Join Us to Optimize Health Through Cohort Research

Deliverable 5.2: Published recommendations for policy makers and educators to integrate RRI in universities and educational institutions

Version 1.0

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Contents

List of abbreviations

AIRR	Anticipation, Inclusion, Reflexivity and Responsiveness
CDC	Competences for Democratic Culture
COE	Council of Europe
EMC	Erasmus Medical Centre
ENGAGE	Equipping the Next Generation for Responsible Research and Innovation
EnRRICH	Enhancing Responsible Research and Innovation through Curricula in Higher Education
Fit4RRI	Fostering Improved Training Tools for Responsible Research and Innovation
HEIRRI	Higher Education Institutions and Responsible Research and Innovation
RRI	Responsible Research and Innovation
RRI-Practice	Responsible Research and Innovation in Practice
STARBIOS2	Structural Transformation to Attain Responsible BIOSciences

Summary

This report concerns deliverable D5.2 as agreed in the grant agreement of the JoinUs4Health consortium (grant number 101006518). In this report, we start by delineating the importance of RRI and how and why the European Commission adopted it. Then we zoom into the European Education policies and try to understand how RRI fits into these policies. We proceed by summarizing the recommendations that we found relevant for this topic and present those from three different angles, 1) organizational aspects and identity, 2) policy makers and 3) educators. Here, we summarize published recommendations and provide useful resources for policy makers and educators to help them integrate RRI in their organizations. By following these recommendations, universities and educational institutions can be a step closer to make science and education more inclusive and responsive to societal needs.

1 Introduction

Responsible Research and Innovation (RRI) was proposed as one of the many paradigms to make science more inclusive and responsive to societal needs. It emerged as a result of a long shift in European governance towards greater legitimacy of European institutions through democratisation and citizen involvement [3]. The proposal and implementation of RRI in science policy follows a growing global trend towards participatory research. Although RRI was proposed with a pragmatic goal to increase trust in science and thus its use in policy, participatory research in general originated from the needs and concerns of activists and researchers in poorer countries or poorer regions of richer countries [4]. Participatory research has been a staple in community settings both in health and education before it made its way into the more "traditional" knowledge making institutions such as universities and research funding organizations.

Unlike most other participatory research approaches, RRI has its origins as a research policy framework which was implemented initially through top-down mechanisms at the European level, where its principles were incorporated in funding instruments, which then triggered the development of RRI as a research approach [5]. The research policy framework is defined through a set of five key domains: science education, gender equality, open access, public engagement and ethics. These keys were conceived to guide action in policy and were defined as such to fit the already existing Swafs governance categories in the Horizon 2020 funding programme [3]. Since the keys were proposed as "key dimensions" of RRI, they were also adopted by projects that aimed to develop methods to operationalise RRI as a research framework. The keys provide concrete areas for action, often approaching concepts with which researchers and other stakeholders are already familiar, which makes it an attractive framework to be used in implementation and pedagogical efforts.

Contrastingly, literature on RRI as a research framework has developed more process-oriented dimensions, where RRI is not defined by a set of methods or themes that it incorporates, but rather by approaches to respond to societal concerns. In the JoinUs4Health project, we ascribe to Stilgoe, Owen, and Macnaghten (2013)'s conceptualization of RRI, which defines RRI as "taking care of the future through collective stewardship of science and innovation in the present" (p. 1570). The authors define four "process dimensions" of RRI: **Anticipation, Inclusion, Reflexivity and Responsiveness (AIRR).** *Anticipation* encourages researchers and organizations to think systematically about the consequences of their research. *Inclusion* refers to including voices of stakeholders and the wider public into a deliberative process where voices that are not normally included in the knowledge making process can be heard. *Reflexivity* refers to institutional reflexivity rather than only individual reflexivity, where value systems and theories that shape how research is conducted are critically examined. *Responsiveness* is about "adjusting courses of action while recognising the insufficiency of knowledge and control" (Stilgoe, Owen, and Macnaghten 2013, p. 1572) [6]. While we do advocate for teaching RRI as a process and adopting such process dimensions in curriculum planning and implementation, we recognise that the RRI keys can be useful to both mobilise internal resources and to plan and execute concrete action within organizations. Many universities and other educational institutions already have invested in advancing the areas delineated in the RRI keys, and thus RRI allows such efforts to be leveraged and integrated under one umbrella concept through a flexible and context-dependent process following the ARRI framework.

In the present report, we outline recommendations for policy-makers and educators and guide them to find the right resources to implement education efforts that incorporate RRI principles.

By following these recommendations, universities and educational institutions can be a step closer to make science and education more inclusive and responsive to societal needs.

2 The Current EU education purpose and aims

The European Commision (EC), as the official executive arm for making European law and legislation, and the Council of Europe (COE), as a distinct entity from the EC and a global leading human rights organization, have recently reinforced collaboration specially in areas that concern human rights, democraties, culture and education.

On the one hand, the EC works with EU countries on mutual issues in education. In 2009 the EU Member States adopted the strategic framework for European cooperation in education and training (better known as the ECs Education Strategy ET2020) [7], in which it discussed that the European higher education is not optimally using its full potential to serve the European society and prosperity. For this the EC developed a set of broad aims for the EU Member States to promote exchange of best practices and learn from each other. Those aims include [7, 8]:

1) make lifelong learning and mobility a reality,
2) improve the quality and efficiency of education and training,
3) promote equity, social cohesion and active citizenship, and
4) enhance creativity, innovation and entrepreneurship.

On the other hand, the CoE promotes education based on Article 2 of the European Convention of Human Rights; “Right to Education” [9]. Even though the CoE is not a regulatory body, it does have the power to push for several agreements made by the Member States. In 2020 the CoE defined a specific set of purposes for EUs higher education and its students. These include: [10]:

1) preparation of students for the labour market,
2) preparation of students for life as active citizens in a democratic society,
3) personal development of students, and
4) development and maintenance of a broad, advanced knowledge base.

How does RRI fit in these aims and purposes

RRI can be seen as catalyst of the implementation process of those strategies and aims. Specifically, RRI can contribute to those aforementioned purposes by

- including fostering students’ problem solving capabilities,
- increasing the sense of stewardship in the society,
- encouraging reflexivity, and
- bridging science and society (http://www.livingknowledge.org/fileadmin/Dateien-Living). [11-13]} (**Figure 1**).

Higher Education Purpose	How RRI links
Preparing students for the labour market	*RRI can contribute to this process by fostering students problem solving, research and innovation capacities, related to addressing societal challenges in a responsible way*
Preparing students for life as active citizens in a democratic society	*RRI can contribute to this process by preparing students to be inclusive, to develop social values, a sense of care and stewardship, and to be active citizens*
Encouraging personal development for students	*RRI can contribute to this process by encouraging reflexivity about personal attitudes, assumptions and commitments and by fostering experimentation with new ways of doing and being.*
Maintenance of a broad, advanced knowledge base	*RRI can contribute to this process by bridging science and society and by equipping students to develop the capacities for advancing knowledge and innovation in society*

Figure 1. Purposes of European Higher Education from RRI perspective (table reference Tassone and Eppink 2016 [12,13]

3 Published recommendations

In our previous deliverable (D5.1), we identified ongoing initiatives that implemented RRI principles in educational programs to stimulate engagement of publics in science. In this report (D5.2), we build on the identified projects of D5.1 by bringing together recommendations of these projects for policy makers and educators to integrate RRI in universities and educational institutions.

3.1 Gold standard

Although our report aims to provide structured recommendations to learn about potential pathways to introducing RRI in education, it does not offer ready-made solutions, because gold standards for this purpose simply do not exist. However, we do see this as the best opportunity for us to agree upon one important point:

Introducing RRI in education depends heavily on the context in which it is applied. Therefore the advice is that RRI should be seen as a process for enacting institutional changes {Fit4RRI, 2022 #68}, re-negotiating the relationships between science, where decisions are taken and articulated using the four process dimensions of RRI as proposed by Stilgoe: anticipation, reflexivity, inclusiveness and responsiveness [6, 14].

