PATTERN.
Empowering Open and Responsible Research and Innovation

D1.1

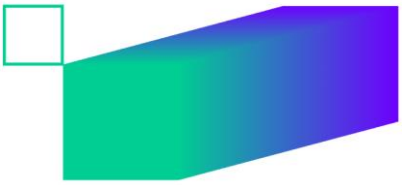
State of the art of Open and Responsible trainings

Project Name	Piloting open and responsible Activities and Trainings Towards the Enhancement of Researchers Networks
Project Acronym	PATTERN
Contract No.	101094416
Type of action	HORIZON Coordination and Support Actions
Call	HORIZON-WIDERA-2022-ERA-01: Widening participation and strengthening the European Research Area centres
Topic	HORIZON-WIDERA-2022-ERA-01-44: Developing and piloting training on the practice of open and responsible research and innovation
Start of Project	1 January 2023
Duration	42 months

OUR CONSORTIUM

Funded by the European Union

Deliverable title	State of the art of Open and Responsible trainings
Deliverable number	D1.1
Deliverable version	1.0
Previous version(s)	N/A
Contractual date of delivery	31 December 2023
Actual date of delivery	22 December 2023
Nature of deliverable	Report
Dissemination level	PU - Public
Work Package	WP1
Task(s)	T1.1, T1.2, T1.3
Partner responsible	AU
Author(s)	Cristina Lagido, Gitte Kragh, Kristian H. Nielsen
DOI	10.5281/zenodo.10409792

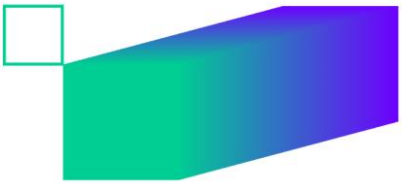


Contributors

NAME	ORGANISATION
Shanmugasundaram Venkataraman	OpenAIRE
Jonathan England	OpenAIRE
Louise Bezuidenhout	DANS
Loek Brinkman	DANS
Pascal Flohr	DANS
Aslak Skarvøy	EARMA
Teodora Konach	EARMA
Borana Taraj	EARMA
Asya Salnikova	ESF
Adam Brandstetter-Kunc	ESF
Muki Haklay	LPI
Andrea Giraldo Sevilla	LPI
Brian Cahill	SciLink
Agnese Baini	SISSA
Chiara Saviane	SISSA
Nico Pitrelli	SISSA
Giacomo Consolini	UniSR
Maya Fedeli	UniSR
Noemi De Lorenzo	UniSR
Sanja Jurković	RBI
Bojan Macan	RBI
Alen Vodopijevec	RBI
Antónia Correia	UMinho
Paula Moura	UMinho
Pedro Príncipe	UMinho
Katharina Koller	ZSI
Ilse Marschalek	ZSI
Maria Schrammel	ZSI

Peer Reviews

NAME	ORGANISATION
Pascal Flohr	DANS
Asya Salnikova	ESF
Muki Haklay	LPI
Andrea Giraldo Sevilla	LPI
Bojan Macan	RBI
Agnese Baini	SISSA
Giacomo Consolini	UniSR
Antónia Correia	UMinho
Katharina Koller	ZSI



Revision History

VERSION	DATE	PARTNER	MODIFICATIONS
0.1	11/12/2023	Cristina Lagido, Gitte Kragh, Kristian H. Nielsen	First draft
0.2	19/12/2023	Partners	Comments from partners integrated
1.0	22/12/2023	Alessio Livio Spera, Claudia Iasillo, Stefania Laneve (APRE)	Final version submitted

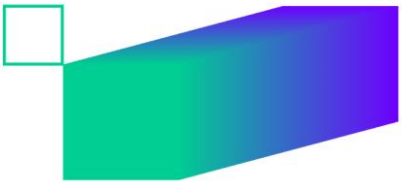
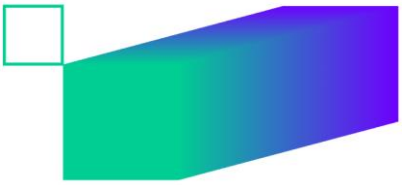


Table of Abbreviations and Acronyms

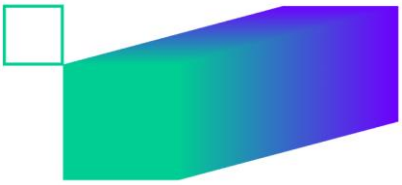
Abbreviation	Meaning
APRE	Agenzia per la Promozione della Ricerca Europea, Italy
AU	Aarhus University, Denmark
CC BY	Creatiive Commons Attribution
CC BY-NC	Creative Commons Non-Commercial
CC BY-ND	Creative Commons No Derivatives
CC BY-SA	Creative Commons Share Alike
DANS	Data Archiving and Networked Services, Netherlands
EARMA	European Association of Research Managers and Administrators
ECR	Early Career Researcher
ECTS	European Credit Transfer and Accumulation System
EOSC	European Open Science Cloud
ESF	Fondation Européenne De La Science, France
EU	European Union
FAIR	Findable, Accessible, Interoperable, Reusable
FORRT	Framework for Open and Reproducible Research Training
GEP	Gender Equality Plan
LPI	Learning Planet Institute, France
MLE	Mutual Learning Event
MOOC	Massive Open Online Course
OA	Open Access
OS	Open Science
PI	Principal Investigator
RBI	Ruđer Bošković Institute, Croatia
RDA	Research Data Alliance
RDM	Research Data Management
REI	Research Ethics and Integrity
RPO	Research Performing Organisation
RRI	Responsible Research and Innovation
SciLink	Stichting SciLink, Netherlands
SCORM	Shareable Content Object Reference Model
SISSA	Scuola Internazionale Superiore di Studi Avanzati di Trieste, Italy
UMinho	Universidade do Minho, Portugal
UniSR	Università Vita-Salute San Raffaele, Italy
WP	Work Package
ZSI	Zentrum Für Soziale Innovation GmbH, Austria



Index of Content

1 Executive Summary 11
2 Introduction 13
2.1 Background to PATTERN's 8 themes 14
2.1.1 Open Access 15
2.1.2 FAIR data and Research Data Management 15
2.1.3 Citizen Science 17
2.1.4 Research Integrity 17
2.1.5 Gender, non-discrimination and inclusion in research 18
2.1.6 Dissemination and Exploitation of Results 19
2.1.7 Science Communication (towards media and policy makers) 19
2.1.8 Management and Leadership 20
3 Methodology 21
3.1 Mapping 21
3.1.1 Metadata and controlled vocabularies 22
3.1.2 Content theme descriptors 23
3.2 Survey 25
3.3 Interviews 25
3.3.1 Transcripts and Summaries 27
3.4 Mutual Learning Events (MLE) 27
3.4.1 First MLE, 27th of February 2023 28
3.4.2 Second MLE, 27th of April 2023 29
3.4.3 Third MLE, 4th of July 2023 29
3.5 Quality analysis of the training programmes and resources 30
3.5.1 Quality criteria 30
3.5.2 Quality assessment process 31
4 Results and analysis 32
4.1 Mapping 32
4.1.1 Open Access 34
4.1.2 FAIR data and Research Data Management 36
4.1.3 Citizen Science 40
4.1.4 Research Integrity 45
4.1.5 Gender, non-discrimination, and inclusion in research 48
4.1.6 Dissemination and Exploitation of Results 53
4.1.7 Science Communication (towards media and policy makers) 55

4.1.8 Management and leadership 59
4.1.9 Collections Catalogues Platforms 62
4.1.10 Open Science and general RRI training 63
4.2 Survey 67
4.3 Interviews 72
4.4 Mutual Learning Events 77
4.4.1 General trends influencing education and training 77
4.4.2 Technological trends 78
4.4.3 Pedagogical trends for early career researchers (ECRs) 79
4.4.4 Pedagogical trends researchers at a later career stage 80
4.4.5 Defining and assessing relevant learning outcomes 81
4.4.6 Strategies for sustainability and impact 81
4.4.7 Overall summary of the mutual learning events 82
4.5 Quality Assessment 83
4.5.1 Resources with low priority for reuse in PATTERN 83
4.5.2 Training resource strengths and desired features, with examples 84
4.5.3 Opportunities for reuse of training in PATTERN 90
5 Overview of gaps and opportunities in OS and RRI training 112
5.1 Challenges in characterising the training landscape 112
5.2 Overarching gap and opportunity analysis 113
5.2.1 Delivery, content, and audiences 113
5.2.2 Implementation 114
5.2.3 Quality, sustainability and impact of training 115
5.3 Gaps and opportunities by theme 116
5.3.1 Open Access 116
5.3.2 FAIR data and Research Data Management 116
5.3.3 Citizen Science 117
5.3.4 Research Integrity 117
5.3.5 Gender, non-discrimination and inclusion in research 118
5.3.6 Dissemination and Exploitation of Results 118
5.3.7 Science Communication (towards media and policy makers) 118
5.3.8 Management and Leadership 119
6 Concluding remarks 120
7 Appendices 122
Appendix I: Agreed definitions relevant to Responsible Research and Innovation 122



