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## On-line Experiments and Their Use within Physics Teaching

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Tekst jest udostępniony do wykorzystania w ramach  
dozwolonego użytku.

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## **On-line Experiments and Their Use within Physics Teaching**

### **1. Placement of ICT into Teaching**

Expansion of communication and computing technologies has filled current scientific as well as unscientific society to such an extent that it has become necessary for a large part of professions. Use of computing and different communication technologies has become recently another requirement which should every school equip young people with and prepare them for future full inclusion in society. Therefore teaching must accommodate and focus primarily on development of students' competence which increases their competitiveness on the labour market.

Physics belongs to science. Thanks to this subject students gain basic knowledge of not only physical phenomena of the Earth, but they also learn about functioning of whole solar system and space. All the knowledge, laws and phenomena can be experimentally verified at physics teaching if the school has got the right equipment for it.

Thanks to extraordinary development of modern technologies, computing has become common material equipment of each school and it brought into teaching a lot of new possibilities which had been inaccessible before. Use of such technologies enabled to make new teaching methods accessible.

Expansionary development of computing caused that its use is not only the domain of ICT lessons but it penetrates into other subjects. Physics as science has got the potential for quality and adequate use of information technologies.

### **2. On-line Measuring in Physics Teaching**

On-line measuring is primarily used in the field of physics research. Therefore it is necessary to prepare students for that already at basic school. This method provides faster and more efficient way of measuring and data processing.

In the Czech Republic there are some possibilities how to integrate on-line experiments into physics teaching. For realization of this new teaching form it is needed to have some facilities which provide this kind of collecting and evalua-

tion of measured data. Among these facilities are for example systems of companies Pasco [Internet 1] and Vernier [Internet 2] which are currently penetrating into czech schools and they significantly contribute to placement of on-line experiments into physics teaching.

Both Pasco and Vernier supply the equipment for science teaching. It means that their aim is to cover the whole science field. Therefore pedagogues do not have to cut down on a particular subject but they can use the whole science field which gives them an opportunity to approach to science teaching more comprehensively.

Educative platforms of the companies Pasco and Vernier dispose of several tens of sensors, several measuring boundaries and at last but not least software thanks to which it is able to measure and work out the measured data in a quality and functional way.

### **3. Particular Demonstration of On-line Measuring in Physics Teaching**

The possibilities of use and placement of on-line experiments in physics teaching with the educative platform of Pasco are shown in the two following experiments. Among didactically demanding experiments in physics teaching at basic school belongs for example certification of phase transition between solid and liquid, i.e. Melting process, or the Ohm's Law.

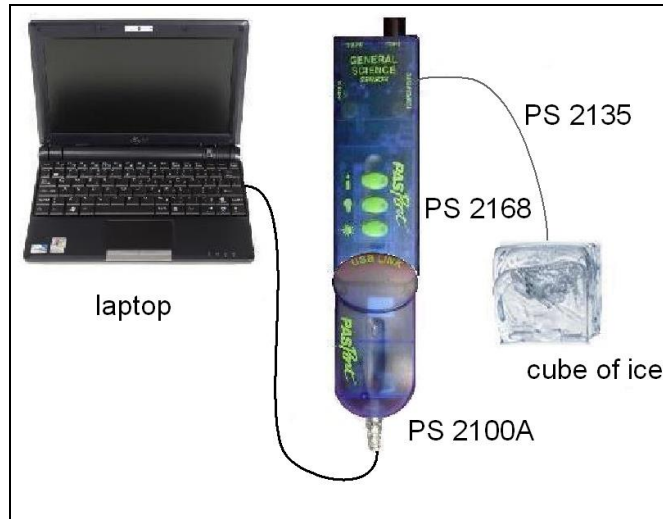
It is possible to find the mentioned experiments and their analysis in the physics textbooks for basic schools [Jáchym, Tesař 2001 or Jáchym, Tesař 2000]. The thesis focused on the on-line measuring in physics deals with a detailed elaboration of the experiments of systém Pasco. It can be seen concretely in the chapters concerning state changes, or the Ohm's Law [Bednář 2011].

### **4. Experiment No. 1 – State Changes**

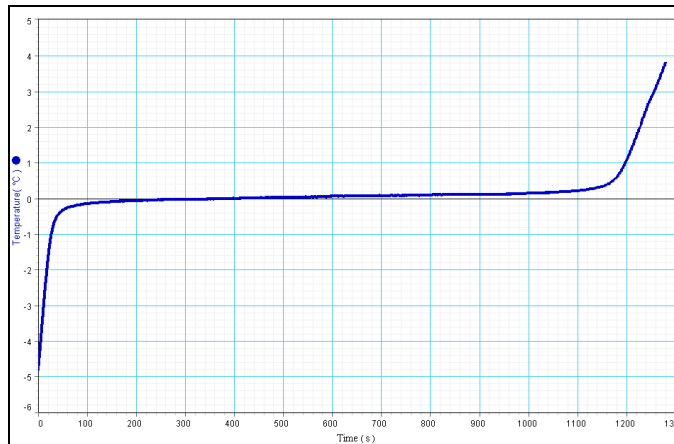
By temperature velocity sensor (PS-2135), General Science MultiMeasure sensor (PS-2168) and USB Link (PS 2100A) connected by a USB connector with laptop and software DataStudio it is possible to demonstrate a phase transition – an ice cube melting with an on-line drawn chart.