> *"Each organization defines its own approach to the practice of RRI based on an interpretation of its own characteristics and of the context in which it operates"*. STARBIOS [14]

Introducing RRI in educational curricula seems a straightforward goal, but it comes with lots of challenges. Educators and policy makers might deal with questions like:

1. Can we redesign available course materials so that they become RRI proof?
2. Do we have to introduce a whole new module to adopt RRI?
3. Is our institution open to adopt these changes?
4. Are the policy makers in my institution ready to adopt the RRI lifestyle?
5. Are the educators sufficiently trained to teach RRI?
6. Where can we find good practice examples?

It might be worth to consider whether the planned changes are sustainable and whether they go hand in hand with a bigger wave of changes in the institution that delivers these educational curricula. For this we will present our recommendations from three different angles.

1- **RRI and general organizational aspects** (**chapter 3.2**), based on recommendations from Fit4RRI (Fostering Improved Training for Responsible Research and Innovation; https://fit4rri.eu/) and STARBIOS2 (Structural Transformation to Attain Responsible BIOSciences; https://starbios2.eu/)
2- **RRI and practical recommendations for policy makers in educational institutions** (**chapter 3.3**), based on recommendations from RRI in practice (Responsible Research and Innovation in Practice; https://www.rri-ractice.eu/), Fit4RRI and STARBIOS2.
3- **RRI and practical recommendations for educators** (**chapter 3.4**), based on recommendations from ENGAGE (Equipping the Next Generation for Responsible Research and Innovation; https://www.engagingscience.eu/en/overview/) and EnRRICH (Enhancing Responsible Research and Innovation through Curricula in Higher Education; https://cordis.europa.eu/project/id/665759), and resources from HEIRRI (Higher Education Institutions and Responsible Research and Innovation; https://cordis.europa.eu/pro) and Foster Open Science (https://www.fosteropenscience.eu/resources) (**chapter 4**).

3.2 RRI and organizational aspects to identify

Institutional change in general requires knowledge of the organization in which these changes are desired. Hammer and Champy (1993) [15] developed a model that concerns organizational components to be considered when change is desired. These include 1) business processes, 2) jobs, 3) management systems, and 4) organizational culture. Gould et. al. (1999) [16] on the other hand proposed to focus on components like business input, process and outputs. In order to understand how RRI aspects can be incorporated into the organization that is willing to change, FIT4RRI [17] (https://fit4rri.eu/guidelines/resources-pt-3/) and STARBIOS2 project ("Guidelines from the STARBIOS2 project" [14] page 36), developed a model in which RRI should be translated into activities or initiatives that take into account four important aspects of the organization:

1- **The culture**: including organization's vision and strategic view
2- **The orientation to change**: Decisions in the organization could be connected to the challenges of the sector in which this organization operates
3- **The actions**: The way missions are translated to actual implemented activities
4- **The identity of the internal structures**: including how the staff is organized and interacts with each other, how to establish relationships with external players

3.3 RRI and recommendations for the policy makers in universities and educational institutions

In this chapter we present recommendations of three different projects as published by **RRI-Practice**; "Handbook for Organizations – section: Implementing RRI in organizations: general

lessons" [18], the **FIT4RRI** guidelines https://fit4rri.eu/guidelines/ [19] and the **STARBIOS** project "Guidelines from the STARBIOS2 project" - section 3 page 39. [10, 14, 19]:

The RRI-practice recommendations (**chapter 3.3.1**) and FIT4RRI guidelines (**chapter 3.3.2**) can be seen as excellent resources for policy makers to understand the rationale behind the importance of introducing RRI in their organizations, and to consider the most important aspects and barriers to such implementation. In addition, these can be seen as important assets to be used to plan the desired intervention using the *"model of the self-reflection process"* as proposed by STARBIOS in **chapter 3.3.3.**

3.3.1 General recommendations by RRI-practice

Below we will highlight a selection of recommendations by RRI-Practice. Please find the full list, including a more extensive elaboration on each of the recommendations in RRI-Practice's Deliverable 17.6. "Handbook for organizations aimed at strengthening RRI" [18].

1- **The scale of implementation**: Policy makers should decide on the scale of implementation. Good practices usually address one RRI key at the time; ethics, gender equality, governance, open access, public engagement or science education (**Figure 2**) [10]. Readers can find detailed examples of good practices in deliverable 15.1 of the RRI-Practice project entitled: Implementing RRI: Comparison across case studies [20].

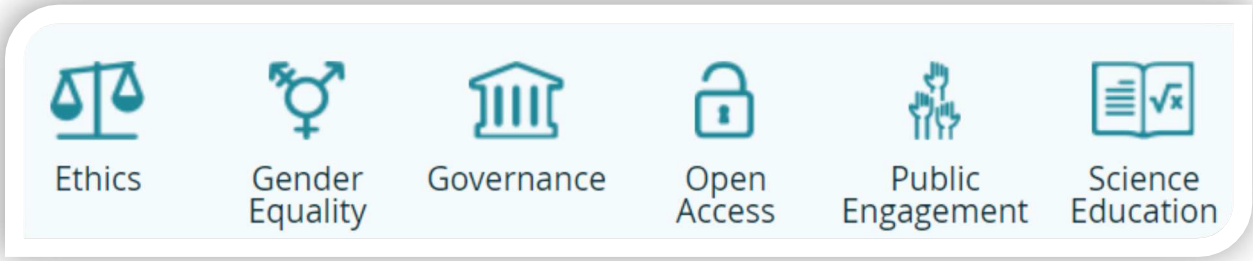


Figure 2. RRI Elements. (figure reference: RRI-tools https://rri-tools.eu/homepage)

2- **Incentives for RRI:** The adoption of RRI by policy makers in any organization does not necessarily mean that this will be adopted by co-workers in other layers of the organization. In order to avoid ceremonial adoption of RRI, policy makers should provide clear incentives for co-workers at all layers of the organization. Those can be in the form of promoting change in the direction of more ethical reflection. For example, when adopting RRI keys or process dimensions, it is important to provide a clear incentive for individual organizational members as well as organizations whilst incentives may be in the form of funding or originate in national policies and the organization's own priorities [10].

Barrier: Policy makers should not only consider new incentives, but also re-evaluate whether the existing incentives function as a barrier to adopt RRI in the organization [10].

3- **Guidelines for RRI aspects**: According to RRI-practice recommendations, guidelines are usually a strong drive for the implementation of RRI. Policy makers should consider making guidelines for aspects of RRI, because in this way policies and priorities will be made clear and actionable for co-workers. RRI-practice recommends considering

uniform messaging and standardization of guidelines across all layers of the organization.

> **Barrier:** *"Our findings indicate that national funding organizations likely would do well to mutually adjust their guidelines, in an effort to avoid the alienation of researchers to the cause. It is a frequently cited issue that researchers have to comply with slightly different standards for the same aspect of RRI, such as research ethics. Such non-standardization appears to drive 'tick the box ethics' and hamper ethical reflection".* RRI-Practice; "https://www.rri-practice.eu/wp-content/uploads/2019/06/RRI-Practice-Handbook-for-Organisations.pdf" [10].

4- **Routines supporting RRI:** RRI-Practice recommends including RRI elements in organizations routines. That is important for the institutionalisation of RRI in the organization. Examples of organizational routines can be checklists, the way recruitment is done (gender and inclusivity) or the way research is planned, conducted and disseminated (ethics and societal engagement).

5- **Use ongoing internal and external changes to introduce and promote RRI:** Current ongoing discussions and debates can be seen as the ultimate opportunity to put RRI elements on the agenda and to create change. Think of societal debates concerning gender inequality or emerging innovative ways of dealing with for example food quality.

6- **Be an RRI champion:** RRI champions are people who are very excited to talk about RRI and implement RRI. Usually, individuals in top-level positions in the organization can be very suitable to be an RRI champion, especially when they have the skills to network and drive initiatives in their organizations.

7- **Create pilot programs and infrastructure:** Pilot programs are important due to 1) their role to transform into organizational routines and 2) to enable organizational learning and promote a certain key element of RRI.

