New Perspectives in Science Education

Raising Awareness of Responsible Research and Innovation (RRI) in Biosciences

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Abstract

STARBIOS2 – Responsible Research and Innovation in Biosciences - is a project funded within the European Framework Programme HORIZON 2020. The project consortium comprises members of 12 partner institutes coming from Italy (coordinator: Universitá di Roma Tor Vergata), Germany, United Kingdom, Slovenia, Poland, Bulgaria, Brazil, United States of America and South Africa. All partner institutes are active in biosciences research. The goals of the project is the activation of structural change processes in research institutions in respect to their culture, rules and procedures focussing on Responsible Research and Innovation (RRI with its key issues: gender, science education, open access, ethics, and societal engagement and technology transfer. The University of Bremen is one of the STARBIOS 2 project partners. The process of implementation of RRI at institutional level at the Faculty of Biology and Chemistry is triggered by the Institute of Science Education by offering "academic building blocks" in a complex training programme for researchers and students of different career levels. The goal is the development and implementation of a RRI mission statement at institutional level.

Keywords: *European project, Responsible Research and Innovation (RRI), teacher education*

1. Responsible Research and Innovation (RRI)

Responsible Research and Innovation (RRI) has been developed by the European Commission and represents a contemporary view of the connection between science and society. To goal is to create a shared understanding of the appropriate roles of those who have a stake in the processes and products of science and technology, scientists as well as educators and the general public. A shared understanding and mutual trust will lead to safe and effective systems, processes and products of innovation [1].

RRI is defined as

> "a transparent, interactive process by which societal actors and innovators become mutually responsive to each other with a view to the (ethical) acceptability, sustainability and societal desirability of the innovative process and its marketable products (in order to allow a proper embedding of scientific and technological advances in our society)" [2:19].

According to the Horizon 2020 framework of the European commission RRI is built on the following key dimensions: Societal Engagement, Open Access, Ethics, Science Education, Gender Equality, and Governance [3]. This framework of RRI allows research institutions to raise the awareness of current and future scenarios regarding the science and technology advances.

1.2. Enhancing Responsible Biosciences

The European project Starbios2- Structural Transformation to Attain Responsible Research aims to contribute to the advancement of the RRI strategy by fostering structural change in biosciences research institutions. The hope is to cope with one of the main risks for European research: its inadequate connection with society [4] by changing the institutional culture, values and procedures in a holistic manner. In the focus there are the following five key issues:

- **Societal Engagement** and technology transfer focus on the promotion of the engagement of all societal actors in the R&I process;
- **Gender** aims at favouring gender equality within research institutions as well as in the R&I content;
- **Science Education** with the goal to provide future researchers with news capacities for attracting children and youth to science and technology;
- **Open Access** focuses on making research and innovation transparent and accessible through making Open Access a reality;
- **Ethics** aims in ensuring high quality research results and ethical standards.

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To reach these goals the project procedure comprises the following steps [4]:
Firstly, Action Plans (APs) to attain RRI structural change in six participating European countries are developed, implemented and evaluated. The experiences about the APs' implementation form the base for the development of new practical knowledge.
Secondly, a learning process is initiated that facilitates the local RRI implementation and that allows the members of the partner institutes to learn from each other.
Thirdly, based on the outcomes emerging from the learning process guidelines for RRI models are deviated to provide Biosciences Departments with formalised orientations and practical knowledge.

