

Birth and death of “Demonstration Experiment” in Physics

Salvatore Ganci¹

¹Monza, museodellascienza.s.ganci@gmail.com.

Abstract: this paper revisits the development of the so-called “demonstration experiment” in Physics, with particular reference to the teaching in high schools in Italy.

Keywords: Demonstration, experiment, classroom

1. Introduction

The historical development of the demonstration experiment in physics seems useful in analyzing a short sentence in a celebrated book by Richard M. Sutton:

Demonstrating in Physics is an old art which has been and should be constantly developing; new methods of illustrating fundamental principles are always desirable and some of the older methods need to be more clearly formulated... Demonstrations are for the student and not for the instructor. If this simple truth were kept constantly in mind, the major crimes of the physics lecture room would be eliminated. (Sutton, 1938)

The Sutton book appeared in times when in Italy a monumental volume (Perucca, 1937) was published under the patronage of the Ministry of Education. At these times, the only Italian high school was the ‘Liceo Classico’, where the fundamental teaching was Latin, Greek, and humanistic disciplines. Physics was studied only in the two final years, and the teacher of Physics was the same in Mathematics for five years. In the last year, math was limited to Algebra, Euclidean Geometry, Analytical Geometry, and Trigonometry. We had a very useful and in-depth book on the demonstration experiment (usually carried out by a technician) without a real possibility of use (two hours in the fourth class and three hours in the fifth class). Pyramidal structure of a school (Ministry Giovanni Gentile) in a unique élite School and, subordinated, Technical Schools. A choice obliged for children aged 11 or 12 years after the Elementary School.

That paradoxical background led Enrico Persico (1956) to write a funny article in *Il Giornale di Fisica*. He refers to an university exam where the student cannot schematically draw an electroscope, she estimates the passage of 20,000 amps in a light bulb, but at the question “write and discuss Maxwell’s equation” the candidate relaxes itself and ‘runs like a train,’ leaving the examiner in a gloomy melancholy.

2. A little history of “demonstration experiment”

Demonstration Experiments in Physics books start from the XVIII century. For example, a notable textbook by J-A. Sigaud De La Fonde (1784) is devoted to the demonstration experiment “seen” with the main intent to strike and amaze. As a simple example, we find in the first volume the quantitative verification of the Archimedes principle in liquids with the same (unchanged) apparatus still present today in the Physics Equipment catalogues¹. During the XIX Century, a German book (Frick, 1862)

¹ i. e. www.leybold-shop.com

translated into English entered the practical details of use and manufacturing apparatuses. Phywe² during the middle of the XX Century sold single apparatus or sets of apparatuses with detailed cards, representing the German interest in the demonstration experiment. All this Literature was distributed and translated in each national Language of the buyer. Demonstration experiments become easy to mount for the technician or the teacher and surely work.

In America, another milestone of the “demonstration experiment” is the Lloyd William Taylor book (Brown, 1959) but out the purpose of an intermediate school.

But with the prophetic *The Times They Are A-Changin’* of Bob Dylan, we found P.S.S.C. project introduced in Italy around 1963. This project spread in Europe and, in general, the times are now ripe to lead to the 1968 revolution. It is the death of the “demonstration experiment? It is an open question. The classroom experiment is replaced by various projects (PSSC/Nuffield) but in Italy, there are now more high schools, and in one of these, devoted to Physical-Mathematical matters (Liceo Scientifico) the scarcity of hours of Physics makes the classroom experiment resurrect as the minor of evils.

3. Pedagogical consideration

It can be useful to start some pedagogical considerations from the textual analysis of the Sutton sentence at the beginning of this paper: “Demonstration experiment in physics is an old art which has been and should be constantly developing”. A good demonstration experiment, well shown and discussed requires a lot of accurate preparation. Colin Siddons jokes about the characteristic of the demonstrative experiment that it doesn’t work:

It it wriggles, is biology
If it stinks, is chemistry
If it doesn’t work, it’s physics (Siddons, 1988, p. 9)

The demonstration experiment is well remembered (particularly if it doesn’t work...) so the words “old art” are fully appropriate. A Technician/Teacher mounts one or more experiments as a support to a parallel lesson and always makes sure everything works by rehearsing just before the presentation. If the experiment works, it has the advantage of being well remembered and the phenomenological data are well impressed, *if* the demonstration experiment measures something, *then* its pedagogical value is valuable.

If it doesn’t work? The reason why it did not work involved more physics but the experiment failed is equally remembered.

Sutton outlines: “New methods of illustrating fundamental principles are always desirable and some of older methods need to be more clearly formulated”. It is evident that technology evolves and some sophisticated measures, not possible in the reality of the past century, become understandable and they are close to the vision of the student who lives in the present era. A CRO oscilloscope is so alien that it is difficult to explain its mechanism. Older methods of analysis (as an example) in resonance become very simple using virtual instruments based on the sound card and some hardware found around the Lab.

4. Conclusions

There are conclusions? It is a matter of point of view, of contingent situations, and/or more other variables. In Italy, the demonstration experiment had value also in undergraduate courses of physics until the middle of the XX century or a little more, with a specific human resource that no longer exists: “the Graduate Technician”. So, the University remains without a precious human resource. The true “death” of the demonstration experiment in high Italian schools is the pandemic that forced all school Headmasters to allocate special classrooms to teaching in order to increase the distance in face-to-face lessons. Now,

² The 1950-1960 old Phywe Physics apparatuses are still the equipment of many schools in Italy.

during the pandemic, students were invited to observe phenomenology with simple experiments at home and various experiments found in web films. The Lab Technicians in High Schools are so engaged in “factotum” works and the teacher has no incentives to use Lab apparatuses.

Demonstrations are for the student and not for the instructor.

The good demonstration experiments it is for everyone; they include the smell of petroleum-tarnished metal, of all little craft-making that reveals the sensibility of the co-working Instructor. It was an “Added Value” lost. All is superfluous? What substitute it in the future?

The answer my friend is blowin’ in the wind.

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