> **Barrier:** "An often-cited barrier to RRI is the lack of resources allocated to the tasks. If no resources are allocated beyond the pilot programme, very little is likely to stick to the organisation. Therefore, a general recommendation is to build infrastructure in pilot programmes that have a longer lifespan than the programme itself." "Handbook for Organizations – page 8: Implementing RRI in organizations: general lessons" [10].

Readers are also advised to read Deliverable 16.2 by RRI-Practice: **RRI-Practice Policy Recommendations and Roadmaps** [21].

3.3.2 Guidelines for RRI governance

The **FIT4RRI** project (https://fit4rri.eu) provided a very comprehensive stepwise set of guidelines and recommendations for policy makers and other actors to start the process of promoting and introducing RRI and open science in their organizations [19]. These guidelines are presented in three different steps: **Guidelines for Interpretation**, **Guidelines for Decision** and **Guidelines for Action** (**Figure 5**).

Figure 3. An impression of the FIT4RRI website, section guidelines, on how to start the process of change (figure reference https://fit4rri.eu/guidelines/).

1- **Guidelines for Interpretation**: *"This first part of the Guidelines is aimed at providing orientations useful for interpreting the changes affecting one's research organization. In an "ideal" pathway toward RRI and open science, analysing these changes should be understood as a necessary step for making appropriate decisions about why, how, and to what extent to activate a governance setting process for making the organization more open and responsible.* ***Chapter One*** *focuses on the deep transformations which are affecting science in general and how they impact on the research organizations.* ***Chapter Two*** *tries to explain the concepts of RRI and Open Science and gives suggestions on how to make a diagnosis of RRI/OS-related actions already carried out in the organization."* (https://fit4rri.eu/guidelines/interpretation-guidelines/). The list of **recommendations** proposed by the FIT4RRI project concerning each of these specific chapters are presented in **Figure 4** in red.

2- **Guidelines for Decision making**: *"The second part of the Guidelines focuses on the decisions to be made for activating the governance setting process. In particular,* ***Chapter Three*** *deals with the decisions concerning* ***if***, ***why***, *and* ***to what extent*** *implementing RRI and Open Science in one's organization. The output of this process should be an RRI/OS profile tailored on needs, features, and expectations of the organization itself.* ***Chapter Four*** *aims to help choose a governance setting model. To this aim, a typology of governance settings is presented with some examples drawn out of real cases. Although the two sets of decisions are analytically separated from each other, they are part of a unique and more complex decision-making process, necessarily entailing different kinds of activities including consultations, exchange, and*

data collection." https://fit4rri.eu/guidelines/decision-guidelines/. The list of **recommendations** proposed by the FIT4RRI project concerning each for these specific chapters are presented in **Figure 4** in blue.

3- **Guidelines for Action:** *"The third part of the Guidelines deals with the actions to be carried out in the context of the governance setting process.* ***Chapter Five*** *concerns the activation of the process,* ***Chapter Six*** *its implementation and* ***Chapter Seven*** *its completion and the shift towards longer-term coordinated activities. This part is not intended to suggest detailed procedures to follow since each case is different from the others. Rather, it is aimed at providing information about aspects and problems recurrently concerned with institutional changes and to suggest conceptual schemes which can be helpful for better managing the process."* (https://fit4rri.eu/guidelines/action-guidelines/). The list of **recommendations** proposed by the FIT4RRI project concerning each for these specific chapters are presented in **Figure 4** in purple.

Figure 3 also shows that each guideline does not only propose recommendations, but also provides **resources**. These resources include a list of models and concepts [17, 22] that can help in activating institutional change processes including **Triple/Quadruple Helix Approach**, **Post-normal science model**, the **innovation systems** concept and the **big science** concepts. Fit4RRI provides on its website https://fit4rri.eu/guidelines/resources-pt-1/ a list of challenges and barriers related to RRI and how these may a) result in a lack of awareness about RRI and b) lead to RRI to be perceived as little relevant, effective or sustainable. We compiled these challenges and barriers in **Table 1**.

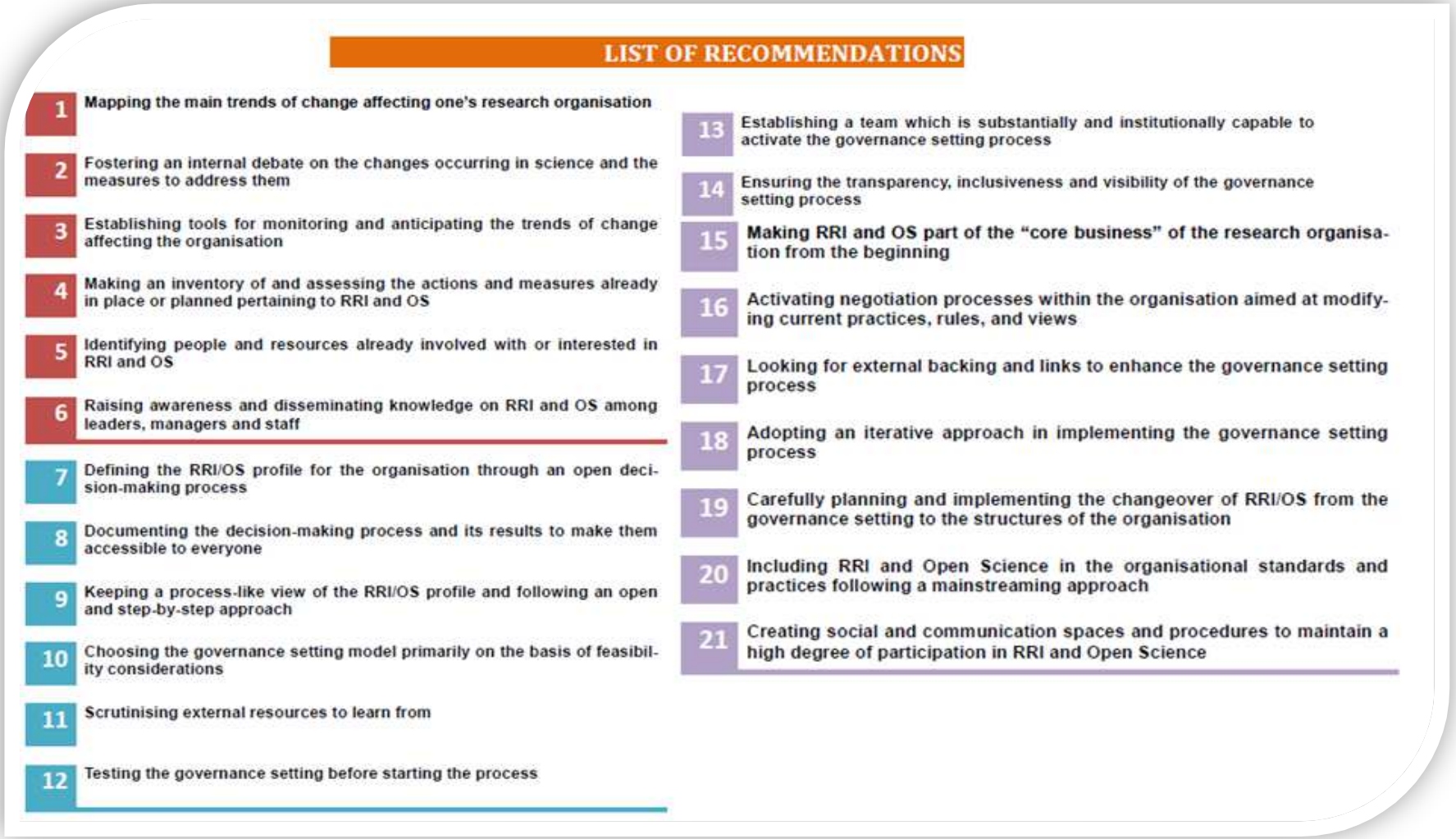


Figure 4. List of recommendations from the Guidelines for Interpretation (red), Decision (blue) and Action (purple)

Table 1. Barriers to RRI as proposed by the FIT4RRI project (text source https://fit4rri.eu/guidelines/resources-pt-1/ section barriers to RRI)

