

Opposing opinion  
on  
*Experiments in Physics Education: Designing Activities & Research*  
habilitation thesis  
by Petr Káčovský

The work is clear and well written, pleasant to read and with the specific literature well documented.

After a brief historical analysis regarding the importance attributed to experimentation, the author, basing on current literature, argues that theory and experiment play an equal role in education and refers to experiments as having a generative role in the construction of ideas.

The discussion then focuses on Lecture Demonstrations and Interactive Physics Laboratories on which he personally worked while also doing educational research.

As regards the Lecture Demonstrations (which take inspiration from Sokoloff's), it is rightly stated that to be well structured they must capture students' attention and help them maintain high interest during the lesson.

The discussion and suggestions about methods and strategies about how this goal could be achieved are adequate.

As regards Practical Work activities, it is observed that students are urged to manipulate and observe the objects they are studying (and, therefore, that this activity cannot be thought "only" as a standard laboratory. It is also suggested that Practical Work improves conceptual understanding, but that attention must be paid since, according to the literature, especially for beginners, manual work involves attention and actions that can obscure conceptual understanding. This fact could, quite obviously, lead to a cognitive overload.

In the future, it could be interesting to deepen the research about the problems related to this issues. The quality of practical work is important; and it is important to well understand what can be done to better our proposals.

I completely agree that when students are asked to explain what they have learned, they repeat what they did and what they saw – not what they understood or what can be learned from it (as Abrahams says). However, this observation is related to a rather transmissive concept of education. In fact it is not so important asking questions students are not interested in, without having been previously

able to observe their manipulations, their judgments and behaviours during laboratory hours, for example. And, in fact, the spirit of this thesis work goes precisely in the direction of understanding the effectiveness of laboratory work as a stimulus for a correct/possibly positive perception of physics.

Indeed, in this thesis is stated that, when planning lab work, it is necessary to prepare tasks that make explicit reference and emphasis to ideas. Practical work triggers attention but not love for science nor long-term interest. In fact, the power of lab work in improving scientific skills is often limited, except under special conditions; this a general feature: practical work, paper and pencil work, computer work and so on are, per se, all unable to make people love and understand science. It is precisely on these aspects that the candidate's appreciable works are concentrated. It is the quality of students' work and the tasks required that make the difference. Future work will be able to make the statements made even more profound and documented, especially discussing the use of active learning in the processes presented, for what concerns the appropriation of knowledge by students, its verification and the many ways of stimulating active learning with examples taken from the great personal experience of doctor Petr Káčovský, and its importance in building disciplinary skills.

From the work here presented, it is clear how active learning can be fostered in different ways and with different strategies, more or less laboratory-based, but also depending on the specific learning styles of the students. In fact, methods are empty containers, mere tools; in the hope to be effective, active cultural teaching and learning is needed; different aspects are to be taken into considerations, together with different environments.

Doctor Petr Káčovský (citing authoritative authors) also observes that events strengthening feelings of competence and autonomy support intrinsic motivation, and events weakening these feelings undermine it. This part of the thesis, that concerns intrinsic and extrinsic motivation, is very interesting. There are many ideas provided and one can perceive a long research effort on this issue.

After an introduction with considerations on barriers and expectations of using technologies in physics experiments. Chapter two focuses on the use of thermal imaging cameras.

By focusing once more on the question of whether or not fostering manual activities, we perceive the risk to completely lose the fundamental point: the need for the creation of an active attitude that allows a personal (therefore culturally important) appropriation of knowledge regardless of the technology used. Indeed, technology is discussed, insofar, as its use allows or not such appropriation.

The disciplinary introduction and description related to the study of thermal conductivity of conductors and insulators, of convection and emissivity is particularly well done. In the future, I'd be delighted if in addition to the Leslie cube, the a black body concept - with its related construction - could also be introduced.

Also interesting are the observations and stimulations made by the author for what regards educational aspect concerning the concept temperature, conductivity, energy flux, etc. and their introduction.

Chapter 3 deals with motivation and on how developing interest in physics. The general overview based on the literature is clear and well done. Also well done is the analysis of the effectiveness of some Lecture Demonstrations reported in the cited paper of which the candidate is co-author. The study of gender differences is also of interest.

It is quite natural that in one-off intervention one cannot expect any kind of in-depth analysis of learning, and, in fact the work is more related the motivation gained and interest generated in students than students' learning.

Overall, a very interesting aspect of the thesis is the capacity for autonomous opinions shown its author who is open to comparison with educational research while still remaining tied to his personal growing experiences.

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