

## SCIENTIFIC PRACTICES AS CULTURAL ACTIVITIES: A CHALLENGE AND AN OPPORTUNITY FOR EDUCATION

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During the 20<sup>th</sup> century, the sciences have been considered as disciplines that are significantly distinct from the humanities, C.P. Snow's term of the "two cultures" has become the key word for this development. However, recent science studies produced arguments for the thesis that sciences are also a cultural activity. As a consequence, science and the related practices become time dependent – what was an accepted scientific practice in a particular period would not meet the standards of another period. Understanding science as a cultural activity poses several challenges to educators, but offers also opportunities. One approach that meets these opportunities is the implementation of the history of science in science education. In the following, two specific approaches in this respect will be discussed: storytelling and the reenactment of historical experiments.

History of science has been an issue for science educators for quite some time; however, the question is which kind of history of science. Classically, historical aspects in science lessons were limited to biographical information about scientists (most of them old men that were dead for quite some time) or anecdotes about scientists. Both aspects are questionable with respect to making science more attractive to students: they do not necessarily offer opportunities to students to identify themselves with scientists; consequently, they do not support the attempt to create at least an interest in the sciences, if not making science a possible career option. However, as our society gets significantly affected by scientific developments, and several political discourses are dealing with the implications of these developments, it appears necessary that students develop at least an understanding of science and the way scientific knowledge is produced in order to be able to participate in the discourse. To avoid misunderstandings: it is not necessary to know the technical details in order to participate in a political discourse on scientific and technical developments, however, it is necessary to have some understanding about the nature of science.

Concerning teaching the nature of science, history of science can be very productive. Several advantages of referring to historical episodes in this respect have been discussed in the literature (see e.g. Matthews 1994, Allchin 2013). Instead of repeating their arguments, two approaches should be emphasized that may offer additional options for implementing historical aspects into science education: storytelling and the re-enactment of historical experiments.

Storytelling is an approach that has become relevant with respect to science education in the last two decades. Stories enable teachers to bring humanistic aspects into the science classroom. Moreover, stories can also be used to create controversies in the classroom as a good story contains (amongst other aspects) also a conflict situation in which the protagonist has to make a crucial decision. Thus, stories are not just narrations but are structured in a particular manner (see Froese Klassen 2013). Of course stories are not necessarily related to historical developments, and there are a lot of stories which are intended for educational purposes and which are completely fictional. However, historical stories have the advantage that they include an implicit authenticity. The main characters are real persons and not imaginary beings, particularly not an imaginary being such as an electron that acts like a human. Consequently, students can understand the motives and the conflicts and realize that scientists are indeed human beings like everyone else. As a result, they are able to identify themselves with the main character and thus identify themselves with someone who is successful in the sciences. However, such an approach is not just offering a positive role model for scientists, but there is evidence that also the interest in the scientific content itself increases (see Hadzigeorgiou et al. 2012). Therefore, such an approach seems to have a significant potential both in terms of changing the attitude of students towards science, and with respect to improving science education. Consequently, there are several approaches with individual peculiarities that advocate the use of historical stories in science education (for examples see the websites in the references).



In a completely different direction aims another approach, the reenactment of historical experiments. Generally speaking, one can distinguish two variations: One approach uses modern equipment (and some experiments with historical references are available on the market such as the Millikan oil drop experiment or the Franck Hertz experiment). This approach is limited to using the working principle of the experiment, and the set-up is stabilized so that students are able (or at least should be able) to produce data sets which are corresponding to the theoretical expectations. Consequently, there is little historical contextualization and little to learn about the nature of science (for a different approach in this respect see Heering & Klassen 2010).

A different approach uses devices which correspond to the source information – these set-ups are less stabilized and therefore enable students to make experiences that are more appropriate in terms of what experimentation in the sciences is. Thus, these experiments focus not (only) on the production of data that correspond to our knowledge, but they aim at enabling students to experience science as a process. Moreover, the experiments do not necessarily meet modern standards, thus, students can realize that these standards and the connected practices are time-dependent and can be understood as a cultural activity (see e.g. Heering 2007, Heering 2009). From such an approach, it is possible to enable students to make their own experiences and develop an understanding of the nature of science in general and of the nature of scientific experimentation in particular. However, and this appears to be a difficulty, there are at least two challenges: at the first glance, the instruments seem to lack – however, as we have shown it is possible to create some simple devices at school level (Heering 2013). Moreover, the teachers need some historical background in order to be able to feel competent in such an approach – and making teachers competent in this respect is certainly one of the challenges that need to be met in order to make these approaches successful.

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