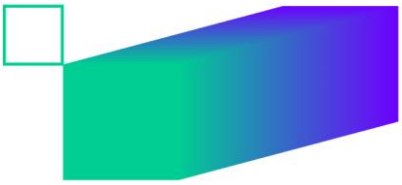
Appendix II: Controlled vocabularies used in training metadata 127
Appendix III: Survey questionnaire 132
Appendix IV: Primary contacts for distribution of survey 139
Appendix V: Informed Consent for Interviews 140
Appendix VI: Interview guide 141
Appendix VII: Mapping and classification of FAIR data training resources 142
Appendix VIII: Experiences of survey respondents of training in Open RRI 147

Index of Tables

Table 1. PATTERN thematic leaders in the transferable skills mapped 22
Table 2. Metadata recorded for the training resources identified. 23
Table 3. Content theme vocabulary per training area. In some instances, e.g., Citizen Science, content themes were reused from previous EU projects. 25
Table 4. Details of interviews conducted. 27
Table 5. Operational details of the quality assessment task. 31
Table 6. Characteristics of the mapped Open Access resources. 35
Table 7. Content themes in Open Access training and number of mapped training resources which include them. 36
Table 8. Characteristics of the mapped FAIR and RDM resources. 38
Table 9. Content themes in Research Data Management training and number of mapped training resources which include them. 39
Table 10. Content themes in FAIR data training and number of mapped training resources which include them. 39
Table 11. Characteristics of the mapped Citizen Science training resources. 42
Table 12. Content themes in Citizen Science training and number of mapped training resources which include them. 44
Table 13. Characteristics of the mapped Research Integrity training resources. 46
Table 14. Content themes in Research Integrity training and number of mapped training resources which include them. 47
Table 15. Characteristics of the mapped Gender, non-discrimination and inclusion in research training resources. 49
Table 16. Content themes in Gender, non-discrimination and inclusion in research training and number of mapped training resources which include them. 51
Table 17. Characteristics of the mapped Dissemination and Exploitation training resources. 54
Table 18. Content themes in Dissemination and Exploitation training and number of mapped training resources which include them. 55
Table 19. Characteristics of the mapped Science Communication (towards media and policy makers) resources. 57
Table 20. Content themes in Science Communication (towards media and policy makers) training and number of mapped training resources which include them. 58
Table 21. Characteristics of the mapped Management and Leadership training resources. 60
Table 22. Content themes in Management and Leadership training and number of mapped training resources which include them. 62
Table 23. Characteristics of the mapped training resources overarching Open Science and RRI. 65
Table 24. Content themes in general Open Science training and number of mapped training resources which include them. 66
Table 25. Content themes in general RRI training and number of mapped training resources which include them. 67
Table 26. Distribution of survey 139
Table 27. Mapping of FAIR data training resources. 146

Index of Figures

Figure 1: FAIR data principles, FOSTER (CCO licence) 16
Figure 2. Schematic diagram of tasks and methods in PATTERN WP1 and respective timeline. 21
Figure 3: Schematic diagram of the MLEs conducted in T1.2 to support the mapping and quality assessment of training, as well as the identification of emergent practices. 28
Figure 4: Number of training resources collected by PATTERN in the 8 RRI areas it covers. 33
Figure 5: Primary language of the resources collected by PATTERN. 33
Figure 6. Current professional activity of survey respondents. 68
Figure 7: Additional training needed at the respondents' organisation 69
Figure 8: Relevance of training characteristics 70
Figure 9: Types of training preferred 70



1 Executive Summary

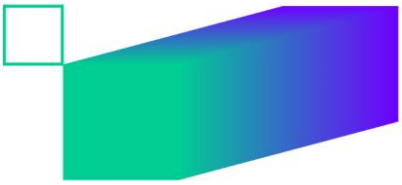
The current document, titled 'State of the art of Open and Responsible trainings' has been developed within the PATTERN project, which receives funding from the European Union's Horizon Europe Research and Innovation Programme (grant agreement No 101094416).

Our main objectives in this report are as follows:

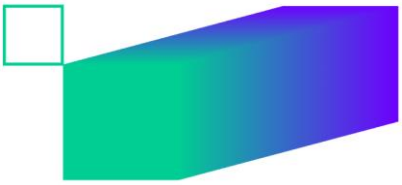
- Mapping Open Science (OS) and Responsible Research and Innovation (RRI) training opportunities for researchers at all stages of their careers, with a focus on Europe;
- Identifying gaps and opportunities in OS and RRI skills training;
- Conveying current trends and insights into OS and RRI skills training in Europe and beyond.

The PATTERN consortium includes partners from across Europe that possess extensive expertise in the following eight Open RRI transferable skill areas: Open Access; Findable, Accessible, Interoperable and Reusable (FAIR) Data Management; Citizen Science; Research Integrity; Gender, non-discrimination and inclusion in research; Dissemination and Exploitation of Results; Science Communication (towards media and policy makers); and Management and Leadership. Through collective knowledge gathering in the consortium, desk research, and a survey, PATTERN has mapped over 500 training resources covering these eight areas. Moreover, this work was complemented by three mutual learning events and interviews to understand gaps, needs and opportunities, as well as current trends and best practices in training.

The training resources span course-type activities, such as courses, workshops, and e-learning, as well as static resources potentially useful in training, including guides, reports, recordings of webinars, etc. Both in-person and online or blended formats, and both informal and formal training, were mapped. We analysed the content themes of all training and resources mapped to identify gaps and opportunities. A subset of trainings and resources, around 250, that are digitally and freely available were quality-assessed based on their relevance, accessibility, ease of implementation and adaption, adequate structure and description of aims, goals and methods, and clear language. We identified their strengths and weaknesses, along with gaps in



training addressed, to evaluate their suitability for reuse and the opportunities for new training in the eight Open RRI themes.



2 Introduction

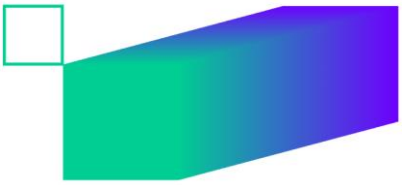
The European Research Area (ERA) envisions a successful transition to a sustainable, digital, and resilient Europe. Research and innovation in the European Union (EU) are grounded in shared values and principles, encompassing pursuit of excellence, value creation, ethics and the integrity of research and innovation, freedom of scientific research, gender equality, equal opportunities and inclusiveness, free circulation, coordination, coherence, commitment, global outreach, and societal responsibility. One of the ERA's top priorities is to train researchers to actively contribute to a closer relationship between science and society and enhance trust in science. Simultaneously, it aims to equip them with the necessary skills for the labour market, focusing on upskilling and reskilling through targeted training.[1] This aligns with the Horizon Europe framework and the European Skills Agenda, which recognise the significance of transferable skills in facilitating intersectoral mobility and knowledge transfer.[2]

The overarching goal of the PATTERN project is to cultivate inclusive and sustainable practices in Open Science (OS) and Responsible Research and Innovation (RRI), through promoting researcher training in the relevant transferable skills. According to the European Commission: 'Responsible Research and Innovation (RRI) implies that societal actors (researchers, citizens, policy makers, business, third sector organisations, 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 society'.[3] The key components are public engagement, gender equality, social justice and inclusion, ethics and research integrity, science education, open science, governance, and sustainability. RRI seamlessly integrates the principle of openness in science, extending to research data, software, publications, and research evaluation - as captured by the motto 'as open as possible, as closed as necessary'.

1 European Commission, Directorate-General for Research and Innovation, Iagher, R., Monachello, R., Warin, C., Science with and for society in Horizon 2020 : achievements and recommendations for Horizon Europe, Delaney, N.(editor), Tornasi, Z.(editor), Publications Office, 2020; Proposal for a COUNCIL RECOMMENDATION on a Pact for Research and Innovation in Europe https://data.europa.eu/doi/10.2777/32018; https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=CELEX%3A32021H2122

2 Bologna Seminar on "Doctoral Programmes for the European Knowledge Society' https://eua.eu/downloads/publications/salzburg%20recommendations%202005.pdf

3 European Commission (2018) The EU Framework Programme for Research and Innovation. Science with and for Society.



PATTERN has a focus on eight main transferable skills within the context of OS and RRI. These eight skills comprise Open Access, FAIR data Management, Citizen Science, Research Integrity, Gender, non-discrimination and inclusion in research, Dissemination and Exploitation of Results, Science Communication (towards media and policy makers), and Management and Leadership. At the core of PATTERN are the mapping and quality assessment of state-of-the-art training opportunities for researchers (Work Package 1, WP1), along with an analysis of policy at institutional, national, and European levels (WP4). These aim to identify existing gaps and to enhance capacity within the ERA to address societal challenges and foster a closer dialogue between science, policy and society.

