

Electronic Collections of Solved Physics Problems and Experiments

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Abstract. Eleven years ago we started to develop a Collection of Solved Problems aimed at introductory undergraduate and upper secondary school level students. The collection is specially designed to encourage students in their active approach to problem solving. Based on users' feedback, the Collection is used by students mainly for their home study and by teachers as a supplementary material. Five years ago we started to fulfill a Collection of Physics Experiments, which uses the same database and user interface. All experiments are described in detail and supported by methodical notes; where appropriate, we connect problems and experiments.

1 Introduction

Problem solving belongs undoubtedly to one of the key abilities in physics [1]. Teaching physics through the problem solving is a traditional method at universities; furthermore, problem solving is one of the primary skills that students of physics need in their jobs [2].

At the secondary school and introductory undergraduate level mostly so-called “plug and chug” problems are used in physics [3]. However, students encounter many obstacles when they are faced with physics problems, even these plug and chug problems [4].

To improve their problem solving skills, students should be guided and corrected while solving problems [5]. However, there is usually a lack of time to solve sufficient number of problems during lessons to develop this competency enough.

Based on the findings and researchers' recommendations, we started to develop a Collection of Fully Solved Problems [6] with intention to encourage students in an active approach to problem solving and to support their good habits in solving problems.

2 About Collections

The Collection of Solved Problems is designed primarily for students in introductory university physics courses to practice and deepen their knowledge gained at secondary school. It is suitable also for upper secondary school students with a deeper interest in physics.

All problems in the Collection contain detailed commented solutions, various hints, notes and other tools to help users with self-study and to lead them to active thinking about presented problems. Free availability enables usage of the Collection by both students and teachers not only at our faculty, but also at other universities and secondary schools.

Problems in the Collection are classified according to difficulty and can be also marked if they are solved using some special way (qualitative problem, graphical problem, problem with unusual solution, etc.). Besides this sorting, selected problems are labelled according to the cognitive skills they are aimed to develop. There are 17 categories based on the Bloom's taxonomy of educational objectives [7].

Both the database and the web interface turned out to be an appropriate platform for presenting materials in “step-by-step” mode, so the idea to develop its “sibling” – a Collection of Experiments in Physics [8] – emerged five years ago. Its aim is to collect ideas for experiments in the long term and present them to physics teachers in a unified and systematic way. All experiments are well tested, described in very detail including photos or video clips, sample measurement results and technical and methodical notes for teachers.

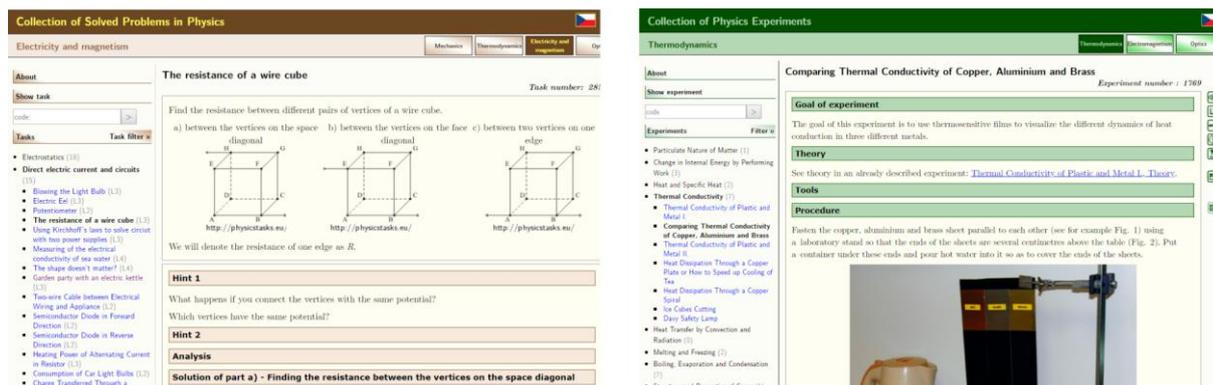


Fig. 1 Appearance of the Collections

Nowadays both Collections (fig. 1) contain more than 800 physics problems and 150 experiments in Czech and more than 210 problems and 40 experiments in English. The same technical solution of both databases challenges us to connect problems and experiments – problems whose solution can be verified should be linked to the corresponding experiment and vice versa to support teachers in linking theory with praxis.

3 Conclusion

On the basis of users' feedback, number of returning web visitors and results of our researches [9], we are convinced that the Collection of Solved Problems as well as the Collection of Physics Experiments are worthwhile projects and meet their main goals.

Students appreciate the detailed, comprehensive and logical way the problem solutions are presented in the Collection of Solved Problems. Teachers use both Collections for inspiration, as a supplementary material for students. They appreciate detailed problems' and experiments' description as well. Creation of new problems and experiment reports is found to be a very useful activity for prospective physics teachers, because it sharpens not only their ability to solve physics problems, but also their capability to explain how to solve problems and it develops their experimental skills.

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