VERNIER SYSTEM IN PHYSICAL LABORATORY AT FACULTY OF AERONAUTICS OF TECHNICAL UNIVERSITY IN KOSICE

Eva KOMOVA, Kristína BUDAJOVÁ
Faculty of Aeronautics, Technical university in Kosice, Rampova 7, 041 21 Kosice, Slovakia
**Corresponding author*. E-mail: eva.komova@tuke.sk

Summary: The paper is focused on computer-based measurements of physical quantities in the students´ laboratory, automated data acquisition and data evaluation with the orientation on Vernier system.

Keywords: computer-based measurement; Vernier system

1. INTRODUCTION

The current tendencies in the teaching of Physics point more and more to the realization of practical tasks. The experimental teaching is realized in order to activate the effective learning and development of the students´ motivation. At the Faculty of Aeronautics, the general physics courses contain only a few practical activities, which were made in the classical laboratory. For their preparation, the students have a short instruction where they can find out the brief description of the practical. Each of this instructions offer a brief theoretical explanation with the concepts, laws and principles that students should analyze and verify in the praxis, the methodology of experiment, procedure to the measurements, the methodology to the calculations of the errors of experimental results, characteristics of the instruments and equipment which are needed to measure.

Each practical has three stages: The students must demonstrate their preparation for the experimental work, their accurate realization and finally the elaboration of a report with short analysis of achieved results. During this practical work, the teacher should help the students in the exact understanding of the problem and must supervise the correct measurements.

If we apply this described concept of teaching in the standard laboratories, it is not possible increase motivation of students for experimental work. We have therefore decided to modernize technical equipment of the physical laboratory with Vernier system.

2. GENERALLY ABOUT VERNIER SYSTEM

Vernier co-founder, David Vernier, had been a high school physics teacher for eight years when he began programming his first Precision Timer software application. David's creativity and his passion for science education were the driving forces behind the early years of Vernier Software & Technology. The company creates world-class data-collection solutions, sensors, software, and curriculum that help engage and excite students through scientific exploration.

Measurements using Vernier technology get students excited about science and deepen their understanding of complex concepts. It gives students the tools to analyse data and think like real scientists. Main benefits to use of this system are:

- It improves student understanding of science concepts.
- It supports engagement in higher order thinking skills, such as analysis, synthesis, and evaluation.
- It enables students to perform many new experiments and measurements not only in the lab.

The basic kit for measurement includes the following components: Interface LabQuest, sensors and software.

Last type of Vernier LabQuest 2 is a standalone interface used to collect sensor data with its built-in graphing and analysis application. The large, high-resolution touch screen makes it easy and intuitive to collect, analyze, and share data from experiments. Its wireless connectivity encourages collaboration and personalized learning. LabQuest 2 can be also use as a USB sensor interface using Logger Pro software or with Graphical Analysis app for iOS, Android, or Chrome to stream data wirelessly to one or more mobile devices.

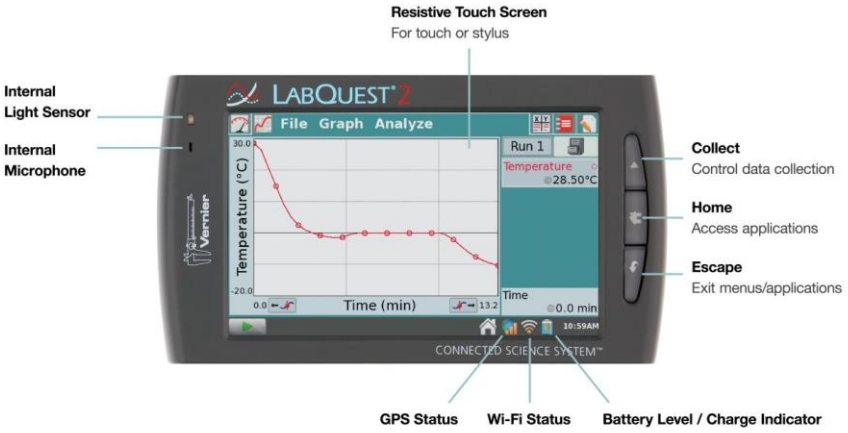

Figure 1 LabQuest 2 [1]

LabQuest 2 (Fig. 1) is compatible with over 70 Vernier sensors, providing a wide selection of experiments. Vernier sensors are designed specifically for education and held to high standards for quality and durability. These sensors, for active hands-on experiments, provide consistent, high-quality results and they are easy to use. There are three basic types of sensors:

1. Interface-connect sensors (Fig. 2) require additional hardware-an interface. This interface includes a powerful data-acquisition processor to send sensor data to data-collection and analysis software. Most of Vernier sensors are interface-connect. They are working on a variety of platforms, such as computers, tablets, or TI graphing calculators.

