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The Image of Chemistry and Curriculum Changes

J. A. Linthorst [a,b,c*]

ABSTRACT
Since the 1980's, the influence of context-based curricula has been growing in curricula and has been taking place in advance of improving the image of chemistry. This article argues that chemical societies should focus on a better understanding of the negative image of chemistry, by supporting historical and philosophical research. Based on that, chemistry curricula should change.

KEYWORDS: Context, public image, history of chemistry, curricula

Resumen (La imagen de la química y los cambios en el currículo)
Desde los años ochenta del siglo pasado la influencia de los currículos basados en el contexto ha sido creciente y ha tenido lugar antes que la mejora de la imagen de la química. Este artículo argumenta que la porción química de la sociedad debe enfocarse hacia una mejor comprensión de la negativa imagen de la química, mediante el apoyo a la investigación en filosofía e historia. Con base en eso, el currículo de la química debe cambiar.

Palabras clave: contexto, imagen pública, historia de la química, currículos

Introduction

With The International Year of Chemistry 2011, the worldwide chemical community tries to improve its image. This is not the very first attempt of the chemical community. Since the 1980's chemical societies, in cooperation with chemical industry, have been opening the doors of laboratories and plants to the public (e.g. *ACS Reaches Out: American Chemical Society Annual Report 1988*; *The Royal Society of Chemistry: 1988 Annual Report* and *The Netherlands Chemical Industry Association Annual Report 1980*). In addition, image considerations also influenced the terminology of chemists and chemical societies, e.g. green chemistry, benign by design chemistry and clean chemistry (Linthorst, 2010a). But how has 'image' influenced the curricula of chemistry at secondary schools? In this short Commentary, I will answer this question and propose a new perspective on the development of chemistry curricula.

The incorporation of contexts

Chemistry educators are concerned with developing positive attitudes of students at secondary school toward the learning of chemistry, see e.g. Hofstein and Mamlok-Naaman (2011) in this journal. Inch (1999) supposed, amongst others, that the negative image holds a causal relationship with the number of students who choose chemistry as their main subject at university. In fact, for many years the chemical community, all over the world, has been experiencing the negative image of chemistry. Therefore, for example, in April 1991 the 'public image of chemistry' was discussed by the presidents of chemical societies during the Meeting of Presidents of World Chemical Societies (*The Royal Society of Chemistry: Annual Report 1991*, p. 11). In this spirit, the American Chemical Society supported projects such as *ChemCom* and *Chemistry in Context* (e.g. *Looking Forward: American Chemical Society Annual Report 1987* and *American Chemical Society Annual Report 1992*). These projects tried to connect chemistry in daily life contexts with chemical concepts. For which purpose? The public understanding of chemistry, or say the image of chemistry. Comparable innovations can be observed in other countries. In Germany, a similar project started at the end of the 1990's: *Chemie im Kontext* (Parchmann *et al.*, 2006). In The Netherlands, since approximately the 1990's contexts have been increasing in textbooks at secondary schools in an evolutionary way. And, probably very soon, also in a revolutionary way, because the Dutch Minister of Education, Culture & Science will soon decide to restrict all chemistry teachers at secondary schools in The Netherlands to join in a context-rich project: *Nieuwe Scheikunde*. Why? Inter alia,

[a] CSG Dingstede, Gerard Doustraat 13, 7944 HD, Meppel, The Netherlands.
[b] Descartes Centre for the History and Philosophy of the Sciences and the Humanities, Utrecht University, Janskerkhof 13, 3512 BL, Utrecht, The Netherlands.
[c] Department of History, Maastricht University, PO Box 616, 6200 MD, Maastricht, The Netherlands.
E-mail: J.A.Linthorst@uu.nl
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to improve the image of chemistry (Apotheker *et al.*, 2010). Apparently, the incorporation of context-based curricula is significantly driven by the negative image of chemistry. Or as Pilot and Bulte (2006) proposed in their overview of context-based curricula, 'all approaches [the context-based curricula] describe in their ideal curriculum how they wish to develop a chemistry curriculum that explicitly shows personal and societal relevance to students'.

But have contexts changed the image of chemistry in a positive way? From a statistical point of view, there is no reliable research done that investigates the relationship between learning results, contexts and the public image of chemistry, with the exception of Tai and Sadler (2007). They claim that 'the use of everyday examples [at High School] is positively associated with college performance' in the USA. These 'everyday examples' should be interpreted as contexts. According to Tai and Sadler, the positive correlation is statistically weak and does not necessarily suggest causality. Those authors do not explicitly discuss the image of chemistry and their research is restricted to the USA. The incorporation of contexts is not unique to chemistry. Fensham (2009) gives an overview of context-based science curricula — Science Technology and Society curricula — that originate from different countries. Of course, these contexts have different meanings and approaches (Pilot and Bulte, 2006; Fensham, 2009). The incorporation of these contexts do at least have one thing in common: to improve the public understanding and image of the natural sciences, e.g. Chemistry, Biology and Physics. But historically, the image of these three major natural sciences has been significantly different (Bensaude-Vincent and Simon, 2008). This opens the pathway for a new perspective on the development of chemistry curricula, one that starts with the lessons from the past.

History of chemistry: image

The problem was, and is, image. The chemical community tried to solve this problem, by increasing contexts in curricula, but forgot to deeply understand this problem. If they did, they would know that, since several centuries, the image of chemistry has been bad in comparison with biology and physics (Bensaude-Vincent and Simon, 2008). For clearness's sake, thus in advance of modern environmental awareness, the image of chemistry was negatively featured. For example, in 1785 the founder of modern chemistry, Lavoisier, decomposed water and collected and weighed the products and this was followed by recombining them into water (Bensaude-Vincent and Simon, 2008; Crosland, 2009). Thereafter, Lavoisier had to convince audiences that water was an analysable element! Moreover, in reality water was a compound of two other elements, so Lavoisier tried 'to change the others' minds about the nature of water' (Bensaude-Vincent and Simon, 2008; Linthorst, 2010b). With regards to the image of chemistry, Lavoisier now had a serious problem, because he had to rationalise about objects that were not visible by the naked eye. Consequently, important contemporaries (e.g. Priestly and Cavendish) of Lavoisier were not convinced by him. Nowadays, we would speak about molecules and atoms, that are still objects which cannot be seen with the naked eye. Whereas physicists and biologists traditionally studied objects that were visible. This is the crux of the public understanding and image of chemistry and we have to improve our understanding, in the nearest future, on this. Therefore, chemical societies, from all countries, must support research of historians and philosophers of chemistry in this direction: how and why were chemical models developed, accepted and rejected with regards to the public image of chemistry in different countries? This will improve our understanding of the image of chemistry in all his facets and based on that, we change our curricula (Erduran, 2001). Unfortunately, history and philosophy of chemistry is a relatively small research area in the academic arena and is hardly taught at universities (Bertomeu-Sánchez, 2007). This explains why the image of chemistry is poorly understood by chemists and chemistry educators whom develop new curricula.

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