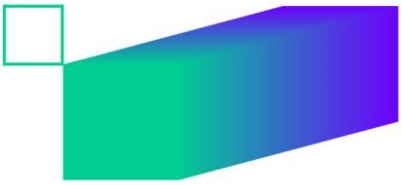
In this report, we present the outcomes of a comprehensive evaluation of existing OS and RRI training activities, conducted in WP1. The report is structured in the following way: Chapter 2 describes the methodology employed in the mapping and quality assessment of the training resources; Chapter 3 presents our results for each of the eight areas considered, as well as overarching training that cover several of them; Chapter 4 outlines our main learnings and recommendations. The report is complemented by several appendices to further document important aspects.

This evaluation serves a dual purpose: identifying the potential for new training activities for researchers and providing a knowledge base for the subsequent development, implementation, and evaluation of training modules in WPs 2-3. Thus, through our thorough assessment, PATTERN endeavours to contribute meaningfully to enhancing research and innovation practices within the ERA.

2.1 Background to PATTERN's 8 themes

PATTERN's eight themes are essential to promote the agenda of OS and RRI. They equip researchers and their organisations with know-how to make research more open, collaborative, and reproducible, whilst also aligned with ethical principles and seizing opportunities to address societal concerns. Moreover, as recognised in the Salzburg II Recommendations, many of these transferable skills prepare researchers for careers beyond academia or at the interface between academia and societal actors.[4] Here, we provide a short introduction to the broader context of each of PATTERN's eight themes.

4 Salzburg II Recommendations, European University Association ISBN: 9789078997221



2.1.1 Open Access

Open Access (OA) pertains to the push to make academic information such as peer-reviewed scientific publications and data (or as a minimum its metadata) accessible to all. OA is fundamental in the context of OS and RRI, as publicly funded research needs to be made available to the public on ethical grounds. Challenges include the various routes to achieve OA and patchy adherence across research domains, geography, mandates, and other factors.

OA has evolved through various public statements and initiatives, such as the Budapest OA Initiative[5] and more recently, since 2021, Plan S[6] and its 10 principles[7]. Plan S states that 'all scholarly publications on the results from research funded by public or private grants provided by national, regional, and international research councils and funding bodies must be published in Open Access journals, on Open Access platforms, or made immediately available through Open Access repositories without embargo'. Many national funding bodies, the European Commission and some charitable and international funders and research organisations already endorsed Plan S (through cOAlition S)[8] but there is a need for more comprehensive global coverage and the implementation of its principles is still incipient as it finds strong opposition from some publishing companies. Training the various stakeholders involved in research is crucial for raising awareness of the importance of Open Access (OA) and enabling its concept.

5 https://www.budapestopenaccessinitiative.org/read/
6 https://www.coalition-s.org/why-plan-s/
7 https://www.coalition-s.org/addendum-to-the-coalition-s-guidance-on-the-implementation-of-plan-s/principles-and-implementation/
8 https://www.coalition-s.org/about/

2.1.2 FAIR data and Research Data Management

In the contemporary era marked by an exponential increase in data, adhering to the Findable, Accessible, Interoperable, and Reusable (FAIR) principles is an imperative (

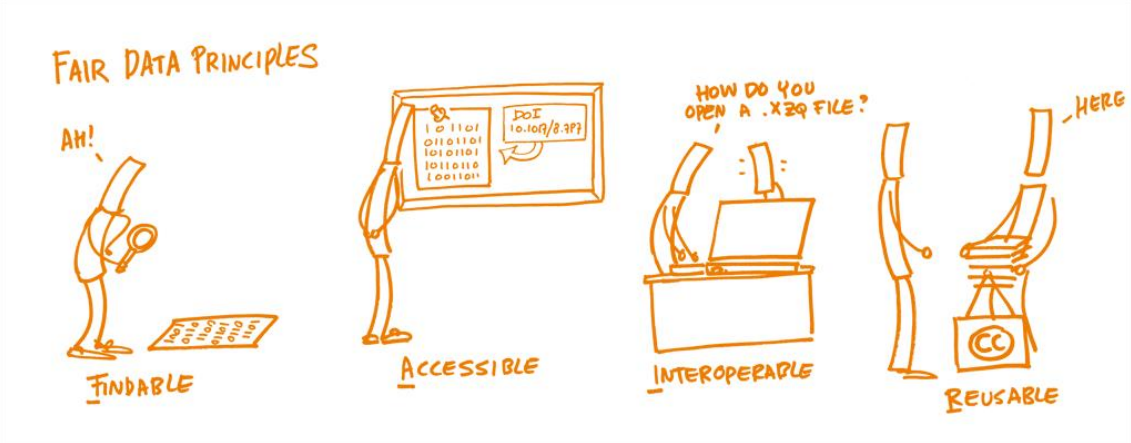


Figure 1). These principles, initially published in 2016, focus not only on human readability but also, significantly, on machine usability. Interoperability is essential for researchers to manage the vast volumes of data, build upon prior work, and collaborate effectively. The principles highlight the importance of employing rich metadata, globally unique identifiers, open protocols, FAIR vocabularies for interoperability, and clear licences to enhance data reusability (see Wilkinson *et al.* 2016 for the full list of principles).[9]

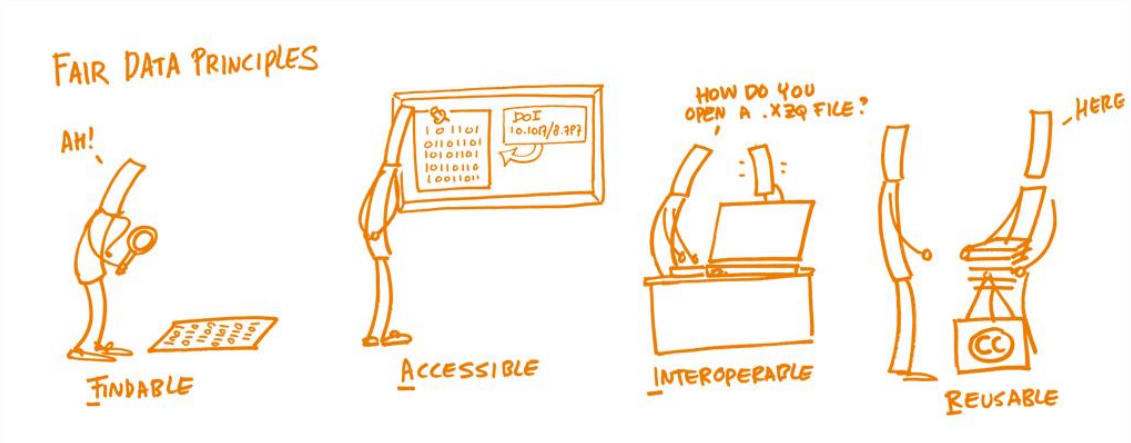
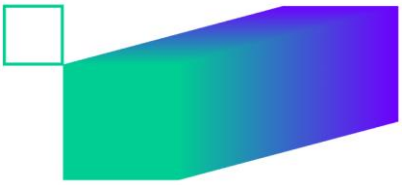


Figure 1: FAIR data principles, FOSTER (CCO licence) [10]

9 Wilkinson, M.D. et al. (2016) The FAIR Guiding Principles for scientific data management and stewardship', Scientific Data, 3(1), p. 160018. https://doi.org/10.1038/sdata.2016.18.
10 https://www.fosteropenscience.eu/learning/assessing-the-fairness-of-data/#/id/5c52e8cf0d3def29462d8cb5



While the FAIR principles have gained broad acceptance, their full implementation is still in progress and many researchers are not yet aware of them.[11] The European Commission recognises their significance in the 'Open Innovation, Open Science and Open to the World' vision, emphasising that 'open' and 'FAIR' are not synonymous. In Horizon Europe, there is a strong emphasis on maximising the 'FAIRness' of research data, with the FAIR principles constituting one of the six guiding principles of the European Open Science Cloud (EOSC).[12]

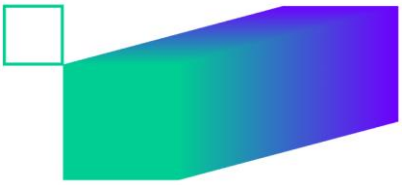
For researchers, acquiring knowledge about FAIR research data management (RDM) is essential. This requirement stems not only from top-down mandates by entities like the European Commission but, more significantly, from the growing recognition among researchers that applying the FAIR principles contributes to 'responsible,' transparent, and accessible research practices. It is worth mentioning that the CARE Principles for Indigenous Data Governance complement the existing FAIR principles and acknowledge that FAIR may create tensions for Indigenous peoples, thus 'encouraging open and other data movements to consider both people and purpose in their advocacy and pursuits'.[13]

2.1.3 Citizen Science

Citizen Science has gained significant traction in recent years as a promising approach within the context of OS and RRI[14], even though the practice of involving the public in research can be traced to the mid-19th century. Recognised in EU's Open Science Policy as one of the eight pillars of OS[15], Citizen Science aligns well with the RRI principles of transparency, inclusivity and addressing ethical, societal, and environmental challenges. Engaging the public in the scientific process not only contributes to research outcomes but also to the process of democratising science, increasing scientific literacy, and forging stronger bridges between science and society.