Barriers resulting in lack of awareness about RRI	Barriers leading RRI to be (perceived) as little relevant	Barriers leading RRI to be (perceived) as little effective	Barriers leading RRI to be (perceived) as little sustainable
Resistance to change	Excellence vs. RRI	Uncertainty about the concept	Bureaucratization
Risk aversion	Pressure to publish	Uncertainty about the promoters	Lack of investments
Protection of academic freedom	Creating growth and making profit	Uncertainty about the process	Resistance and institutional barriers
Short-term time frame	Distrust in scientific institutions and in RRI	Uncertainty about the impacts	Inadequate legal and regulatory framework
Researcher specialization	Lack or material incentives	Lack of resources	Inadequate policy framework
Value systems	RRI as disincentive for scientific recognition	Lack of communication channels	Difficulties in defining the objectives
Lack of training	Lack of incentives for non-R&I actors	Management of public participation	Difficulties in defining responsibilities and implementation procedures
Stereotypes	Unclear benefits of RRI	Turning public participation into policies	Lack of evidence and data about RRI
Lack of a collaborative culture			
Diverging visions of societal benefits			
Conflicts between local, national and international cultures			

3.3.3 Design the intervention: the scheme of the self-reflection process

STARBIOS2 provided in their "Guidelines from the STARBIOS2 project" - section 3 page 39 [14] a scheme for a self-reflection process for organizations, which aims to design an intervention for RRI-oriented structural changes within bioscience research organizations (**Figure 3**). We think that this approach might be also applicable to other types of organizations. The scheme consists of five steps to reflect upon, that start from positioning the organization within the network of relevant relations (Step 1) to developing an action plan to the observed problem(s) that the organization wants to work on (Step 5) (**Figure 5**). The STARBIOS2 guideline describes each step in great detail.

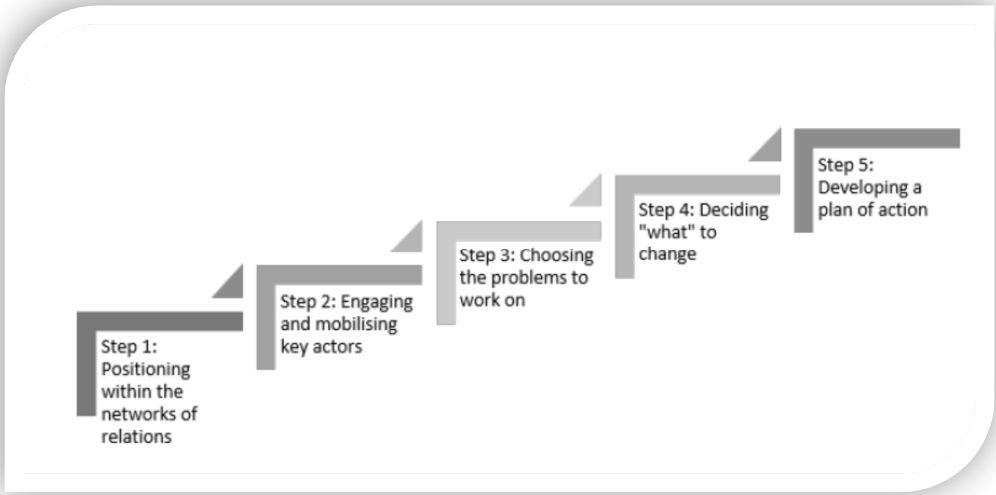


Figure 5. Scheme of the self-reflection process developed by the STARBIOS2 consortium. (Figure reference [14])

3.3.3.1 How to develop a plan of action?

STARBIOS2s' recommendations on how to develop a plan of action were described in "Guidelines from the STARBIOS2 project" - section 3 page 48-49 [14]. STARBIOAS2 developed a scheme of the structural change process through the action plans. **Figure 6** shows how STARBIOS2 describes the steps to active RRI-oriented changes. Policy makers are strongly advised to adopt this scheme as an organised effort for institutional change. The STARBIOS2 report describes each step in great detail and provides also handy tools in the appendix including:

1) stream of actions sheet template (page 195) and

2) action plan summary chart (page 201).

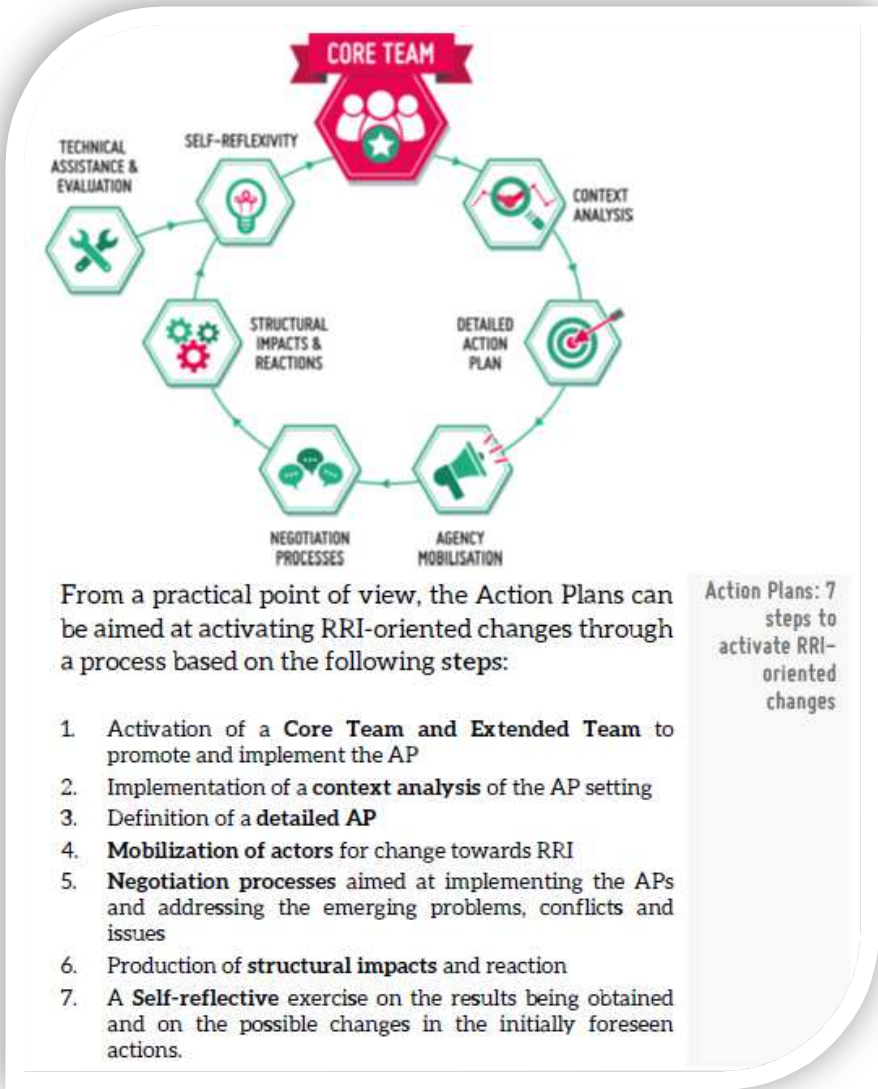


Figure 6. Scheme of the structural change process through the APs (Figure and text reference [14] pages 48-49)

3.4 RRI and recommendations for the educators

3.4.1 Competences for Democratic Culture

In this section, we highlight the output of two important Horizon 2020 projects; ENGAGE (Equipping the next generation for Responsible Research and Innovation) [23] and EnRRICH (Enhancing Responsible Research and Innovation through Curricula in Higher Education) [24]. Interestingly, both projects focus on equipping teachers and students with the right skills to increase value thinking and social value. By doing so they also meet the purposes of the CoE [10] as discussed earlier in chapter 2 including:

1) preparing students for the labour market,
2) preparing students for life as active citizens in a democratic society,
3) personal development of students, and
4) development and maintenance of a broad, advanced knowledge base.