1.3. Project partners

In total 12 Partners cooperate in the four-years lasting Starbios2 project. The six European Partners developing and implementing APs are the Universitá di Roma Tor Vergata (project coordinator; Italy), Agrobioinstitute (Bulgaria), Oxford University Medical Sciences Division (UK), University of Bremen (Germany), Univerza na Primorskem – Universitá del Litorale (Slovenia), and Uniwersytet Gdanski (Poland). They get support by Aarhus Universitet (Denmark; monitoring and assessment), Laboratorio di Scienze della Cittadinanza (Italy; technical assistance for APs), and Sparks & Co (France; communication and dissemination). For consultancy, advice and development of APs three international partners join the project: Fundacao Oswaldo Cruz (Brazil), International Centre for Genetic Engeneering and Biotechnology (Italy and South Africa), and University System of Maryland (USA).
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2. Development of a RRI Mission Statement at the Faculty of Biology and Chemistry at the University of Bremen

Higher education institutes have a prominent role in research and innovation as they are vital actors in transforming society and dealing with today's grand societal challenges. In the view of the Starbios2 consortium it is important to identify multiple RRI strategies tailored to each research institute as each community is characterized by its own features, culture, languages, networks, communication means and power dynamics [4].
The University of Bremen is one of the Starbios2 project partners. It is a relatively young university with 12 faculties and about 20 000 students. Faculty 2 - Biology and Chemistry wants to implement a RRI mission statement aiming at activating a structural change process in biosciences. The overall objectives are the set up of a Core Team with important stakeholders (dean, vice dean, member of the quality management). As we follow a top down – bottom up implementation approach we work with permanent focus groups of students, doctoral students, postdoctoral researchers and senior researchers. A central goal is the negotiation of RRI issues at faculty level (stakeholders, researchers, students) regarding the RRI keys Societal Engagement and Technology Transfer, Science Education, Gender, Open Access and Open Access. In addition we want to identify supportive and hindering factors in the structural change process. The close cooperation with the Quality Management and Control Group of the faculty shall help to implement RRI in a broader institutional frame.

The already developed Action Plan comprises the following eight Streams of Actions (SoAs) [6].
A. Setting up criteria for successful societal engagement and technology transfer
B. Promoting societal engagement through socio-scientific contextualization
C. Education to raise the awareness of RRI Keys
D. Raising awareness of gender issues
E. Raising awareness of ethical issues
F. Promotion of Open Access
H. Setting up a RRI mission statement at faculty level
G. RRI AP management and periodic revision

To put these Streams of Actions (SoAs) into practice our pathway comprises the following important steps (see figure 1):

State-of-the-art analysis	Development of RRI building blocks	Intervention	Structural change
• Literature analysis • Interviews with focus groups • Questionnaire survey • → First draft of recommendations	• Workshops and • Guidelines about Education, Engagement, Gender, Open Access, Ethics • → A set of RRI specific activities	• Conduct and evaluation of RRI educational building blocks with different focus groups • → Flexible RRI training program	• Negotiation with stakeholders at faculty / university level • Highlighting Good Practice • → Common shared recommendations • → RRI Mission Statement of the Faculty 2

Figure 1. Important steps in the structural change process

Step 1. We start with a comprehensive **state-of-the-art analysis**. This comprises a complex analysis of literature and research programmes. The findings of the analysis build the basis for the development of theoretical framework to analyse research projects (SoA A) or to develop interview guidelines (SoA B, D, E, F). The interviews are conducted with different focus group(s) (doctoral students, postdoctoral students, students, researchers, and/or educators). The interview results form the basis for the development of categories of a questionnaire. The questionnaire survey is conducted online at the faculty with different target groups.
Outcome: From the findings of the interviews and the questionnaire survey we identify key-specific criteria for the successful promotion of the specific RRI issues. The criteria form the basis of a first draft of recommendations.

Step 2. The Development of RRI specific building blocks comprises the development of RRI workshops and activities in respect to the keys Societal Engagement, Technology Transfer, Gender, Ethics, and Open Access. These building blocks and activities will be tested and evaluated within the different focus groups.
Outcome: A set of RRI key-specific building blocks. They form the basis for the educational intervention at step 3.

Step 3. The goal of the **educational intervention** (SoA C Education) is the connection of the key-specific building blocks to a RRI training programme in accordance of the needs and the interest of the specific target group(s). The RRI programme will be evaluated, the results will contribute to a further development of the RRI recommendations and the RRI mission statement of the Faculty.
Outcome: Flexible RRI training programme for different target groups.

