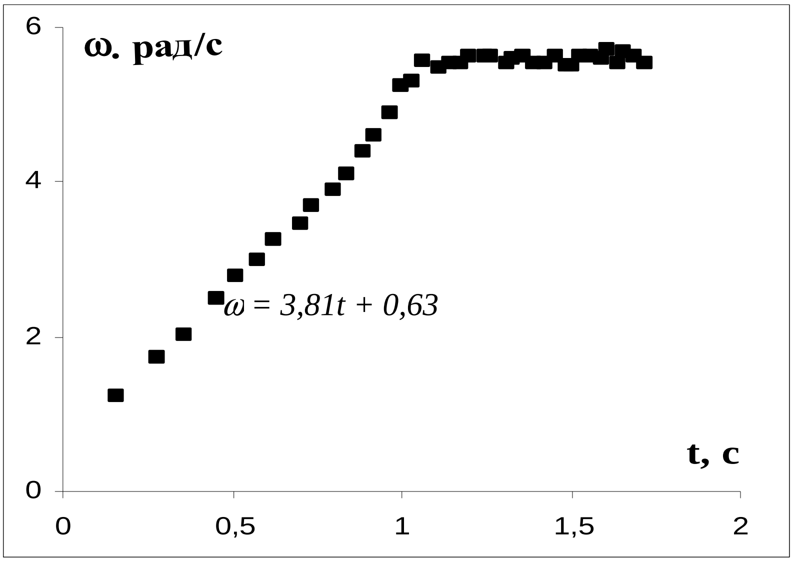

Figure 4: The dependence of angular velocity ω of the block on time t

Here there is also the equation of the inclined part of the graph received with the least squares method and by means of the tabular processor Excel. This equation is corresponding to one of uniformly accelerated rotational motion of the block:

$$\omega = \omega_0 + \varepsilon t \quad (2)$$

Thus, with the help of the given installation one can get average and more exact meanings of kinematic values by using student's self-constructed graphs of these values dependence on time. This installation also helps to check up the laws of rectilinear motion including the dynamic laws of rotational and translational motion.

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