The CoE developed recently the **Reference Framework of Competences for Democratic Culture** where it offered a systematic approach to design the teaching, learn and assess competences and guide implementation of Competences of Democratic Culture (CDC). For this, a competences model for democratic culture was designed including 20 competences in four descriptor domains (**values**, **attitudes**, **skills** and **knowledge and critical thinking**) that individuals require in order to function as "democratically and interculturally competent citizens" [25] (**Figure 7**). The website of the CoE offers an extensive list of (validated) learning outcomes for each descriptor classified as basic, intermediate or advanced (**Figure 8**). The output of this framework is incredibly valuable and important for teachers to use in their daily practice.

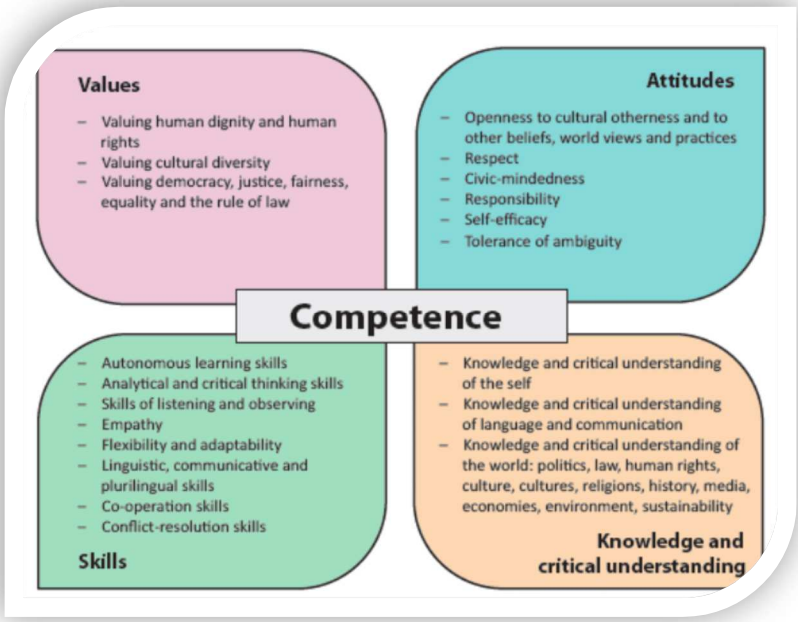
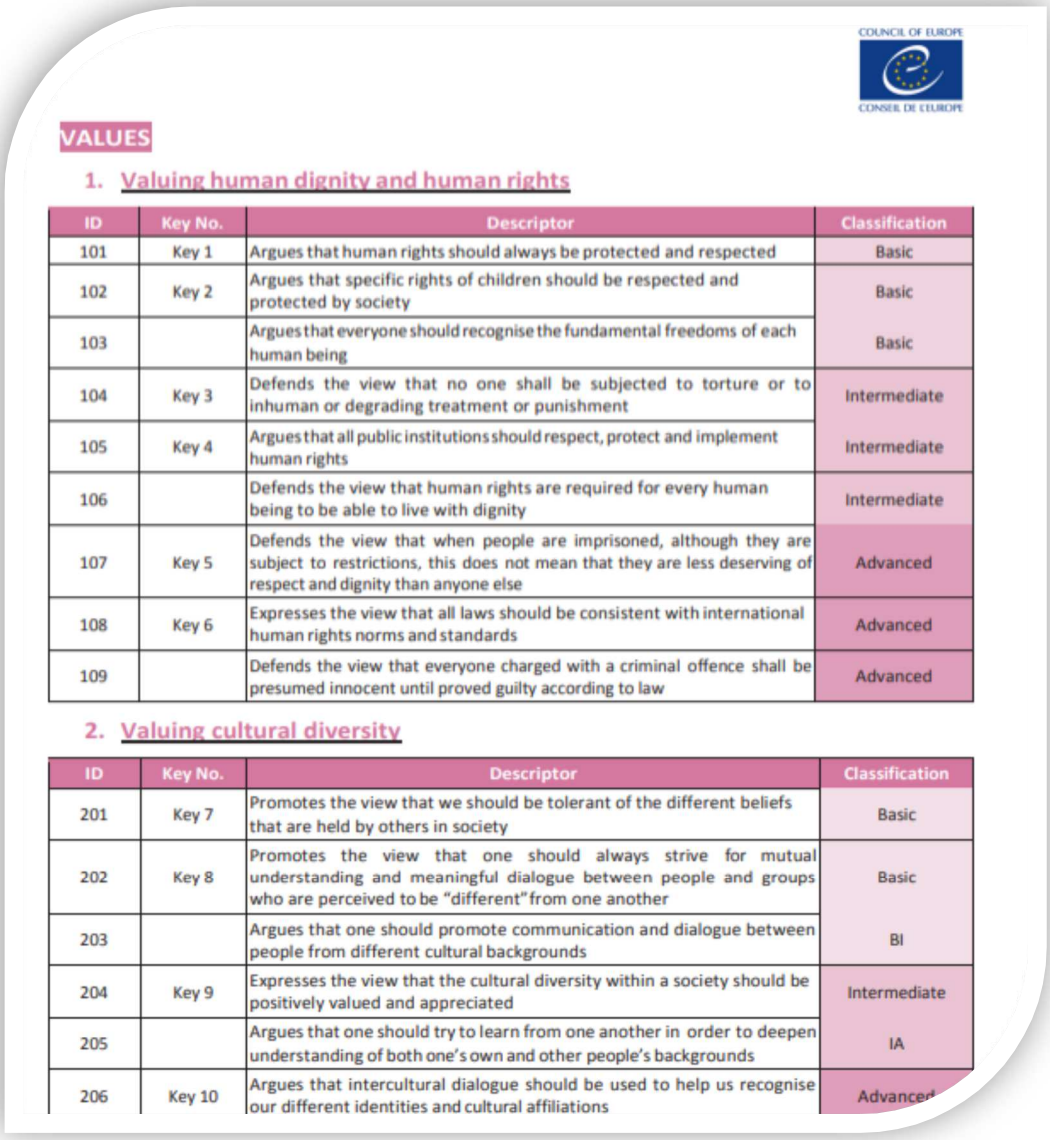


Figure 7. Model of competences for Democratic Culture (Council of Europe, 2018c, p.127 https://rm.coe.int/a-model-of-the-competences-required-for-democratic-culture-and-intercu/16809940c3 [25]

"Competences for Democratic Cultures (CDCs) are relevant to – and can and should be implemented throughout – all strands and levels of education and training. Training is understood to focus on the provision of practical skills, while education is seen as a more comprehensive process aimed at equipping students with the skills and competences required to develop a considered view of the role of their own speciality in a broader societal and philosophical context" [26]



VALUES

1. Valuing human dignity and human rights

ID	Key No.	Descriptor	Classification
101	Key 1	Argues that human rights should always be protected and respected	Basic
102	Key 2	Argues that specific rights of children should be respected and protected by society	Basic
103		Argues that everyone should recognise the fundamental freedoms of each human being	Basic
104	Key 3	Defends the view that no one shall be subjected to torture or to inhuman or degrading treatment or punishment	Intermediate
105	Key 4	Argues that all public institutions should respect, protect and implement human rights	Intermediate
106		Defends the view that human rights are required for every human being to be able to live with dignity	Intermediate
107	Key 5	Defends the view that when people are imprisoned, although they are subject to restrictions, this does not mean that they are less deserving of respect and dignity than anyone else	Advanced
108	Key 6	Expresses the view that all laws should be consistent with international human rights norms and standards	Advanced
109		Defends the view that everyone charged with a criminal offence shall be presumed innocent until proved guilty according to law	Advanced

2. Valuing cultural diversity

ID	Key No.	Descriptor	Classification
201	Key 7	Promotes the view that we should be tolerant of the different beliefs that are held by others in society	Basic
202	Key 8	Promotes the view that one should always strive for mutual understanding and meaningful dialogue between people and groups who are perceived to be "different" from one another	Basic
203		Argues that one should promote communication and dialogue between people from different cultural backgrounds	BI
204	Key 9	Expresses the view that the cultural diversity within a society should be positively valued and appreciated	Intermediate
205		Argues that one should try to learn from one another in order to deepen understanding of both one's own and other people's backgrounds	IA
206	Key 10	Argues that intercultural dialogue should be used to help us recognise our different identities and cultural affiliations	Advanced

Figure 8. An example of a list of validated learning outcomes for the descriptor VLUES according to the competency model as proposed by the Council of Europe (table reference https://rm.coe.int/values-the-full-bank-of-validated-descriptors-descriptors-of-competenc/1680994dbe)

3.4.2 ENGAGE and inquiry-based learning

The ENGAGE project [23] aimed to promote RRI in education and change the way science is taught. The project won the Open Education Award for excellence in 2017 on Topical Science Education for RRI.

