

The Experimental Approach of Physics in Secondary School

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Abstract. *The first meeting with Physics is very important, especially because this subject matter is perceived like a very difficult one by most people and parents too.*

The theoretical approach of any science is abstract and difficult. An experimental approach is more interesting and attractive.

Our college is an associated member of the "Hands on Science" network from 2004. Here are some pictures with experimental devices and experiments made by my students. They are 12 and 13 years old and they are to the beginning. Details are also given about the experimental scientific method and the steps involved.

Keywords. Experiment, Physics, Science, Scientific method.

1. Introduction.

In Romania, students begin the study of Physics on 12 years old and they study two hours by week in secondary school. Curriculum included all the chapters of Physics: Mechanics, Thermodynamics, Electricity and Magnetism, Optics, Atomic and Nuclear Physics. In high school all these chapters are studied again, but at a higher level. The number of hours for Physics' study in high school is 3 hours by week for classes with scientific profile and 2 hours weekly, first two years only, for classes with other profiles.

Education reforms are under way in Romania like in other European countries during the last 15 years. Despite the fact that Science Education becomes a major constituent of school curriculum, comparable to language, in all Europe, in Romania things took the opposite direction. The number of hours allocated for Science's study dropped and many changes, some favorable and many mistaken, have been performed.

2. Experimental approach of Physics

The first meeting with Physics is very important, especially because this subject matter is perceived like a very difficult one by most pupils and parents too.

The modern society demand not only theoretical knowledge, but also practical skills. Our students must solve interdisciplinary problems. They must participate in an active way to the teaching/learning process.

The theoretical approach of any science is abstract and difficult. An experimental approach is more interesting and attractive. I found this thing to more generations educated by myself.

Physics is a science which explains the world, the Universe.

For the first time, was the question. Any science starts like this.

Of what are things made?

What is time meaning?

Can we build a Sun?

Why things are fall down?

What is the light?

From answers was born Physics.

If you put the student find the answers by him, instead of give them directly, you made him curious.

When he found the first answer, he thinks he discovered the world. This is the first step. Then he starts by himself to ask questions and to search for answers. As a teacher, you can teach him how to search for answers. How can you do that?

To find out how works the Universe, we must recreate it. How? By experiment. Experimental science is actually the search for cause and effect relationships in nature. A hypothesis is our best guess at what this cause and effect relationship is. Our conclusions will allow us to predict the result of future cause and effect relationships.

3. Steps in doing an experiment

An experiment must not be made at random. Here intervenes the role of the teacher. He must teach students a scientific method to make an experiment. Such a method must have next steps:

- 1) Define the purpose of the experiment. You must define what you want to find out.
- 2) Make a hypothesis. A hypothesis is a supposition made on the basis of known facts or of an impression.
- 3) Plan the experiment (choice of the title, state of what we must observe, the successions of operations, what measurements we must make etc.)
- 4) Choose of materials necessities;
- 5) Experiment; Experiments are often done many times to guarantee that what you observe is reproducible, or to obtain an average result. Reproducibility is a crucial requirement. Without it you cannot trust your results. Reproducible experiments reduce the chance that you have made an experimental error, or observed a random effect during one particular experimental run.
- 6) The examination of data, calculations and errors;
- 7) Conclusions.

Some students work alone, some works in team. The team spirit must be encouraged. Also, the teacher may give like homework, experimental projects for students and parents together because the involving of parents in the school life is very important.

Here are some pictures with experimental devices and experiments made by my students, presented in Fig.1, Fig. 2 and Fig. 3.

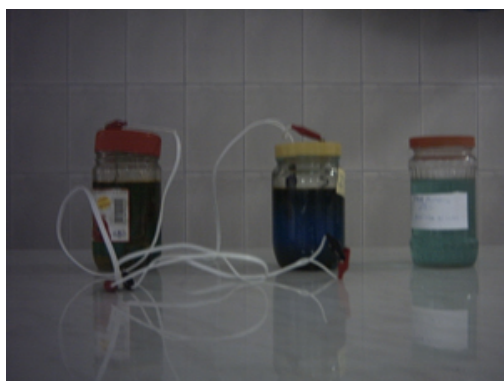


Figure 1. Experimental devices: copping devices



Figure 2. Experimental devices: hydraulic pumps



Figure 3. Experimental devices: cars by land and by water

They are 12 and 13 years old and they are to the beginning. All devices were presented by their authors in front of all students during a special class. Students had right to ask questions, to discuss and critic the devices. They manufactured an electrical rotating lamp, phone network, water mills, copping devices, electrical circuits, a steam machine, vehicles with air suspension, hydraulic pumps, batiscafs, boats, cars by land and by water, electromagnetic devices, little robots and others like these.

Like teacher, I evaluated the projects. First, I told to my students the evaluation criteria: the manufacturing effort, the originality and the utility of the project, the explanation for the phenomena that are to the basis of their device. After that, each student has received a grade.

The interest of students was major. Parents and students came to me and told me that they damaged toys, electrical apparatus, battery for manufacture their devices.

Also, I organized an exhibition-contest "How can I study Physics by experiments?" in the frame of Comenius 3, "Hands on Science" network.

Here all devices were presented to all school, teachers and students, and a jury evaluated and awarded prizes. The success was enormous (Fig. 4).



Figure 4. Exhibition-contest “How can I study Physics by experiments?”

Our competition provided the pupils with an opportunity to compare their own achievements with these of their colleagues. I think that exhibition-contest must become an annual one.

This year, the winners were invited to participate to a similar activity with students from all the country to “Grigore Moisil” High School, Bucharest, where they were awarded with some prizes.

Also, I encouraged my students to participate to “Science Fair” contest organized by “Hands on Science” network.

3. Conclusions

I will use the devices manufactured by my students like didactic material for classes of Physics, so they be more attracted and interested to understand physics phenomena. Self-made devices and simple materials are more appropriate for students in smaller ages. Teacher must guide pupils and teach them scientific method.

I think this approach combined with theoretical one is very advantageous and leads to a better understanding and interest for Science. Physics teaching and Science teaching in general, must develop creative spirit, imagination, logic reasoning, team spirit and practical skills. The “Hands on Science” network provides a frame to promote experimental teaching of Science as a way of improving in-school scientific education.

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