Training researchers in Citizen Science is crucial to ensure successful research projects involving the public. Citizen Science requires researchers (or research

11 European Data Landscape, 2022, doi 10.2777/3648
12 EOSC Association (2022) 'Strategic Research and Innovation Agenda (SRIA) of the European Open Science Cloud (EOSC), Version 1.1, 1 November 2022. Available at: https://eosc.eu/sria-mar.
13 https://www.gida-global.org/care
14 Smallman, M. (2018). Citizen Science and Responsible Research and Innovation. In Hecker, S. et al. (eds.), Citizen Science: Innovation in Open Science, Society and Policy, pp. 241-253. UCL Press.
15 https://research-and-innovation.ec.europa.eu/strategy/strategy-2020-2024/our-digital-future/open-science_en



support staff) to have a wide skillset including skills in participatory methodologies, data management, communication, engagement and training, volunteer management, and ethics, to name but a few. Many training materials are available out there covering some of these aspects and more. To ensure efficient uptake of learnings and impactful implementation of Citizen Science research projects, training needs to be designed and implemented with the cultural, institutional and research-field contexts in mind, while also addressing multi- and inter-disciplinary aspects.

2.1.4 Research Integrity

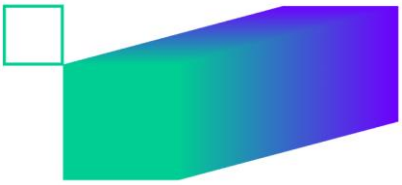
Every research performing organisation should offer training in research ethics and integrity (REI). While research ethics is often related to research outputs, research integrity relates to the adherence of ethical principles and professional standards by researchers. REI training promotes high-quality research and compliance with high standards of ethics, integrity, and compliance, thus cultivating a better and more responsible research environment.[16] This multifaceted domain encompasses not only moral, ethical, and legal considerations but also addresses cultural, gender, inclusion, and equity issues.

As a result, REI training programmes are highly diverse, covering a range of topics such as policies on data management, open access, supervision and mentoring, authorship, and the handling of alleged cases of research misconduct, among others. The specific content and emphasis within the training may vary depending on the organisational size, capacity and resources, main goals, strategic developments, and the existing legal and administrative framework. The overarching goal is to tailor the training to the unique context of each research entity, fostering a comprehensive understanding of Research Integrity across various dimensions.

2.1.5 Gender, non-discrimination and inclusion in research

The Horizon Europe approach to gender equality and diversity in research and innovation institutions focuses on the interlocking systems of power between gender and other social categories and identities such as ethnicity and race (including migrants and refugees), social class and wealth, gender identity and

16 EARMA: Stefanie van der Burght, Jonas Akerman, Eva Casamitjana, Karim Mahmoud, Borana Taraj, Nik Cleasen, 'Guidance for implementation of ethics and integrity training' (2020).



sexual orientation (LGBTI+ issues), neurodiversity, and disability. This is known as an 'intersectional' approach and helps to better address the multiple and interacting factors of inequality experienced by research and innovation actors.

For instance, the Academic Wheel of Privilege, introduced by the Framework for Open and Reproducible Research Training (FORRT)[17], includes in its intersectional approach: 'demographic characteristics', such as gender identity and ethnicity or race; 'experiences and circumstances', like citizenship status and childhood household stability; and 'career characteristics', such as the level of education and the type of institution individuals are affiliated with. This framework has been initially used to respond to the need for a social justice-based method of determining authorship status.[18]

The related activities involve two main aspects. One involves advancing gender research by integrating gender (and other social or relevant categories) considerations into broader research efforts, to develop a broader understanding of gender equality and intersections with other inequalities. The other involves incentives to promote the adoption of gender equality plans, diversity initiatives, and strategies for non-discrimination and inclusion, through comprehensive approaches that drive institutional change. Both aspects are needed to ensure equal representation in research and equal access to research outcomes.

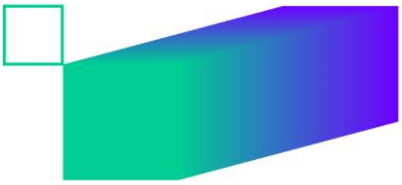
To empower RRI, knowledge pertaining to gender, non-discrimination and inclusion should be incorporated into researcher's education, research projects, and overall working environment.

2.1.6 Dissemination and Exploitation of Results

The significance of robust training programs for the dissemination and exploitation of research outcomes cannot be overstated. It provides researchers with better communication skills to engage with the scientific community and the public, preparing them for communicating their results through presentations or posters, scientific papers, or public speaking.

17 inspired by the Wheel of Power of Sisneros, J., Stakeman, C., Joyner, M. C.,Schmitz, C. L.(2008). Critical Multicultural Social Work. United States: Oxford University Press. 136 p.

18 Elsherif, M. M., Middleton, S. L., Phan, J. M., Azevedo, F., Iley, B. J., Grose-Hodge, M., ... Dokovova, M. (2022, June 20). Bridging Neurodiversity and Open Scholarship: How Shared Values Can Guide Best Practices for Research Integrity, Social Justice, and Principled Education. https://doi.org/10.31222/osf.io/k7a9p.



It also empowers researchers to contribute to groundbreaking solutions, real-world applications, and a vibrant and impactful research ecosystem, as well as providing career opportunities.

As stated by Scherer *et al*. (2022, p. 7): '*excellent science needs effective communication and dissemination. Bringing research and its outcomes to the attention of non-scientific audiences, scientific peers, potential business partners or policy makers fosters collaboration and innovation. Strategic communication and dissemination will help explain the wider societal relevance of science, build support for future research and innovation funding, ensure uptake of results within the scientific community, and open up potential business opportunities for novel products or services*'.[19]

2.1.7 Science Communication (towards media and policy makers)

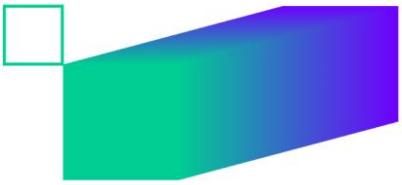
Within the RRI framework, Science Communication plays a pivotal role in connecting researchers and society. Faced with contemporary challenges and the relationship between Science, Technology and Society, Science Communication proposes new forms of discourse on how scientific knowledge is produced, focusing not only on findings but on methodologies, implications and conveying their uncertainty.

Training in Science Communication should be included in the career path of all researchers. In the later stages of their careers, researchers will have increased opportunities to engage in dialogue with the media and policymakers. This dialogue should not only present data and research results but also put forward ideas and proposals. The goal is to comprehend the reasoning and priorities of the media and policymakers.

2.1.8 Management and Leadership

Researcher's career progression requires proficient management and leadership skills to navigate projects, foster cross-disciplinary collaborations, and guide and motivate teams towards collective goals.

[19] European Commission, European Innovation Council and SMEs Executive Agency, Scherer, J., Weber, S., Alveen, P. et al., European IP Helpdesk – Successful valorisation of knowledge and research results in Horizon Europe – Boosting the impact of your project through effective communication, dissemination and exploitation, Publications Office of the European Union, 2022.



Researchers are directly involved in managing colleagues at various career stages, and therefore need to cultivate skills in interpersonal communication, conflict resolution, emotional intelligence, care of others, and team dynamics. Simultaneously, with the expanding boundaries of research, researchers face new challenges in the business environment. Utilising their leadership skills becomes crucial in navigating funding intricacies, fostering strategic partnerships, and effectively communicating research outcomes.

Increasing the opportunities for management and leadership training for researchers and the broader academic community has a transformative impact, not only on individual careers but also on academic institutions as hubs of innovation and excellence.

3 Methodology

In analysing current OS and RRI training programmes and resources, we utilised diverse methods such as desk research, data sprints, a survey, interviews, and mutual learning events, followed by quality assessment (Figure 2).

Figure 2. Schematic diagram of tasks and methods in PATTERN WP1 and respective timeline.

3.1 Mapping

The consortium first established common definitions for the RRI skills (see Appendix I: Agreed definitions relevant to Responsible Research and Innovation).

PATTERN partners possess extensive professional networks and comprehensive knowledge of various European Union-funded projects related to training in OS and RRI. The compilation of training resources drew upon the collective expertise of the entire consortium (Table 1), with direct involvement from AU (as the lead partner on WP1), ESF, SISSA, LPI, OpenAIRE, EARMA, UniSR, DANS, RBI, SciLink, and UMinho. PATTERN partners actively sought resources through desk research and their information channels. Five collaborative 1-hour data sprints took place to collect data in an Excel document. Partners added information and completed the required metadata until the end of August 2023.

