

EDITORIAL

Thinking about 'real-world science' for career orientation

Sarah M. Hayes

SSPC, University of Limerick, Ireland

Sarah.Hayes@ul.ie

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'Real-world science' for career orientation

With this editorial I am happy to introduce the first issue of the second volume of the ARISE Journal. The purpose of this editorial is to briefly discuss perspectives on scientific pursuits, students' choices to study science and how we can better support and explicitly link to students' perception of scientific careers, and potentially enhance uptake of science subjects.

There are many differing perspectives for how and why scientific pursuits are deemed valuable. Osborne, Simon and Collins (2003, p. 1051) noted that "the nation's standards of achievement and competitiveness are based on a highly educated, well trained and adaptable workforce." Osborne and his team also observed that "the low uptake of mathematics and science and the negative attitudes towards these subjects poses a serious threat to economic prosperity". This perspective views science and science education for its economic importance and benefits for society, others including policy makers share this view. This has long been on the agenda for the European Union (European Commission, 2004) and the US (National Academies 2005) with a perceived need for scientists to contribute to the achievement of economic growth, and research stressed as a key priority for tackling societal challenges (European Commission, 2014). In parallel to this approach, contemporary science education reforms (Mahaffy, Krief, Hopf, Mehta & Matlin, 2018; Duschl, Schweinguber & Shouse, 2007; National Research Council, 2000, 2012; Millar & Osborne 1998) have focussed on developing scientifically literate citizens and sustainable development (UN, 2015), yet these perspectives are frequently ignored (Hofstein, Eilks & Bybee, 2011). There is an aligning of perspectives in recent years, with school engagement with authentic research and scientific practices at the core of much research and many policy documents.

Uptake of Science

Linked to the idea of the need for more scientists and a more scientifically literate public, there has been widespread concern regarding the declining numbers of students studying science at both second and third level education. It is believed that this continued cry of falling enrolments in science has manifested itself at second level (Woolnough 1994, 1996; George 2000; Smyth & Hannan 2002; Lyons 2006). Again, the primary concerns of educators and government bodies

are related to the need to generate and develop scientific literacy among the population, and to attract both sufficient numbers and high achieving pupils into science-related fields, and to create equity in terms of participation in science courses and careers. Much research regarding pupils' subject choice has been primarily conducted under the individual choice framework (i.e. examining the pupil-based factors). This model emphasises the role of career value, interest and performance expectations in 'shaping student decisions about subject choice' (Bandura 2006; Tytler & Osborne 2012). Essentially, pupils are driven to take subjects that they believe to be useful for their future careers, which they find interesting and in which they believe they will perform well academically (Cleaves 2005; Lyons 2006; Smyth & Hannan 2006). Additionally, research has indicated that students' interest in scientific phenomena and science aspirations are not stable over time (Ardies, De Macyer & Gijbels, 2015) and we repeatedly see a downward trajectory from primary school until school completion (Bennett & Hogarth, 2009).

This model, does acknowledge the role of parental or teacher influences, but neglects to take into account external factors such as school subject provision, the manner in which the subject are offered to the pupils and the school's timing of these decisions. Other factors such as the pupils' socio-economic status and gender have also been acknowledged to play a part in the uptake of science subjects (Dekkers, Bosker & Driessen, 2000, Smyth & Hannan 2002, Lyons 2006, Smyth & Hannan 2006). Pupils from a higher socio-economic background are more likely to take science subjects, in particular, the physical sciences. Gender is also widely acknowledged as playing a significant role in the uptake of science subjects. But, even if students have generally positive attitudes towards science, they are still in contrast with the students' perspective of not envisioning their future selves in science areas (Archer, De Witt & Osborne, 2015; DeWitt, Osborne, Archer, Dillon, Willis, & Wong, 2013; Osborne Simon & Collins, 2003). What we are frequently seeing is that society, including school students, believe that science is important, has value and the potential to change how we live, but 'it's not for me'. What we now must strive to do is to make more explicit connections between scientists as real people, scientific careers and students.

As noted in Stapleton, McHugh, Childs & Hayes (2018) our "perception of scientists starts in early childhood, with children of primary school age envisaging a scientist in a stereotypical way" (Fung, 2002). A person's experience of their science teacher at school, along with the manner in which scientists are portrayed in books, films, on the internet and in the general media all influence our perception of scientists. For many people, their own sense of self may contrast strongly with their perceived image of scientists. Thus, the stereotypical image of a scientist may be discouraging. If people cannot relate any aspect of their sense of self with their perception of a scientist, their likelihood of pursuing science is severely diminished (Bennett & Hogarth, 2009).

To connect the idea of action research to innovate science teaching (ARTIST) with the aim of improving the career opportunities and aid students to envision their future self as an active participant in science, a unique feature of ARTIST has been the development of networks of universities with schools and industry/SMEs (Small and Medium Sized Enterprises). Each HEI within ARTIST has built a regional network around it, consisting of the HEI, secondary schools

and representatives of industry/SMEs. The rationale for this practice was to provide a concrete pathway, drawing from the large body of research on relevance of science education, authentic and real-world science, uptake of science and perceptions of science and self, for schools and students to engage in a meaningful fashion with industry and develop a greater sense of the diversity of individuals and activities involved in scientific careers and perhaps see more of themselves reflected back. As further work indicates, exposure to scientists and authentic practices can have powerful effects for students (Childs, Hayes & O'Dwyer, 2015; Coll, 2015; Kashefpakdel & Percy, 2016), leading them to finding their own sciences classes more relevant and applicable (Hofstein & Kesner, 2015), and can lead to broadening certain aspects of students' perceptions of scientists and scientific careers (Stapleton, McHugh, Childs & Hayes, 2018).

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