Step 4. The evaluation of the RRI buildings blocks are the basis for the actions for **structural change**. We will foster sensitiveness and awareness in respect to RRI through dialog with important stakeholder, offer academic lectures and round tables, highlight transparency and offer an user-friendly website, changes in the PhD-programme especially in the PhD defence, good practice examples, and recommendations at the faculty level and at the university level.
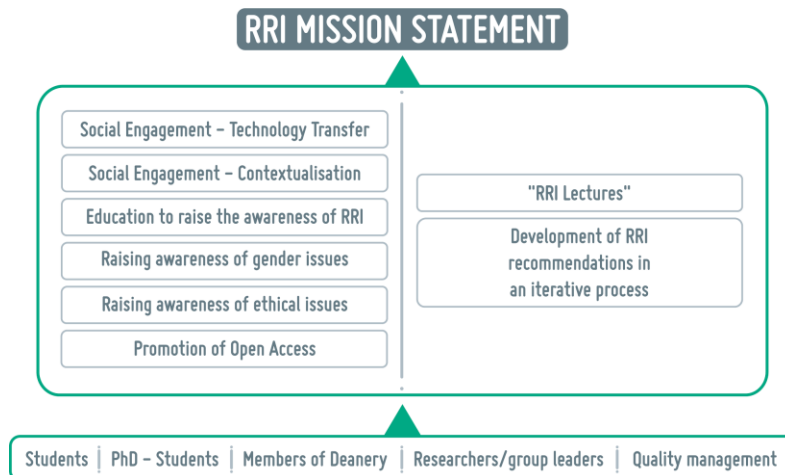**Outcome:** RRI Mission statement at Faculty 2

Figure 2. Development a RRI mission statement at the faculty level.

2. Purpose of the study

At this early stage of the project we present some of our outcomes of the state-of-the-art analysis in respect to societal engagement and technology transfer.

3. First findings – a frame for Societal Engagement and Technology Transfer

Based on a literature analysis, an analysis of past and current (7 projects) and interviews with researchers and teachers as informed citizens (N=6) we developed a theoretical frame to analyze past and current research projects in respect to technology transfer and public engagement. The analysis of the contextualization of teaching and learning activities offered at the outreach lab Backstage science ((8 master theses in science education about socio-scientific issues) in respect to their interest for the public (schools and teachers) and for researchers led to the development of a frame of complex academic transfer activities. They are summarized in table 1 and 2.

Table 1. Activities for Technology and Knowledge Transfer in addition to or in the context of research and academic teaching.

Technology and Knowledge Transfer			
Knowledge development	**Knowledge transfer**	**Knowledge marketing**	**Widening Transfer**
Promotion of networks: Curricular cooperation	Networking with academic target groups	Marketing of high school knowledge	Innovation networks with partners from politics, economy and society
Promotion of innovations	Networking with non-academic target groups		Promotion of foundations

Table 2. Activities for Societal Engagement in addition to or in the context of research and academic teaching.

Societal Engagement			
Education	**Citizen Engagement**	**Community Service**	**Widening Participation**
Academic training (all career levels)	Promotion of voluntary engagement – citizen science	Consolidation of cultural diversity	Promotion of underrepresented groups
Pre-service teacher education	Promotion of intercultural dialog – talks, workshops, lectures	Offering of public services	Educational offers for non-academics

In-service teacher education	Citizen science activities for schools and non-formal learning	Offering of infrastructure for exchange processes	
Outreach lab (socio-scientific issues)	Promotion of democratic values		

3. Conclusions

Activities in respect to Societal Engagement and Technology Transfer are strongly interconnected with the Third Mission activities, those academic achievements and overlapping fields besides the main tasks of the university since the 19th century: research and academic training [5]. Starbios2 may be seen as a motor for a structural change process to promote Responsible Research and Innovation (RRI) in respect to biosciences research. Further detailed findings will be reported at the NPSE conference.

Acknowledgement

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