Educ. quím., **22**(2), 90-102, 2011. © Universidad Nacional Autónoma de México, ISSN 0187-893-X
Publicado en línea el 19 de enero de 2011, ISSNE 1870-8404

High-School Students' Attitudes toward and Interest in Learning Chemistry

*Avi Hofstein & Rachel Mamlok-Naaman**

ABSTRACT
Developing positive attitudes toward and interest in science in general and learning science in particular is one of the key goals for teaching and learning the sciences. Thus, over the years, this area fuelled many research studies, these being focused on: content, pedagogical, and curricular issues. In this paper we focused on the issue of enhancing attitude and interests in the context of chemistry learning mainly at the upper secondary level of schooling. The authors of this manuscript suggest that the three key factors that should be considered for enhancing attitudes and interests are the methods used to present the content (e.g. relevance, and historical approach), instructional techniques that are implanted, and gender issues. Although throughout the years we have learned a lot regarding teaching and learning of chemistry we are unable to provide conclusive recommendations regarding how in the context of chemistry education affective constrains could be enhanced. However, based on scholarly developments and research we suggest areas (see above) that should be considered by science (chemistry) educators, curriculum developers, and chemistry teachers who believe that developing positive attitudes one of the central goals.

KEYWORDS: attitude, interest, affective domain, learning science

General introduction and bibliographical background

For nearly 40 years, hundreds of journal papers as well as reviews (Gardner, 1975; Schibeci, 1984; Simpson, Koballa, Oliver, & Crawley, 1994; Osborne, Simon, & Collins, 2003; Koballa & Glynn, 2007) and dissertations were published all over the world with the goal in mind of investigating the sources, reasons, and theoretical constraints for developing students' attitudes towards and interests in science in general and learning the sciences in particular. Throughout the years, very often, scientists, science educators (curriculum developers), and teachers emphasized the importance of the affective domain in general and attitudes in particular, as central components of the goals for teaching and learning the sciences.

Here are a few examples of quotes regarding the importance of developing positive attitudes in the context of learning the sciences.

Sears and Kessen (1964), in the context of the AAAS Commission on Science Education, wrote that:

> The first task and central purpose of science education is to awaken in the child, whether or not [he] will become a professional scientist, a sense of the joy, the excitement, and intellectual power of science. (p. 4)

In their comprehensive review of science education, Shulman and Tamir (1973) wrote:

> We are entering an era where we will be asked to acknowledge the importance of affect, imagination, intuition, and attitude as outcomes of science instruction as at least as important as their cognitive counterparts. (p. 1139)

Although research on students' attitudes towards learning science fueled many research projects for a long time, in the late 1980s there was a significant decline in science education researchers' interest in science-related attitudes (Koballa & Glynn, 2007; Hofstein & Lunetta, 2004). However, toward the turn of the century, the issue of attitudes towards and interest in science became an international concern. Recent publications (Osborne et al., 2003) presented a gloomy picture regarding students' ignorance in science, the decline in their attitudes toward science in general and science learning in particular, and the decline in enrollment in science-based careers.

In addition, in many western countries, the gloomy results of the recent international comparative assessments in science education (TIMSS, since 1995 and PISA, since 2000) also sparked a tidal wave of documents, all of which called for rethinking the goals, content, and pedagogy of science education (Bybee, Fensham, & Laurie, 2009). This rethinking has led to a diverse set of reports on the practices and future of science education, for example, in the US report by John Glenn's committee entitled *Before it is too late* (2000); in the European context, we can find *Beyond 2000* (Millar & Osborne, 1998), the *Relevance of Science Education* study

* Department of Science Teaching, The Weizmann Institute of Science. Rehovot, 76100 Israel.
Corresponding author: avi.hofstein@weizmann.ac.il
Tel.: 00 972 8934 3811

(Schreiner & Sjöberg, 2004), and *Science Education in Europe: Critical Reflections* (Osborne & Dillon, 2008). All these initiatives and reports include one common feature: that the content of school science and its related pedagogical approaches are not aligned with the needs, motivational patterns, and interests of most of the students (Gräber, 1998; 2002; Jenkins, 2005; Sjöberg, 1997; Sjöberg & Schreiner, 2006). Even in countries in which the results of TIMSS and PISA were above average, students do not view science learning as either motivating or relevant (Black & Atkin, 1996; Morell & Lederman, 1998; Osborne, 2003). This is specifically true for chemistry and physics education, and especially for those students who probably will never embark on science or science-related careers, but will nevertheless need science — personally and functionally — for their future as literate citizens (Roth & Lee, 2004; Holbrook & Rannikmae, 2007).

