

RESPONSIBLE RESEARCH AND INNOVATION: AN OPPORTUNITY TO REFRAMING SCIENCE (AND TECHNOLOGICAL) EDUCATION?

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The term Responsible Research and Innovation (RRI) is gaining currency across Europe and worldwide aiming a better alignment between responsiveness and governance of scientific knowledge production, innovation and citizen participation facing current grand challenges we are living. This broad and complex purpose has been simplified with a normative framework involving six dimensions labeled as public engagement in research and innovation, science literacy and scientific education, gender equality, open access to scientific knowledge, research results and data, governance and ethics. This paper analyses the rationale and ways by which RRI is being introduced in science education field, including 13 projects developed in both formal and informal education. We apply a heuristic approach building on an extensive literature review focusing on Relevance and Responsible Science Education (RSE) and the recent framework proposed by Stilgoe et al. (2013), which comprises the principles of anticipation, reflexivity, inclusion and responsiveness. Our findings show a limited advance in both the understanding and benefits in the implementation of RRI and the existence of fragmented initiatives where the concept remains underdeveloped. The uncritical implementation of RRI and the emphasis in ‘responsibility’ linked to research contrasts with the scarce knowledge of what innovation and ‘responsible innovation’ mean and could contribute to increase imbalances rather than overcoming current barriers in science education. They also reveal the opportunity to open up the debate on a number of aspects ignored or barely considered to date and provide some suggestions for new research avenues in the science education field. In particular, we propose to broaden the inter-disciplinary studies towards comprehensive scopes on the Nature of Science, Technology and Innovation (NoSTI).

Keywords: Responsible Research and Innovation; responsible citizenship; relevance; Nature of Science, Technology and Innovation (NoSTI); literacies

BACKGROUND

The term Responsible Research and Innovation (RRI) –and Responsible Innovation (RI)- is gaining prominence in policy and academy circles, notably in Europe and USA. RRI relates to the demand of new capacities to cope with current grand challenges claiming to the co-responsibility of academy, business, government and civil society (Von Schomberg, 2013; Owen et al., 2012; EC, 2011; Guston, 2014). Introduced as a key action of the ‘Science with and for Society’ programme of Horizon 2020, RRI is considered an instrument to enrich dialogue and cooperation between science and society and, simultaneously, enable participatory policy-making (Owen et al., 2013). Science education and science literacy are crucial components of the RRI policy agenda in encouraging a responsible citizenry (EC, 2013, 2015). In this context, the contours of an early RRI epistemic community are taking shape within science education field through a fast development of various European and international projects and the recent dissemination of toolkits and guidelines to introduce RRI at formal, non-formal and informal levels (Okada, 2013; Bayram-Jacobs, 2015). Notions like ‘responsible development’ and ‘responsible knowledge-based innovation’ are present in earlier discussions about research integrity and the ethical, legal and social implications of research (ELSI) in relation to the Human Genome Project and the National Nanotechnology Initiative (2006) in USA (Blok & Lemmens, 2015). Which is the novelty that RRI represent for both science education practice and science education research? What are the implications of this renewed attention on responsibility to educational practice? Despite the growing visibility acquired by RRI in the last years, debates on ‘collective responsibility’ has been at the heart of the European Research Area (ERA) since 2000 and for more than four decades in the science education field (Hodson, 2003; Roth & Lee, 2004; Stuckey et al., 2013). On other hand, considerable efforts have been devoted in successive reforms and projects with the objectives of preparing students for a major understanding of our world’s future and their active participation in decision-making processes. This is present in citizen science (Ratcliffe & Grace, 2003), scientific literacy (DeBoer, 2000; Dillon, 2009), the socio-scientific issues (SSI) movement (Sadler &

Zeidler, 2009), the science, technology, society, and environment (STSE) perspective (Edwards-Schachter et al., 2004; Pedretti & Nazir, 2011), among others. Nevertheless, contributions to an effective responsible social activism seem to be sparse (Hodson, 2003; Bencze et al., 2012). RRI is defined by the European Commission as ‘a transparent, interactive process by which *societal actors and innovators become mutually responsive to each other* with a view on the (ethical) acceptability, sustainability and societal desirability of the innovation process and its marketable products’ (EC, 2011, p. 9). A process where ‘*all societal actors* (researchers, citizens, policy makers, business, third sector organizations, etc.) *work together during the whole research and innovation process* in order to better align both the process and its outcomes with the values, needs and expectations of European society’ (EC, 2013, p. 4). This extremely complex purpose has been simplified with a normative framework comprising the development of six dimensions labeled as public engagement, science literacy and scientific education, gender equality, open access (to scientific knowledge, research results and data) and governance and ethics.

There is an increasing criticism on the ambiguity of the RRI notion and these dimensions. For example, although research and innovation seem to be closely related areas, the focus on responsibility in both areas is quite different and these differences have direct implications on how best to equip citizens’ appropriate competencies. Blok & Lemmens (2015) argue that RI is questionable and calls for a radical transformation of the concept of innovation, which exceeds technological innovation and includes non-technological and non-market innovations (Edwards-Schachter et al., 2012). In our view, the RRI notion not only implies differences among ‘responsibility’ in research and innovation but claims for a deeper reflection on science education, on the Nature of Science, Technology and Innovation (NoSTI) as well as its scope and limitations as socio-political action on matters of social, economic, environmental and ethical concerns.

Research questions & Methodology

Taking into account the concepts of ‘responsibility’ and ‘relevance’ in science education (Stuckey et al., 2013) together the framework developed by Stilgoe et al. (2013), this paper aims to explore the meaning, implications and possibilities opened by RRI to reframing science education field. Our principal objective is to explore the state-of-the-art on this topic and critically analyze its relationships with both research and current practices in science education. We conducted a search in Scopus scientific database and reviewed 132 registers from European project database, with a final sample of 13 projects on the topic.

Findings

Our analysis shows a limited advance in both the understanding and implementation of RRI, being reflection and/or discussion on the notion missing. Focus in most projects related to responsible ‘research’ (scientific research) and it is by no means clear what innovation and ‘responsible innovation’ refers to. The ‘science education & science literacy component’ of RRI is used as a rationale to solve the persistent problem of the shortfall in science-knowledgeable people across Europe and the declining students’ interest towards science education (EC, 2015). RRI is introduced through methodological approaches and strategies following traditional scopes on Socio-Scientific Issues (SSI) and citizenship education together Inquiry-Based Science Education (IBSE), Socio-scientific inquiry based learning (SSIBL) and the STEAM approach (Science-Technology, Art, Mathematics). Less attention is paid in providing changes deepening how NoSTI is acknowledged and/or how the learners’ capabilities could/should be modified attending to aspects like, e.g., gender bias and socio-cultural exclusion. Overall RRI is an evolving concept that enables the opportunity to open up the debate on a number of aspects ignored or barely considered to date by science education as a research field, in particular regarding the inclusion and responsiveness principles. As Feinstein & Kirchgasser (2015) maintain, doing research according to the Next Generation Science Standards would not allow students to discuss on the social and political dimensions of scientific and technological developments. The same seem to be the case of STEM proposals (Garibay, 2015). Relevant aspects in which science education should have the role to encourage, such as the others ‘literacies’ (Roth, 2009), i.e. political, ethical, engineering, environmental, and economy literacy that the knowledge society, and in particular innovation (technological, social & cultural) demand are missing. Would these lead to a greater acceptance of scientific ‘products’ and simultaneously advance towards the aspired sustainability without a necessary critical vision?

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