ENGAGE provided teachers with the material to support their students on socio-scientific issues, by applying inquiry-based teaching methods. Based on an RRI-based curriculum, students are then equipped with the right skills and competences *"to be able to form evidence-based opinions on societal needs and social values"* (https://www.engagingscience.eu/en/overview/).

Educators are strongly advised to consult the publications and deliverables by the ENGAGE project to learn more about teaching materials and read about interesting case studies. The ENGAGE materials and pedagogical tools were designed to help teachers to support students in understanding four emerging areas and develop ten inquiry skills for RRI as presented in **Figure 9** of this report. The educational material can be found on the website www.engagingscience.eu and be filtered by one of the ten inquiry skills.

Figure 9. Inquiry skills for RRI as proposed by the ENGAGE project including four key areas and eight inquiry skills. Source: https://www.engagingscience.eu/en/overview/ [27]

"Traditionally students gain an image of science as a body of content, whereas RRI deals with uncertain areas of knowledge, where values and arguments matter as much as facts. ENGAGE focuses on a more inquiry-based methodology, which gives students opportunity for self-expression and responsibility for coming to informed decisions." https://rri-tools.eu/-/engage

The ENGAGE "**Innovative Teaching for Responsible Citizenship Policy Report**" emphasized that inquiry-based learning, where discussion, argumentative discourse and scientific reasoning are used, is the predominant method to integrate RRI into the classrooms [1]. Based on a survey in eleven European countries, ENGAGE identified a list of challenges and recommendations for curriculum design, and those concerning inquiry-based learning and RRI, which are presented in **Figure 10** and **Figure 11,** respectively.

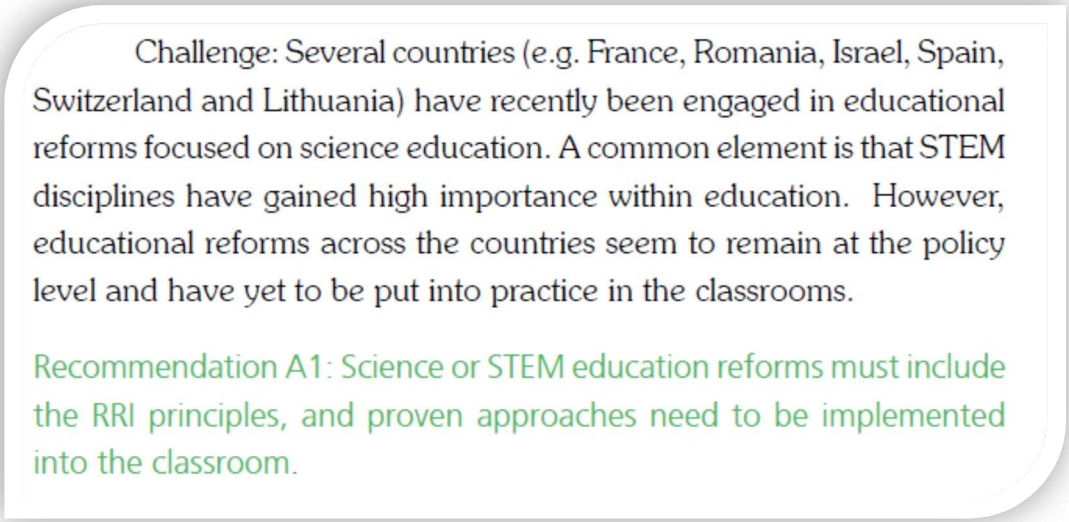


Figure 10. Challenges and recommendations identified by ENGAGE based on the RRI curricula analysis (section references Okada, Alexandra (2016). Innovative Teaching for Responsible Citizenship: Policy Report. The Open University pages 6-7) [1]

Challenge: In various countries (e.g. UK, Germany, and Greece) the curricula prioritises acquisition of content above the development of competences. This, in turn, means that the assessment focuses on content knowledge rather than competence.

Recommendation A2: There should be better alignment between curriculum objectives and assessment systems, ensuring that assessment includes the development of competences.

Challenge: In countries where science is taught in a multidisciplinary or interdisciplinary way (e.g. Greece, France, Israel, Spain, Norway, Switzerland, Lithuania, and Cyprus) rather than by subject (physics, biology, chemistry) there are more opportunities for linking science with other subjects, and incorporating RRI.

Recommendation A3: Opportunities to integrate science education with other subjects and disciplines can aid an RRI approach.

Challenge: The education policy agenda does not focus on pre-service or in-service teacher training. It is vital to bridge the gap between what is envisioned in theory, the curriculum and what is implemented in practice.

Recommendation A4: Coherence is required between policy objectives, the curriculum and teacher education in order to embed RRI.

Challenge: In all countries there are important teachers and policy makers that are implementing and promoting RRI initiatives. However there is little collaboration or connection between informal settings and formal schooling, or between general and vocational education. There is also a lack of opportunities to promote knowledge exchange.

Recommendation A5: Professional networks developed during EU funded projects should be promoted by national policy makers, in order to foster collaboration between teachers and with researchers on new methods, materials and topics.