The ice cube is frozen drinking water. For this experiment it is necessary to prepare so much ice that the experiment is feasible within one lesson, or about 30 minutes. At the beginning of the lesson it is necessary to do a preparatory analysis of the process with the students followed by a continuous monitoring going. After finishing the process, by the end of the lesson, we interpret the graph gained from the measuring in terms of internal structure and energy balance.

## 5. Visualization of Diagrams and Measured Results



**Pic. 1. Connection diagram for the experiment**



**Pic. 2. Measuring results - melting process**

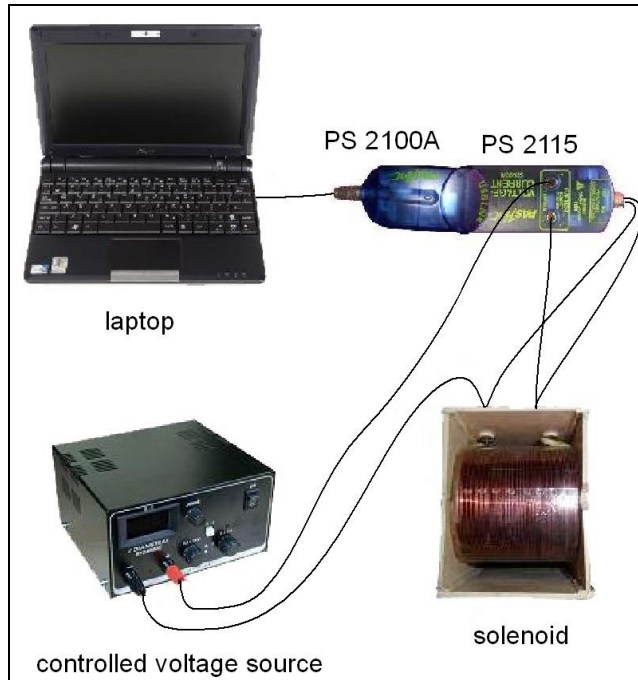
## 6. Experiment No. 2 – The Ohm's Law

By probe for voltage and current measuring, UI probe (PS-2115), solenoid of 12 000 threads, controlled voltage source, USB Link (PS 2100A) and laptop it is possible to discover instantaneous value of current passing according to the size of the DC input voltage at a constant resistance of conductor, constant temperature.

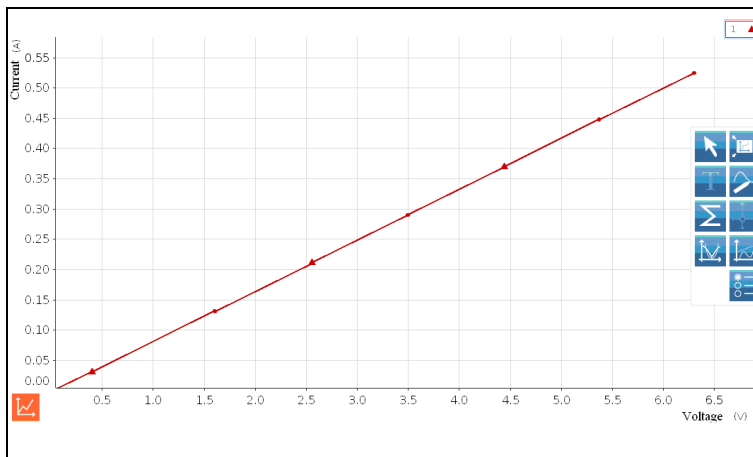
The biggest advantage of the on-line verification of the Ohm's Law is that students do not have to occupy with drawing a graph of the pre-measured values

any more. They can concentrate only on the graph itself and its evaluation and interpretation. They are also able to foreknow and verify process of the graph according to the change of element in the circuit, representing the resistor.

### 7. Visualization of Diagrams and Measured Results



**Pic. 3. Connection diagram for the experiment**



**Pic. 4. Measuring results – The Ohm's Law**

Both the experiments, graphs, gained by on-line measuring confirm well the theoretical solutions. To quality confirm of those solutions of the melting process, the Ohm's Law, students must draw up a graph from the measured values with the use of classic method. Creation of a graph is usually very demanding for students but by this on-line measuring there is no routine activity any more.

This method of data processing can enable students a better understanding of the phenomena and laws not only from the physics field but also within the whole area of science education. On-line drawn graphs provide students a direct connection with theoretical hypotheses based on single educational areas.

## Literature

Bednář V. (2011), Diploma thesis: *On-line experiments by physics education at basic school*, Department of Applied Physics, Faculty of Education, University of South Bohemia in České Budějovice.

Internet 1, <http://www.pasco.cz>, 1.4.2012

Internet 2, <http://www.vernier.cz>, 1.4.2012

Jáchym F., Tesař J. (2000), *Physics for 8<sup>th</sup> year of elementary school*, SPN, Praha.

Jáchym F., Tesař J. (2001), *Physics for 9<sup>th</sup> year of elementary school*, SPN, Praha.

## Abstract

On-line experiments and their use within the physics teaching are a contribution which has got as an aim to point out the possibilities of using new methods of data measuring and processing. It is so called on-line measuring within the physics teaching at basic schools.

**Key words:** On-line Experiments, Placement of ICT into Teaching.

## Eksperymenty on-line i ich wykorzystanie w nauczaniu fizyki

### Streszczenie

Ekseprymenty on-line i ich zastosowanie w nauczaniu fizyki dają nowe możliwości wykorzystania metod pozyskiwania i przedstawiania danych pomiarowych. Jest to tak zwany on-line pomiar stosowany w nauczaniu fizyki w szkołach podstawowych.

**Słowa kluczowe:** eksperyment on-line, zastosowanie ICT w nauczaniu, fizyka.