The Art/Science dialogue in Science Education

We all know that Art and Science are two different aspects of Human activity and frequently considered (inappropriately) as two different cultures (Snow, 1959). Historically, it is useful to go back to the XVII century rationalist ideas of René Descartes in order to trace the divorce between Art and Science. The aesthetic emotion, which is at the heart of artistic creation, did not fit with the mechanistic principles proposed by the French philosopher and mathematician. Later on, the emergence of positivist ideas and the extraordinary expansion of scientific ideas "legitimated" a hierarchical view of knowledge with a clear separation of the epistemological status between the different disciplines: the experimental Sciences at the top and the Social Sciences and Arts somewhere near the bottom. Such an organization of knowledge is still quite widespread today although we should reflect on the wise comments of the Nobel Laureate (Biology), François Jacob (1981), when he suggests that any system of thought will explain the world in all its details. So what?

In epistemological terms, an alternative representation to the positivist hierarchical organisation of knowledge (the "architectural" metaphor) is a network organisation (the "archipelago" metaphor), proposed by Caraça and Carrilho (2001) (probably not by chance the two authors came from the fields of physics and philosophy, respectively), a view which is in line with more complex and pluralistic views of knowledge defended by Morin (2005). The two authors defend the heuristic value of such a pluralistic perspective as it facilitates the establishment of links between the domains of science, philosophy, ethics and aesthetics. This does not mean to undervalue the empirical or epistemological relevance of the internal diversity of disciplines, but rather to better understand the elements of disciplines that make that diversity possible.

From the field of science and based on neuroscience research, Damásio (1994) questioned the divorce between the world of truth and rationality and the world of emotion and beauty (aesthetic emotion). In short, in his thoughtful book, the author shows the relevance of the emotional input in rational decision and argues that René Descartes was mistaken about the dualistic divorce between rationality and emotion. The author warns us that knowing the relevance of the role played by emotions in the reasoning processes does not mean that reason is less important than the emotions. This simply means that we know better how the human mind works.

Thus, nowadays, the interesting question is not whether Art and Science are different. The interesting question is what kind of similarities they may have after all and how this may open new horizons in science education.

This issue is familiar both to contemporary scientists and artists: for example, the Max Planck Institute physicist Stefan Muller (1988), with his fascinating pioneering work in the computer arts and for whom the divorce between Art and Science remains one of the major challenges of cultural reflection; the Nobel Laureate Ilya Prigogine (1988), who maintained that it is one of the great testimonies to human evolution over thousands of centuries to see how artefacts produced by man have become progressively both more functional and aesthetically more appealing. Art and Science have never been divorced. Leibowitz (2008) also refers to the influence of the new sciences - the theory of relativity and quantum physics - on Surrealism because of the metaphysical implications of the new physics Thus, we should now consider both indeterminacy and uncertainty as part of our ability to make sense of the world and that means a major breakdown with Cartesian determinism and Comte's positivism. The same kind of influence is apparent in the science-based aesthetics of Pointillism, which explores the scientific works of the chemist Eugène Chevreul, or the physicist Nicholas Rood on the theories of colour and of James Maxwell on the nature of light. The list is a long one. Some authors like the art historian Kemp (2000) go a step further in the theoretical elaboration of the relations between Art and Science, offering a systematic framework for exploring the possible dialogue between Art and Science.

The above considerations call for innovative perspectives in many domains of our activity as science education teachers and/or researchers, and particularly for new efforts to explore interdisciplinary approaches to the science curriculum, teaching and research strategies. This should start to pass to our students a less deterministic and more humanistic and tolerant view of science, an aspect which is not always well considered in science classes. There are many ways of exploring appropriate links between Art and Science. For example, (i) using drama and art to teach chemistry (Lerman, 2003); (ii) science contests, such as the one used in Princeton University (2010), in which the organizers solicited images of scientific research that have aesthetic value and were representative in some way of "energy", such as photographs through a microscope or a telescope, or generated by computer simulations, or 3D renderings of data sets…; (iii) exploring selected paintings relating to relevant episodes of science such as the painting of Joseph Wright of Derby in 1768 representing an experience of the so-called gas chemistry "An experiment on a bird in the air pump" (Gorri & Filho, 2009); (iv) classroom research such as the example presented in this issue of JSE.
I am quite aware that some of the points referred to above are not easy to implement in our activity as teachers and/or researchers. But it might help to close these lines with a quotation from Samuel Beckett, a great man of the theatre: *Try again. Fail again. Fail better.*

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