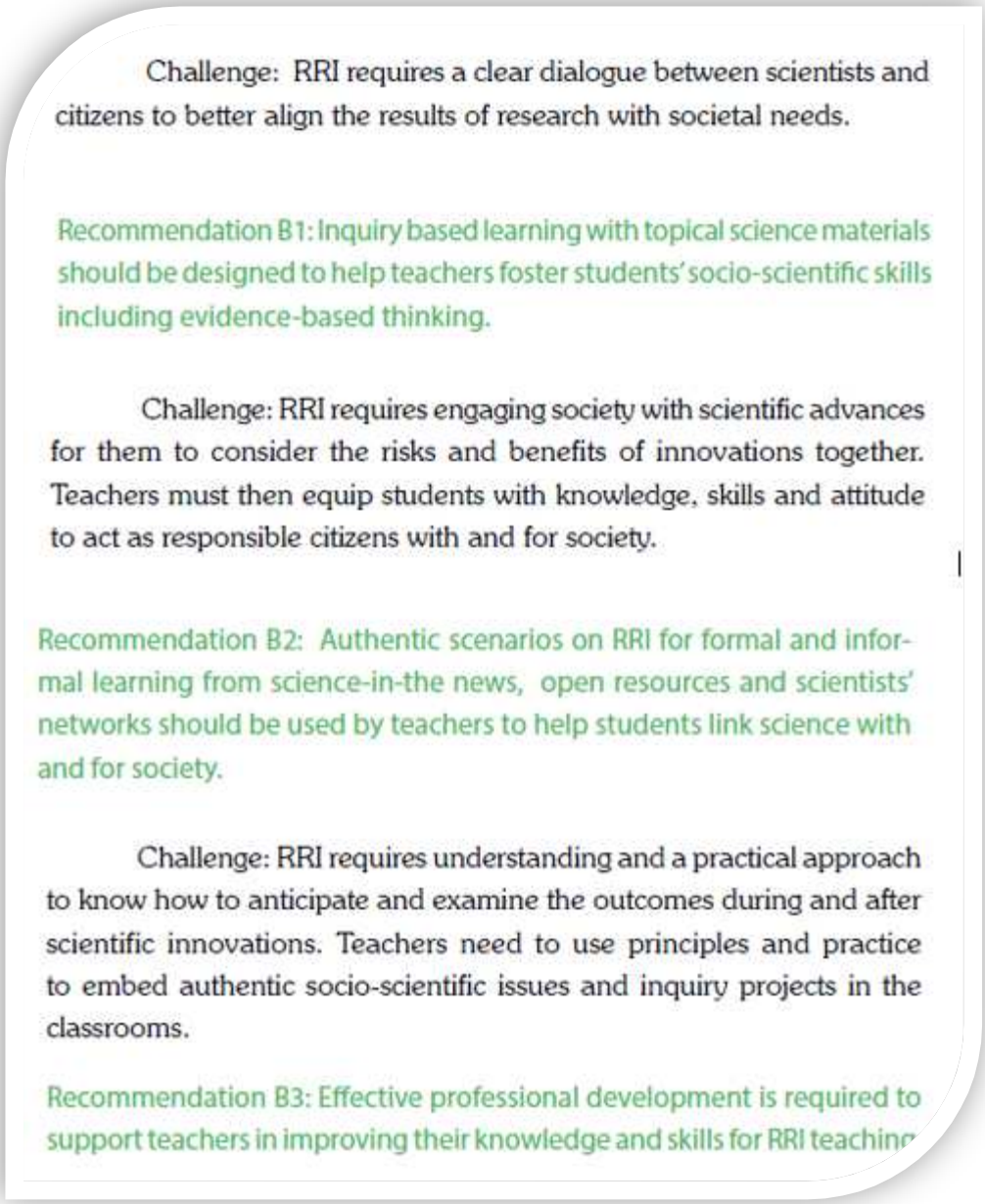


Figure 11. Challenges and recommendations identified by ENGAGE based on expert views on RRI and Inquiry-based learning (section references Okada, Alexandra (2016). Innovative Teaching for Responsible Citizenship: Policy Report. The Open University pages 8-11) [1]

3.4.3 The EnRRICH tool: A guide to design curricula from a RRI perspective!

The EnRRICH (Enhancing Responsible Research and Innovation through Curricula in Higher Education) project aimed to support educators and students in higher education, in terms of knowledge, skills and attitudes, to make them able to adapt to societal challenges and response to its needs through RRI. To meet these aims, the **EnRRICH tool** was developed as a guide for educators, to develop or revitalize curricula from a RRI perspective. The tool has three main pillars, a **working definition of RRI** and four **design principles** including **RRI competencies proficiency (Figures 12** and **13) [28]**

The EnRRICH principles were developed to ease uptake of RRI in higher education and consist of:

1) Education for society, where the aim is to engage students with societal challenges,
2) Education with society, where the aim is to connect student with the right societal actors,
3) Education to whole person, where the aim is to foster students learning in terms of knowing, being and doing, and
4) RRI competency proficiency, where the aim is to foster students' competencies for participating in RRI processes.

Educators are strongly advised to read the deliverables of the EnRRICH project to learn more about teaching strategies, key steps to articulate learning outcomes, and interesting case studies [2].

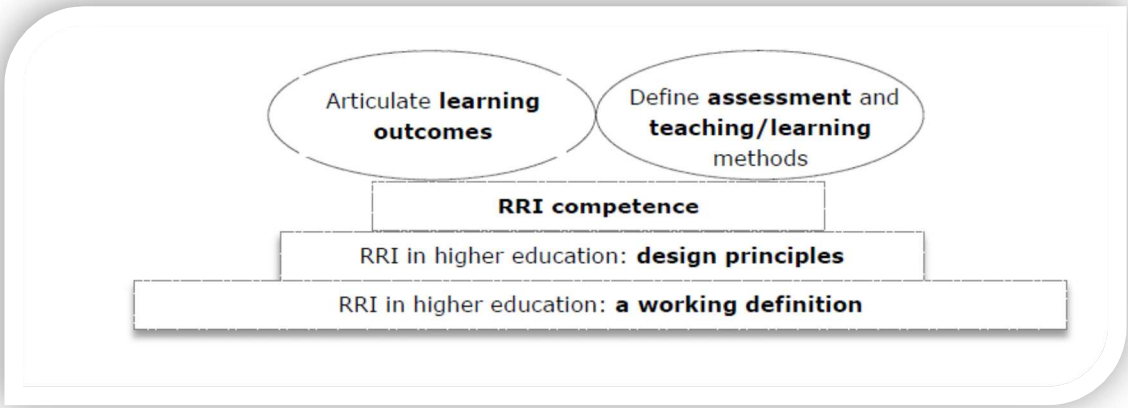


Figure 12. The EnRRICH tool as presented by the EnRRICH project (figure reference https://doi.org/10.1007/s10734-017-0211-4) [2, 12]

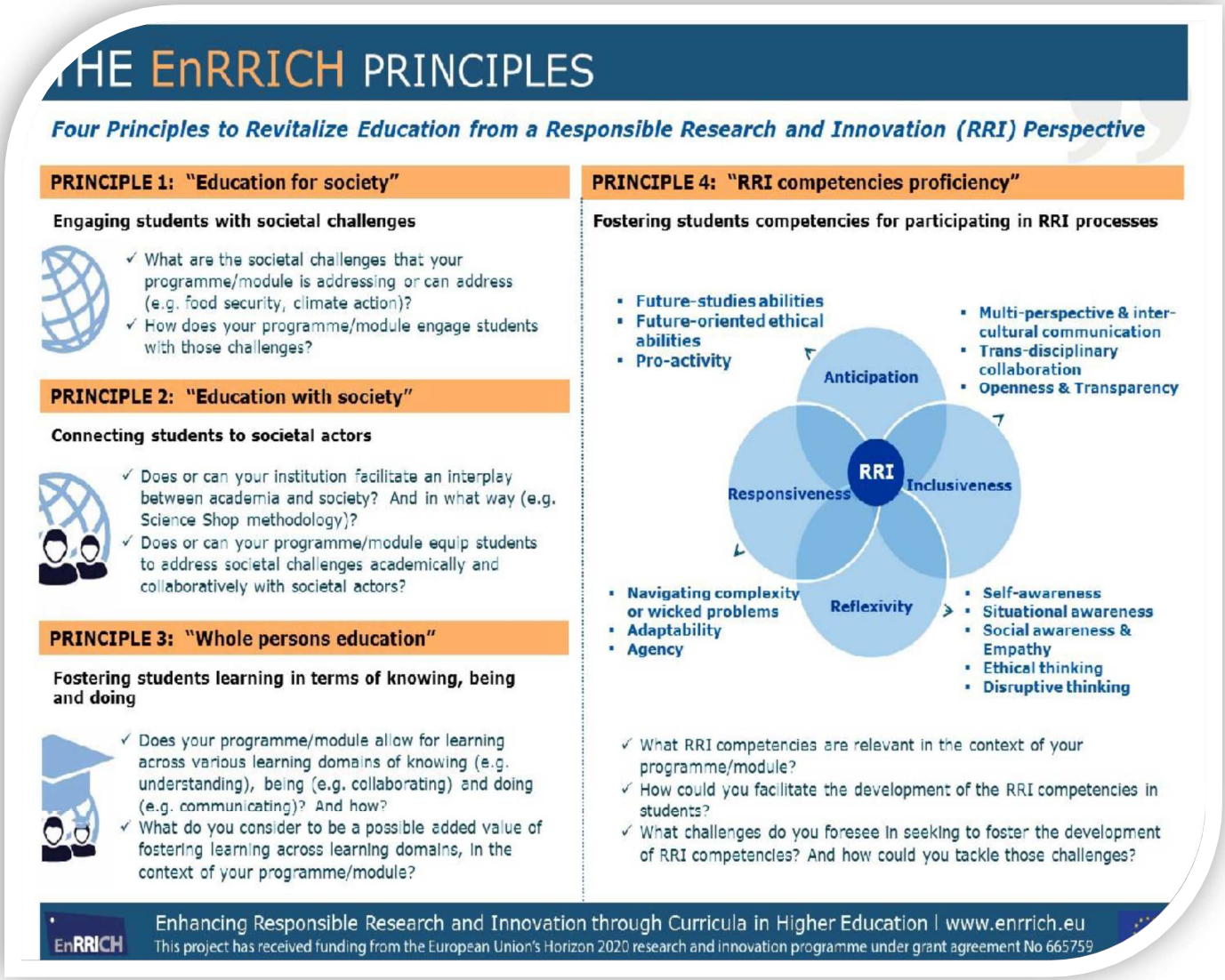


Figure 13. The EnRRICH principles (figure reference D2.3 The EnRRICH Tool for Educators.pdf (livingknowledge.org)) [2]

4 Practical tools

In this chapter we present a list of practical tools (**Table 2**). We are very proud to present here the JoinUs4Health website and interactive platform, which are available in four languages (English, Dutch, German, Polish). The interactive platform is an online environment where everyone is welcome to participate in science in different ways. Either by submitting suggestions, voting on other suggestions, contributing to topics by working on tasks or in teams or just by exploring exciting contents.