Transferable skill in Open and Responsible Research and Innovation	PATTERN thematic lead
Open Access	**OpenAIRE**
FAIR Data Management	**DANS, OpenAIRE**
Citizen Science	**AU, LPI**
Research Integrity	**EARMA, UniSR, AU**
Gender, non-discrimination and inclusion	**ESF, UniSR**
Dissemination and Exploitation of Results*	**APRE, LOBA**
Science Communication (towards media and policy makers)	**SISSA, AU**
Leadership and Management	**SciLink, UniSR**
General training in Open Science and RRI	**UMinho**

Table 1. PATTERN thematic leaders in the transferable skills mapped
Partners oversaw the collection of training materials in their respective area of expertise, making sure the resources collected were comprehensive and the metadata were provided.
*Dissemination of Results was overseen by SISSA; RBI was responsible for Collections, Catalogues and Platforms.

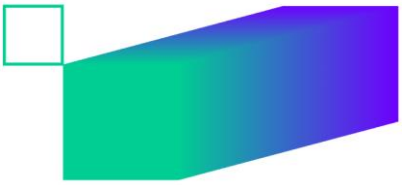
3.1.1 Metadata and controlled vocabularies

Metadata refers to descriptive information about the mapped training resources. We followed the Research Data Alliance (RDA) recommendations on minimal metadata for learning resources, with some adjustments.[20] Metadata included title, most recent version date, author(s), language, keywords, URL, licence, access rights (rather than access cost), learning resource type, learning outcomes, target group, and expertise level (Table 2). Additional metadata included: organisation/provider, content description, content themes (skills trained)/curriculum, duration, training mode, and learner assessment, as inspired by the EU-funded TIME4CS[21] deliverable on training resources.[22] Moreover, additional languages, connection to EU projects, scientific domain of training, predominant content resource type, and provision of a qualification were added to the metadata.

The 'learning outcomes' metadata was noted when provided in the resource or easily obtained from the description of the resource or its quick examination. Although learning objectives and learning outcomes are not necessarily the same, for practical purposes, they have been treated as interchangeable.

Type of information	Metadata	Part of RDA minimal metadata set (Y/additional)
General information	**Title**	**Y**

20 Hoebelheinrich, N., Biernacka, K., Brazas, M., Castro, L. J., Fiore, N., Hellstrom, M., Lazzeri, E., Leenarts, E., Lavanchy, P. M., Newbold, E., Nurnberger, A. L., Plomp, E., Vaira, L., Gelder, C. V., & Whyte, A. (2022). Recommendations for a minimal metadata set to aid harmonised discovery of learning resources. Research Data Alliance. https://doi.org/10.15497/RDA00073
21 https://www.time4cs.eu
22 D4.2: Second version of the Description of TIME4CS training programmes https://zenodo.org/records/7560973



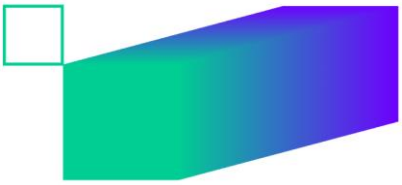
Type of information	Metadata	Part of RDA minimal metadata set (Y/additional)
	Most recent version and date	Y
	Author	Y
	Organisation/Provider	Additional (TIME4CS: Publisher)
	URL to resource	Y
	Language	Y
	Other languages	Additional
	EU project (if relevant)	Additional
Access information	Licence*	Y
	Access Rights*	Y
Content information	Scientific domain*	Additional
	Content description	Additional (TIME4CS)
	Content themes (skills trained)/curriculum	Additional (TIME4CS)
	Keywords	Y
Learning information	Target group (audience)*	Y
	Expertise level*	Y
	Duration	Additional (TIME4CS)
	Learning Resource Type* (predominant)	Y
	Learning outcomes	Y
	Training Mode*	Additional (TIME4CS: Training format)
	Content resource Type	Additional
	Learner Assessment*	Additional (TIME4CS)
	Qualification*	Additional

Table 2. Metadata recorded for the training resources identified.
PATTERN metadata fulfil the minimal metadata for learning resources recommended by the RDA. Additional metadata were included, taking inspiration from recent projects and current trends.
*Controlled vocabularies were used for these metadata

To facilitate standardisation and machine readability, controlled vocabularies were used when possible, and existing vocabularies reused when available. This was the case for (primary) Language, Licence, Access rights, Scientific domain, Target group (audience), Expertise level, Learning resource type, Training mode, Learner assessment and Qualification (see Appendix II: Controlled vocabularies used in training metadata).

3.1.2 Content theme descriptors

The identified training resources cover various aspects of Open Science and RRI. To facilitate analysis and identify gaps, a controlled vocabulary (content theme descriptors for each thematic area) was employed to categorise the topics addressed in the training resources (Table 3). These descriptors outline the skills, capacities trained, or curriculum and were provided by the PATTERN thematic leaders (Table 1). PATTERN adopted the Citizen Science content themes from the



TIME4CS project. For Research Integrity, the content themes were predominantly derived from the main areas outlined in the European Code of Conduct for Research Integrity and the SOPs4RI project's Research Integrity taxonomy.

RRI training area	Content theme vocabulary
Open Access	**Open Access, Funder requirements, Rights Retention Strategy, Repository, Copyrights, Publishing lifecycle, Preprint servers, Scholarly publishing, Predatory publishing, Research evaluation**
FAIR data Management and Research Data Management (RDM)	**FAIR, data management, sharing data, reusing data, data archiving, data discovery, quality assessment, ethics, open data, Open Access, Open Science**
Citizen Science	**Best practices, Co-creation, Communication, Citizen Science stories, Data quality and standards, Empowerment, Engagement, Evaluation of Citizen Science, Event planning, Funding, Impact, Introduction to Citizen Science, Link with formal education, Project management, Project sustainability, Reflections on science, Regulations and ethics, Research design and methods, Institutional change**
Research Integrity	**Research Integrity, Research ethics, Responsible research and good scientific practice, Ethical review, Biomedical Ethics, Informed consent, Privacy and confidentiality, Data practices and management, Intellectual property rights and authorship, Declaration of interests, Research misconduct and questionable research practices, Governance, Vulnerable participants, Moral-compass: values-based trainings, Research collaborations, Research environment, Publication and communication, Open Science, Supervision and mentoring**
Gender, non-discrimination and inclusion in research	**Gender equality, diversity, intersectionality, inclusion, gender equality plan, gender budgeting, gender-based violence, gender dimension, gender sensitive research**
Dissemination and Exploitation of Results	**Communication and dissemination plans, Public Speaking, Tools for Presentation, Scientific and Technical Writing, Social Media & Digital Communication, Multimedia, Team creation, Proof-of-Concept experiments, Technology transfer; Market analysis, Business plans, Business/Go-to-market, Strategy, Industry collaborations, Intellectual property, Copyright, Regulatory Affairs, Investments and funding, Entrepreneurship, Social and economic impact**
Science Communication (towards media and policy makers)	**Science Communication Theory, Media training, Science Policy, Institutional Communication & Public Relations, Risk Communication, Science Journalism, Publishing, Event Organisation, Science Museums & Science Centres, Social Media & Digital Communication, Multimedia, Communication with Policy Makers, Health Communication, Environmental Communication, Communicating AI**
Leadership and Management	**Team development, Conflict resolution, Coaching/Supporting and Leading Change, Managing Performance, Leadership, Communication styles and strategies, Problem solving, Recruitment, Empowerment, Project management, Resources management, Project sustainability, Cope with pressure, Self-organisation, Strategic thinking,**

RRI training area	Content theme vocabulary
	Promote inclusion and diversity, Build mentor-mentee relationships, networking/career development
Open science	**Open Data, Open Software/Open Source, Open Access, Open Notebooks, Open Peer Review, Open educational resources, Open methodology, Open reproducible research, Open Science definition, Open Science evaluation, Open Science guidelines, Open Science policies, Open Science tools, Open Science projects, Citizen Science, IPR and legal skills, train the trainer, Research Integrity and OS**
General RRI training	**Open Access; FAIR data; Open Science; RDM; Citizen Science; Dissemination; Exploitation; Research Integrity; Science Communication and Public Engagement; Management and Leadership; gender; Diversity and Inclusion; implementing RRI; Governance; organisational support for OS; Reproducibility in Research**
Collections, catalogues, platforms	**Open Access; FAIR data; Open Science; RDM; Citizen Science; Dissemination & Exploitation; Research Integrity; Science Communication; Management and Leadership; Policy; Research evaluation**

Table 3. Content theme vocabulary per training area.
In some instances, e.g., Citizen Science, content themes were reused from previous EU projects.

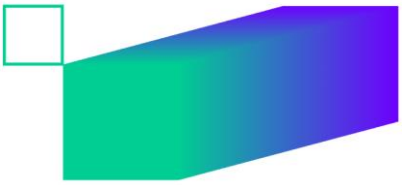
3.2 Survey

Aarhus University conducted a survey using SurveyXact by Rambol to expand data collection to stakeholder communities and gain additional insights into training needs and valued aspects in training. The anonymous online survey comprised 14 questions and was preceded by a consent statement (see Appendix III: Survey questionnaire). Before distribution, the survey was reviewed by the project partners and received clearance from the Research Ethics Committee at Aarhus University (approval no. 2023-001).