Attitudes towards science and understanding science

According to the literature, the way students perceive and evaluate their acquaintance with any kind of knowledge is very important in their learning process (e.g. Bloom, 1976). If students are not interested in science, they tend not to make an effort to learn and understand the meaning of concepts that are being taught to them. It was shown that the most effective factor contributing to students' decisions to study science is their interest in the subject (Milner, Ben-Zvi, & Hofstein, 1987; Lindahl, 2003). It is suggested that when students feel that they are familiar with concepts or issues from their previous studies, and feel confident enough to explain them, it affects their motivation and achievements. Such data are very important for developing learning materials and for planning teaching strategies (Arzi, Ben-Zvi, & Ganiel, 1986). It is assumed that students who are interested in science and understand the scientific concepts, will have more positive attitudes towards science and science studies compared to those who have learning difficulties in the science disciplines. Munby (1988) claimed that an attitude consists mainly of three characteristics: feeling, cognition, and behavior. According to Koballa, Crawley, & Shrigley (1990), attitudes are feelings of "like or dislike". Simpson & Troost (1982) referred to attitudes towards science and science learning and concluded that people are committed to science when they better understand it and want to take more science courses and to continue reading about science. Fairbrother (2000) claimed that pupils learn only if they want to learn. There are many problems regarding the way science is taught in school, especially if we consider non-science-oriented students as an important target population. Many countries tended to give students a taste of an assortment of facts considered as important by the scientific community. Apparently, the idea underlying this philosophy was the feeling that if students will have access to knowledge, their ability to cope with the modern world as well as their attitude towards science will improve. Unfortunately, it appears that in general these hopes were not realized and the feeling nowadays favors the idea that 'less is actually more'.

O'Neill and Polman (2004) wrote:

> We suggest that on a societal scale, schools would function more effectively if they covered less content, in ways that would allow students to build a deeper understanding of how scientific knowledge claims and theories are constructed. This would be of use to all students in their decision making outside of school and beneficial to those pursuing postsecondary studies in science as well. (p. 237).

What is the meaning of attitudes towards science and how are they measured?

The meaning of attitudes towards science

Although this paper focuses on attitudes towards chemistry, we believe that the nature of attitudes towards chemistry serves as an example for all the natural sciences studied in school.

Osborne et al. (2003) claimed (regarding attitudes towards science) that:

> Even a cursory examination of the domains reveals that one of the most prominent aspects of the literature is that 30 years of research into the topic have been bedeviled by lack of clarity about the concept under investigation. (p. 1053)

In addition, Koballa and Glyn (2007), in their review of the literature, suggested that often attitudes are used interchangeably with terms such as interest, beliefs, curiosity, opinions, and other commonly used affective-related variables. Clearly, the concept of attitudes towards science (often referred to as constructs) is a conglomerate of several components. Osborne et al. (2003) summarized a range of studies (e.g., Gardner, 1975; Ormerod & Duckwort, 1975; Woolnough, 1994) related to the attitude issue and suggested a list of components used and incorporated a range of components in these studies including the following:

- the perception of the science teacher
- anxiety towards science
- the value of science
- self-esteem regarding science
- motivation for science
- attitudes of peers towards science
- enjoyment of science
- the nature of the classroom learning environment
- achievement in science and fear of failure in taking a science course
- preference of learning approaches (pedagogy)-subject preference courses and
- enrollment in science courses in school.

How are attitudes towards science measured?

Over the years many research instruments have been devel-