Table 2 also includes links to training programs and online courses as well as links to other deliverables by the highlighted projects. We invite our readers to take their time to explore the content of these websites.

Table 2. Practical tools

Project name	Access to tool(s)
Joinus4health website and interactive platform	https://joinus4health.eu/ https://platform.joinus4health.eu/
HEIRRI Training Programs	https://rri-tools.eu/heirri-training-programmes
Engage (publications, factors influencing adoption or AR inquiry games)	https://www.tandfonline.com/doi/full/10.1080/10494820.2018.1473257 https://www.engagingscience.eu/en/documents/ https://www.engagingscience.eu/en/deliverables/
FIT4RRI resources	https://zenodo.org/communities/fit4rri/?page=1&size=20
Foster open science courses	https://www.fosteropenscience.eu/courses
Foster open science resources	https://www.fosteropenscience.eu/resources
RRI-tools	https://rri-tools.eu/nl/homepage
The Science Shop by the University of Twente and Saxion University of Applied Sciences	https://kennispark.nl/en/services/633/
Lifelong learning platform	https://lllplatform.eu
University of Twente- Centre of expertise in learning and teaching	https://www.utwente.nl/en/ces/celt/ https://www.utwente.nl/en/ces/celt/toolboxes/
Open Schooling Roadmap: A Guide for School Leaders **And Innovative Teachers**	https://portal.opendiscoveryspace.eu/sites/default/files/u34111/osos-all.pdf
Irresistable (Engaging the Young with Responsible Research and Innovation	http://www.irresistible-project.eu/
RRI-Practice publications and deliverables	https://www.rri-practice.eu/publications-and-deliverables/
EnRRICH deliverables	https://cordis.europa.eu/project/id/665759/results

5 Concluding remarks

In this report we aimed to summarize published recommendations for policy makers and educators to integrate RRI in educational programs. Our aim was not to create original recommendations, but rather summarize and organize the already existing recommendations to create maximum benefit for the reader.

This report can be seen as an eye opener for the tremendous effort that has been done around the theme “RRI in Education”. Not only recommendations and intervention design tools were developed for policy makers (**chapter 3.3**), but also resources were shared for educators (**chapter 3.4**). These include

1) validated learning outcomes by the CoE for domains like values, attitudes, skills and knowledge and critical thinking,
2) shared experiences on adopting inquiry-based learning methods,
3) guidelines to design curricula from a RRI perspective, and
4) course materials for different education levels (**chapter 4**).

Therefore, this report can also serve as a guideline for policy makers and educators on where to start looking for the right resources when they plan to introduce RRI in their organizations.

Learning about RRI is a very exciting process, but not a simple one. While working on this deliverable, we understood that “**time**” is crucial to digest and understand the dimensions of RRI and its importance. Now that we ourselves got what we call “**RRI fever**” we understand that we need to give our readers the time to absorb this knowledge. We believe that implementing RRI in our organizations is no more than a logical next step to the already ongoing initiatives in our organizations and invite you to become one of us, an **RRI champion**!

We conclude this report by presenting **Figure 14**, where we summarize the topics that we discussed in this report for policy makers and educators to consider when they desire to implement RRI in their universities and educational institutions.

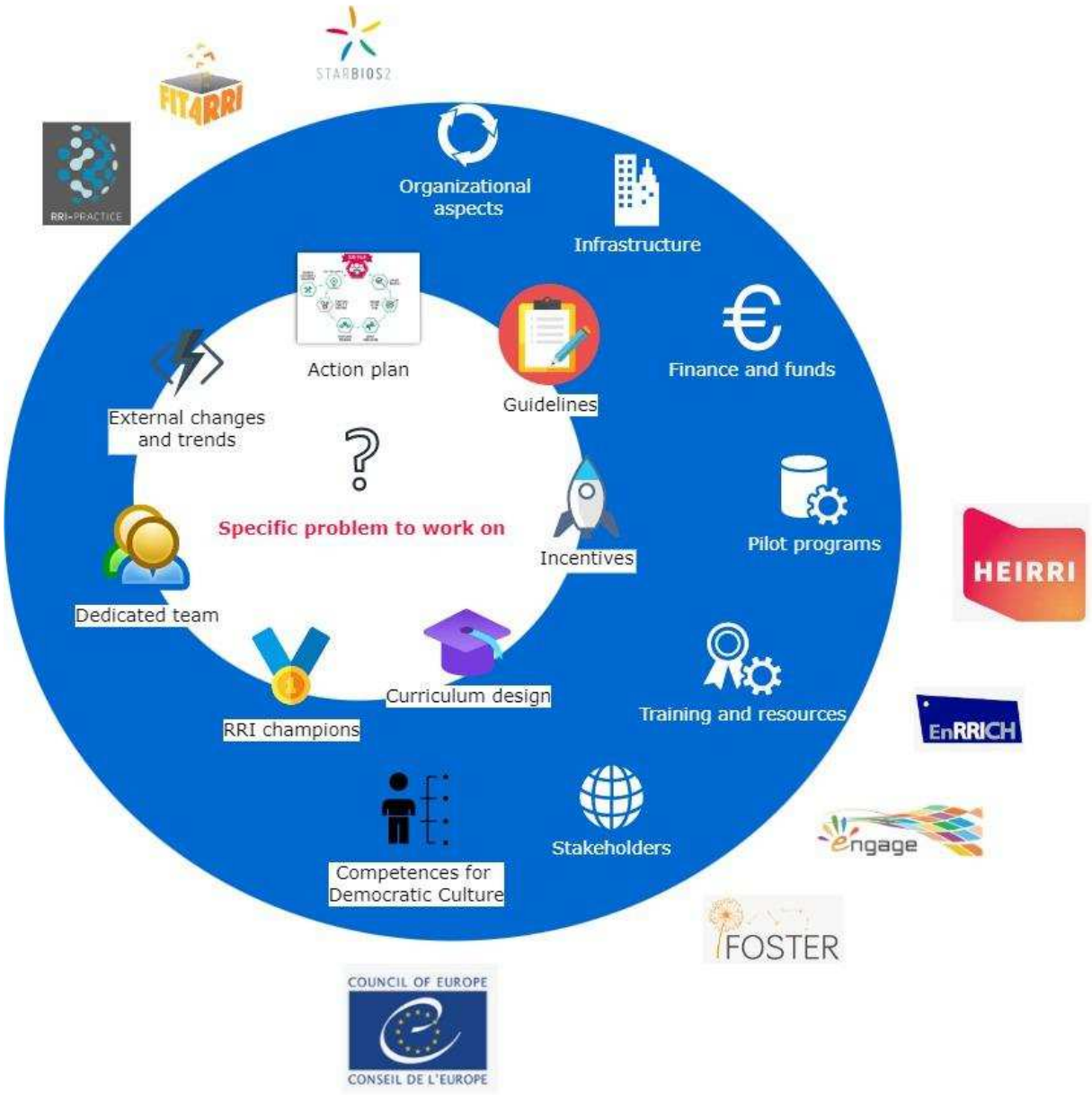


Figure 14. Summary of the recommendations in this report (inside the circle), linked to the projects that published these recommendations (outside the circle).

To implement RRI elements within an organization, policy makers are advised to start working on one problem at a time (centre of the white circle), for that it is best to start at the self-reflection process and make a plan of action, together with a dedicate team. Also making guidelines, providing incentives, changing curricula and making use of external changes and trends may help accelerate the process of change (outer part of the white circle). To achieve this, it is important to consider the topics that are presented in the blue circle.

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