The survey was distributed between March and April 2023, and the results were gathered at the beginning of June 2023 to allow for any late responses. All PATTERN partners engaged in distributing the survey through their extended networks and encouraged further distribution of the survey (see Appendix IV: Primary contacts for distribution of survey).

3.3 Interviews

The purpose of the interviews was to gather insights from key opinion leaders, scholars, and trainers in fields of relevance to OS and RRI, focusing on the training of researchers. Additionally, the goal was to collect examples of good practice and gain a better understanding of the parameters that contribute to high-quality and impactful training. The interviewees were suggested by the consortium partners



and informed consent was obtained before the interviews (see Appendix V: Informed Consent for Interviews). The PATTERN thematic areas covered in the interviews were Open Access, FAIR data and Research Data Management, Gender, non-discrimination and inclusion in research, Research Integrity, Science Communication (towards media and policy makers) and Open and Responsible Science in general (Table 4).

AU and SISSA conducted the interviews through over MS Teams or Zoom, except for one interview which was conducted in-person. The semi-structured interviews lasted between 30 and 45 minutes and followed, with some flexibility, an interview guide previously agreed between AU and SISSA (see Appendix VI: Interview guide). At the start of the interview, the interviewees were asked to confirm their consent to the recording for internal purposes and analysis.

No. of Interviewee(s)	Role/Organisation	Interview date/ duration	PATTERN area discussed
2	**SPARC, Scholarly Publishing and Academic Resources Coalition (USA)**	**2023-04-4/ 30 min**	**Open Access, Open Science and responsible research in general**
1	**Research Integrity scholar/ KU Leuven**	**2023-05-16/30 min**	**Research Integrity**
1	**Diversity and Inclusion author and trainer/ Copenhagen Business school**	**2023-05-26/30 min**	**Gender, non-discrimination and inclusion in research**
1	**Science and technology communication & Digital Culture scholar/ University of Vienna**	**2023-05-29/46 min (in person)**	**Science Communication (towards media and Policy makers)**
1	**Philosophy of language and semantics scholar/UniSR**	**2023-05-30/35 min**	**Gender, non-discrimination, and inclusion; Science Communication**
1	**Science Communication/ UWE Bristol**	**2023-06-01/32 min**	**Science Communication (towards media and Policy makers)**
1	**Social epistemology of science scholar/UniSR**	**2023-06-01/37 min**	**Science Communication (towards media and Policy makers)**
1	**Science Communication scholar/ Cornell University**	**2023-06-12/40 min**	**Science Communication (towards media and Policy makers)**
1	**Science Communication scholar and trainer**	**2023-06-16/45 min**	**Science Communication (towards media and Policy makers)**
1	**RDM/DANS**	**2023-06-21/32 min**	**FAIR data and RDM**

No. of Interviewee(s)	Role/Organisation	Interview date/ duration	PATTERN area discussed
1	**Coordinator/Elixir Europe**	**2023-08-24/30 min**	**Training of researchers including RDM/quality of training**

Table 4. Details of interviews conducted.

3.3.1 Transcripts and Summaries

Transcripts of the interviews were automatically generated by MS Teams. For the interviews conducted on Zoom, the audio file was imported into https://otter.ai/ for transcription. The interviewer used the transcripts along with any notes taken during the interviews, to create summaries of the interviews. These highlighted the main points made and the information obtained and were shared internally with the consortium. Transcripts were also used to extract quotes and corrected by consulting the recordings when needed.

3.4 Mutual Learning Events (MLE)

Three Mutual Learning Events (MLE) were conducted and facilitated by ZSI to identify existing practices of open and responsible trainings, understand current trends in different modes of learning and for different target groups, and reach experts and participants on a global scale, including widening countries. These activities supported the mapping and analysis carried out, in addition to forming the basis for the quality assessment of trainings, together with the mapping.

Each mutual learning event followed a specific methodology tailored to its respective goal and audience and builds upon the previous one (Figure 3).

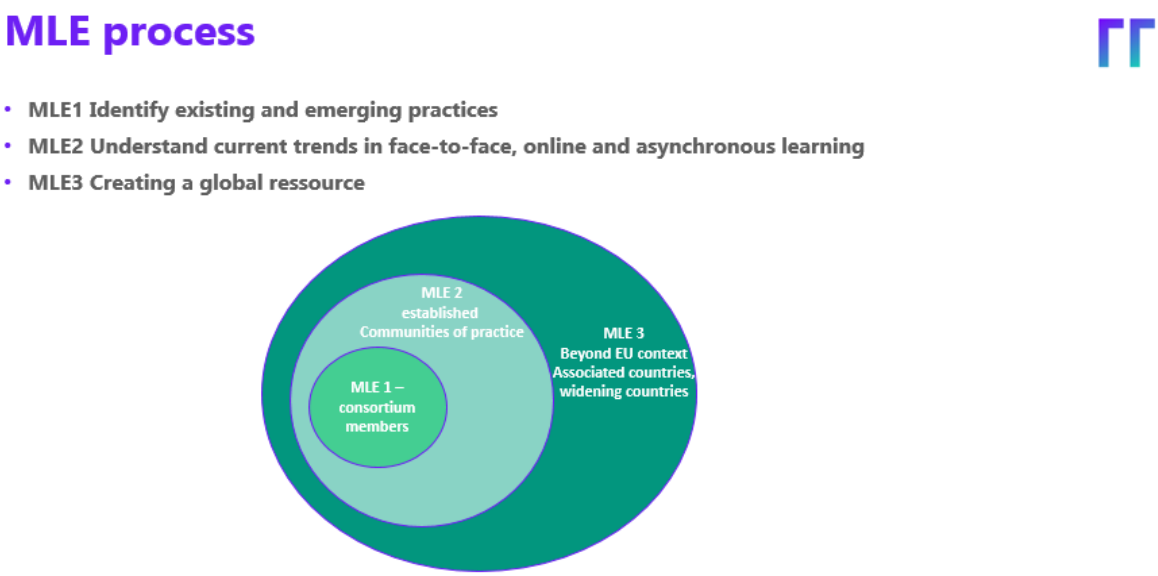
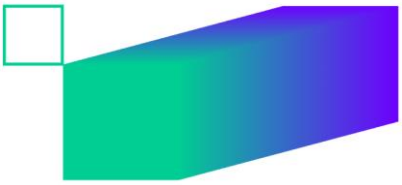


Figure 3: Schematic diagram of the MLEs conducted in T1.2 to support the mapping and quality assessment of training, as well as the identification of emergent practices.

3.4.1 First MLE, 27th of February 2023

The focus of the first MLE was to uncover existing practices and supplementing mapping activities by leveraging the expertise within the whole consortium. Thus, only PATTERN project partners were invited, resulting in 29 participants. The MLE incorporated various exercises. Initially, four thematic leaders within PATTERN presented case studies of training activities or resources within their respective fields. Small group discussions ensued, aiming to extract requirements, key considerations, and the pros and cons of each case study. The thematic leaders were strategically chosen to address information gaps in the mapping exercise, and represented the fields of Gender, non-discrimination and inclusion in research; Research Integrity; Open Access and FAIR Data Management; and Dissemination and Exploitation of Results.

Participant inputs and discussion points were captured using Miro boards. Subsequently, a group exercise involved small groups discussing quality criteria for the assessment in T1.3 (quality analysis of training programmes and resources) and the development of training modules in WP2. The MLE finished with a data sprint with the entire consortium.



3.4.2 Second MLE, 27th of April 2023

The objective of the second MLE was to engage experts in a dialogue about ongoing activities and emerging trends in open science training. The goal was to explore both successful aspects and challenges while generating innovative training concepts. The MLE drew participation from 24 individuals, with approximately 53% being PATTERN project partners and the remaining 47% external experts. External contributors included institutions like the Aalborg University, University of West England, University of Deusto, TU Dublin, as well as adult training entities such as IS Global, LOPE, and CRG.

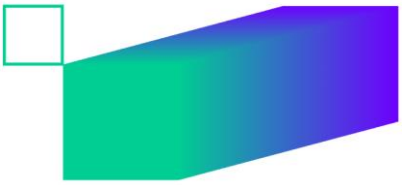
The event started with icebreaker activities, fostering participant interaction, and involving the selection and discussion of images representing successful open science training attributes. Subsequently, a 'brain walk' session enabled participants to share individual reflections on an online whiteboard, covering five key topics: technological trends (online, face-to-face, asynchronous formats); pedagogical trends for early career researchers; pedagogical trends for late-career researchers; learning outcomes; and sustainability and impact.