Figure 2 Magnetic field sensor [1]

2. USB sensors (Fig. 3) connect directly to a computer or LabQuest 2, or, in some instances (CBR 2 and EasyTemp sensors), with TI handhelds and calculators. No sensor interface is required in this case.

Figure 3 The Go!Motion detector connects directly to computer USB port – no interface is required. It is used to collect the position, velocity and acceleration data of moving objects. [1]

3. LabQuest Viewer software allows to view and control LabQuest wirelessly from computer or iPad. Wireless sensors (Fig. 4) communicate directly with host devices (iPad, LabQuest 2, computer) via Bluetooth communication. No sensor interface is required.

Figure 4 The Go Wireless Temp is a general-purpose, wireless temperature sensor. It can be used to remotely monitor temperature with a mobile device. [1]

All Vernier sensors are automatically detected and set up for data collection when used with Vernier software. This student-friendly technology is designed for ease of use. Frequently used types of sensors, for measurements in laboratory of physics, include accelerometers, dynamics sensor system, motion detector, rotary motion sensor, conductivity probes, current sensors, electrode amplifiers, force sensors, light sensor, magnetic field sensor, sound level probes, gas pressure sensor, spectrometers, spirometer, temperature sensors, voltage probes including differential voltage probe, UVA and UVB sensors, structures and materials tester.

Vernier system provides software designed to collect and analyze data - Logger Pro for Windows and Mac computers. With this software in a basic configuration is possible:

Collect live measured data from more than 80 different sensors and devices.
Draw predictions on a graph before collecting data.
Use a variety of data-collection modes, as needed, for experiment: for example time-based data.
Manually enter data for graphing and analysis.
Import data from Vernier interfaces.
Lay out graphs, tables, and text as needed across multiple pages to describe experiment.
Read values and slope from graphs.
Create and print graphs and data tables (Fig. 5). [1]

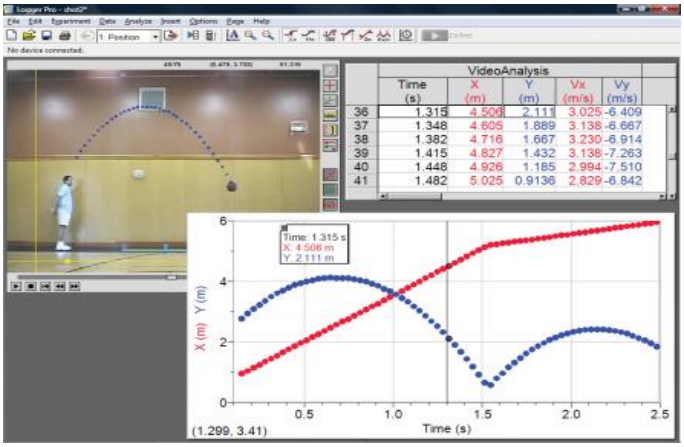

Figure 5 Analysis two-dimensional motion. [1]

3. VERNIER SYSTEM IN PHYSICAL LABORATORY AT FACULTY OF AERONAUTICS

At the Faculty of Aeronautics, the basic course of physics is taught in the classical laboratory. Analysis of current situations shows that it is necessary to modernize not only the content but also the forms of the teaching. Our aim is to increase students' motivation and their autonomy in experimental work. This can be achieved by use of modern information technology. We chose Vernier system as the best way of achieving a higher quality of teaching. The actual project includes modernization of the experiments. First of all are the measurements of the physical pendulum period, the free fall acceleration, the magnetic field explorations and determination of kinematic viscosity.

Acknowledgment

This work was supported by KEGA grant No. 081TUKE-4/2015.

References

[1] *Vernier 2015* Available at: http://www.vernier.com/