To finish, participants engaged in small group discussions, delving deeply into one of the five topics. They covered success factors, challenges, needs, aspirations and requirements, and recommendations, providing a comprehensive exploration of the landscape of open science training.

3.4.3 Third MLE, 4th of July 2023

The focus of the third MLE was to deliberate on the outcomes and recommendations from the second MLE, encompassing key trends and insights, with the participation of global experts. A total of 35 attendees, representing diverse countries including Israel, Jordan, Brazil, and widening countries like Croatia, Estonia, Greece, Lithuania, Portugal, and Romania, took part in the event. While 24 external experts registered for the event, a number of them did not attend on the day.

The event unfolded in several parts. Initially, facilitators from ZSI presented the primary findings from the second MLE. Subsequently, a world café format was employed, wherein various topics were established, and participants chose a topic to discuss in groups before rotating to another topic for further discussion with different participants. Given the online setting, breakout rooms were designated for



each of the five topics explored in MLE 2, with three rounds allowing each participant to engage in discussions on three of the five topics. Finally, rapporteurs presented the key findings for each topic to the entire audience.

3.5 Quality analysis of the training programmes and resources

Quality analysis has evaluated the information gathered from preceding project tasks, including the mapping, survey, interviews, and mutual learning events. This integrated knowledge forms the basis for informing upcoming training activities. Our focus was on identifying training programmes and resources that aligned with established quality criteria detailed below and singling out those most suitable for reuse. Additionally, we sought to identify gaps and potential for new learning opportunities, providing actionable recommendations for the long-term quality assurance and sustainability of training materials and activities.

3.5.1 Quality criteria

We adopted the quality criteria from the EU-Citizen.Science[23] project, a SwafS project (Science with and for Society, Horizon 2020) that developed a training platform for Citizen Science, as well as training. These criteria are currently utilised in the European Citizen Science project (ECS) which continues to maintain the eu-citizen.science platform and, therefore, ensure the compatibility of PATTERN outputs with the effort in ECS. Initial criteria, considered during the mapping task, included the relevance of the content to the PATTERN thematic areas and an appropriate set of descriptive metadata (see 3.1.1). Subsequent criteria covered five key quality aspects from the eu-citizen.science platform, rated on a scale of 1 to 5 (1 being very poor, 2 poor, 3 acceptable, 4 good, and 5 very good)[24]: resource accessibility (easy user entry); readability and legibility; clear statements of the aims, goals and methods; ease of implementation and adaptation; and image and audio quality of the object under consideration. Additional criteria included any prior evaluation of the training resource in terms of content, methods and/or results obtained, as well as the potential or actual impact of the resource on science, policy, or society (Fraisl *et al.*, 2020).[25]

[23] https://eu-citizen.science

[24] There was also an option for 'I don't know'

[25] Fraisl D., Hager G. & See L. (2020) Framework Report Describing Criteria and Rationale for Sharing and Selecting State of the art Citizen Science Resources https://zenodo.org/record/3716236#.ZKvIc3ZBw2w

3.5.2 Quality assessment process

For the quality assessment, we selectively chose digital resources with free and relatively straightforward access, suitable for the PATTERN target audience, namely researchers. Resources specifically tailored for secondary school teachers, librarians, or those for the general public deemed too basic were excluded.

We assigned scores to the resources based on the outlined quality criteria presented above (see 3.5.1), followed by an analysis of strengths, weaknesses, and opportunities which also considered interactivity, knowledge exchange opportunities, coverage of important topics for specific audiences and levels of expertise, and the addressing of known gaps. These additional considerations were agreed in consortium level discussions about quality criteria (first MLE). The analysis was performed for each of the PATTERN themes, as well as for the general training on OS and RRI. Table 5 outlines the PATTERN partners involved in quality assessment and the respective training resources evaluated.

Transferable skill area	**PATTERN partner responsible**	**No of people involved**	**Number of resources assessed**
Open Access	UMinho	2	23
FAIR data Management and RDM	DANS	2	48
Citizen Science	AU	1	55
Research Integrity	UMinho	2	21
Gender, non-discrimination and inclusion in research	ZSI	2	31
Dissemination and Exploitation of Results	SISSA/AU/APRE	4	11
Science Communication (towards media and policy makers)	SISSA	2	10
Management and Leadership	UniSR	2	10
Open Science and RRI	DANS	2	31 (OS); 17 (RRI)

Table 5. Operational details of the quality assessment task.

4 Results and analysis

In this section we present our findings across the three tasks of the first work package of PATTERN. Namely: T1.1 Mapping and analysis of training activities, modules, models of training and platforms – involving mapping (section 4.1), a survey (section 4.2), and interviews (section 4.3); Task 1.2 Mutual Learning events to identify existing and emerging practices (section 4.4); and Task 1.3. Quality assessment of existing learning opportunities (section 4.5).

4.1 Mapping

Here, we present the results of the mapping exercise, already incorporating information on training activities and resources crowdsourced through the survey. A worksheet containing the mapped resources will be available on Zenodo.[26]

PATTERN mapped more than five hundred training resources (571), with the following breakdown (Figure 4): Open Access (34), FAIR and RDM (62), Citizen Science (109), Research Integrity (32), Gender, non-discrimination and inclusion in research (64), Dissemination and Exploitation of Results (35), Science Communication (towards media and policy makers) (114), Management and Leadership (47), General RRI and Open Science (66), Collections, Catalogues and Platforms (19). Eleven records were common to Science Communication (towards media and policy makers) and Dissemination and Exploitation of Results. As Figure 5 shows, most of the resources collected were in English, reflecting its status as the global common language and the language of many projects that developed training resources, including that of the PATTERN project.

Nevertheless, the mapping also includes some of the languages spoken by consortium members, such as Italian, German, French, Spanish, Croatian, Portuguese, Finnish, Greek, Dutch, Hungarian, etc. It is worth noting that we refer to primary language here, and due to time constraints, no separate records were entered in the worksheet for translated materials, but this information was noted down.

[26] https://zenodo.org/communities/pattern?q=&l=list&p=1&s=10&sort=newest

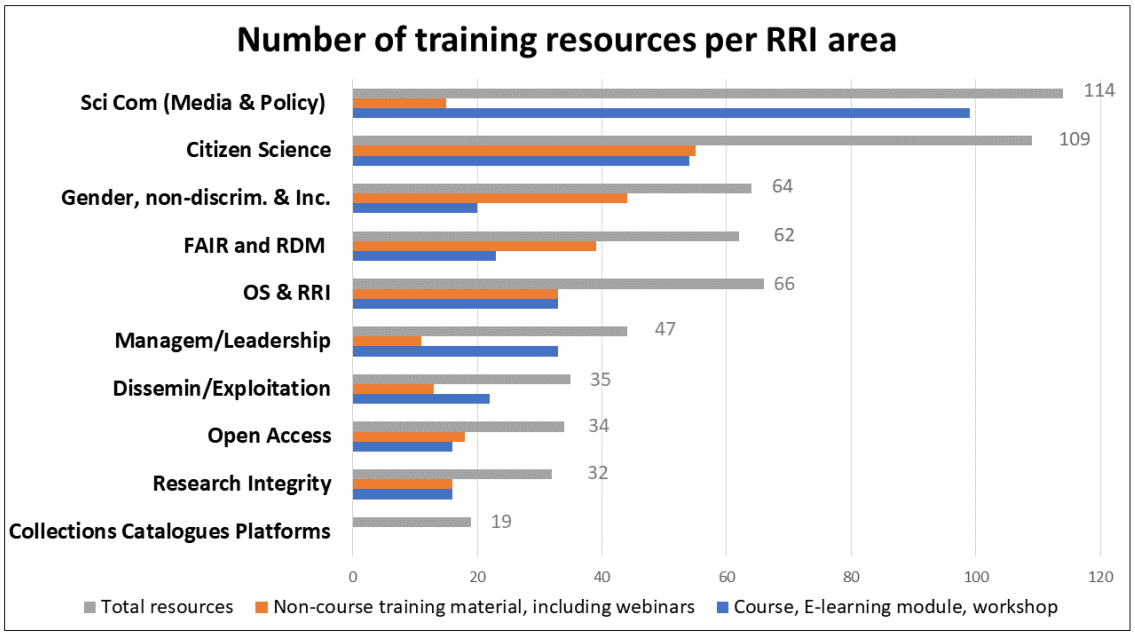


Figure 4: Number of training resources collected by PATTERN in the 8 RRI areas it covers.

The numbers in grey refer to the total number of resources in each area, comprising both courses and non-course training such as static materials, webinars/recordings of lectures. PATTERN mapped both courses, e-learning modules (e.g. Mooc), workshops and non-course training materials. The methodology consisted of joint exercise of desk research, knowledge gathering by project partners, plus a survey to reach out to communities. Partners involved in T1.1: AU, ESF, SISSA, LPI, OpenAIRE, EARMA, UniSR, DANS, RBI, SciLink, UMinho.

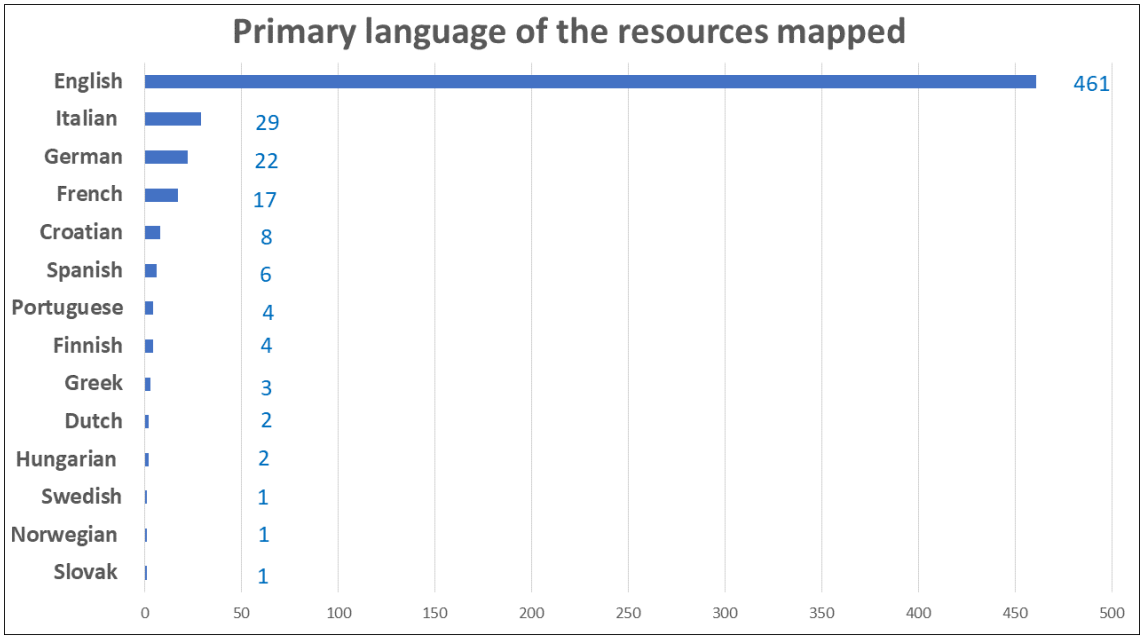
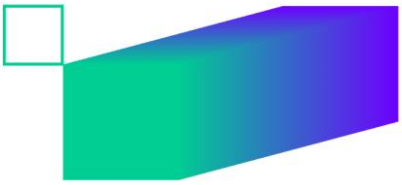


Figure 5: Primary language of the resources collected by PATTERN.



4.1.1 Open Access

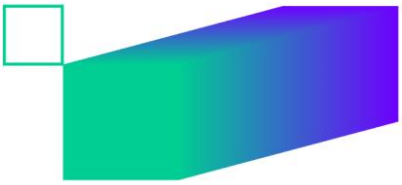
- Training resources mapped

Sixteen training resources and eighteen non-course resources were identified (Table 6). These resources cover various delivery methods, except for blended learning. The majority (28) are designed for beginners, while only a few (three) cater to intermediate levels. None are available for advanced levels, although a few cover all levels (three). In terms of target audiences, there is a notable focus on 'all audiences' (14) or 'all researchers/academics' (eight). More specific targets include 'students' (four) and 'doctoral/PhD students' (five), with two resources intended for trainers.

There is a noticeable bias towards generic content (28), with only a few exceptions for social sciences (two) and medical sciences (one). English is the dominant language (28), but there are a few exceptions, with resources available in French (three), Croatian (two), and Italian (one).

Most (20) of the identified resources presented learning outcomes, while a significant number (14) did not. Furthermore, the majority (24) did not offer any form of qualification. The prevalent type of qualification noted was the awarding of badges (seven), and one resource contributing to the European Credit Transfer and Accumulation System (ECTS).

Characteristic	Open Access – Training resources	Open Access – Non-Course Materials
Number of training activities (e-learning, courses, workshops)		
Online	**10**	
Blended	**0**	
In-person	**6**	
Number of non-course resources (static resources, webinars)		
Static resource		**9**
Webinar/lecture		**9**
Expertise level		
Beginner	**14**	**14**
Intermediate	**2**	**1**
Advanced	**0**	**0**
All	**0**	**3**
Main audience		
All audiences	**10**	**4**
All researchers / academics	**1**	**7**
Students	**3**	**1**

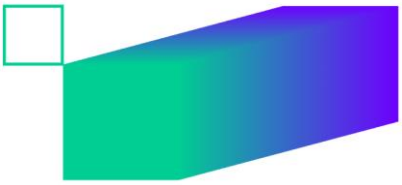


Characteristic	Open Access – Training resources	Open Access – Non-Course Materials
Doctoral/PhD students	**2**	**3**
Postdoctoral researchers	**0**	**0**
General public	**0**	**0**
Research support	**0**	**0**
Trainers/ teachers/ lecturers	**0**	**2**
Other	**0**	**0**
Learning outcomes		
Stated/implied in description	**12**	**8**
Scientific domain		
Generic	**13**	**15**
Natural Sciences	**0**	**0**
Engineering & Technology	**0**	**0**
Medical & Health Sciences	**1**	**0**
Agricultural Sciences	**0**	**0**
Social Sciences	**2**	**0**
Humanities	**0**	**0**
Primary language		
English	**12**	**16**
Others	Croatian **1**; French **3**	Italian **1**
Qualification		
Badge	**7**	**0**
Certification	**0**	**0**
Accreditation	**0**	**0**
ECTS	**1**	**0**
Other	**0**	**0**
None /unknown	**8**	**16**

Table 6. Characteristics of the mapped Open Access resources.

- Content themes of training available and any gaps

The range of topics covered by Open Access learning resources is fairly extensive. Ten content themes were identified (Table 7), with 'Open Access' itself receiving the highest count (28). Followed by 'scholarly publishing' (nine), 'publishing lifecycle' (six), and 'rights retention strategy' (six). 'Copyright' (five) and 'preprint servers' (five) demonstrated comparable levels of coverage. However, some themes were notably underrepresented, including 'predatory publishing' (four), repositories (two), and 'funder requirements' (one).



These findings suggest discernible gaps, particularly in the last three themes mentioned. Funder requirements emerged as a potential area for further development. Additional topics of significance that would benefit from more in-depth exploration include addressing specific OA routes such as gold, diamond, etc., as well as regional and EU-funded programmes. Plan S is also fundamental to the current state-of-the-art and needs explicit attention.

Content themes	Number of training resources
Open Access	**28**
Funder requirements	**1**
Rights retention strategy	**6**
Repository	**2**
Copyright	**5**
Publishing lifecycle	**6**
Preprint servers	**5**
Scholarly publishing	**9**
Predatory publishing	**4**
Research evaluation	**6**

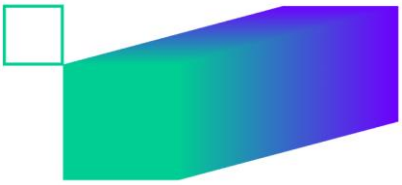
Table 7. Content themes in Open Access training and number of mapped training resources which include them.

The coverage of training and learning resources presented here is relatively limited. Indeed, numerous sources of information that are not traditionally classified as 'training' may have been omitted. These sources could be further investigated to assess their suitability (as will be discussed in 4.5.3.1). Despite their broader scope, these guides serve as a valuable forum for community engagement, benefiting OS and RRI.

4.1.2 FAIR data and Research Data Management

- Training resources mapped

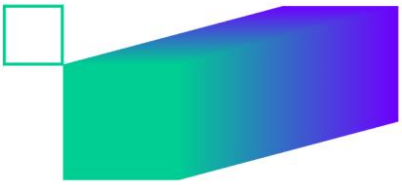
Table 8 summarises the findings. By chance, an equal number of resources was collected for FAIR data (31) and Research Data Management (RDM) (31), with most being generic but some targeting specific disciplines. Most resources are static, including webinar recordings, videos, and documents/websites. These can be useful as components of training/teaching or as references for 'further reading.' Course type trainings (e-learning, courses, workshops) were also identified, six for FAIR and thirteen for RDM, offering valuable potential contributions to PATTERN training.



Many of the resources are available for reuse, mostly under a Creative Commons Attribution (CC BY) licence. The courses under copyright, as well as those with restricted or paid access (mostly this occurs together) will not be suitable for reuse by PATTERN (or others).

Most of the resources suitable for reuse cater to a beginner or general expertise level ('all' expertise levels). In FAIR and RDM the expertise levels are often not so much about increasing in 'difficulty' but increasing the variety of topics or increasing in-depth knowledge. As with other themes, the vast majority of the resources are in English. Most of the courses do not (clearly) offer a qualification.

Characteristic	FAIR	RDM
Number of training activities (e-learning, courses, workshops)		
Online	**5**	**13**
Blended	**0**	**2**
In-person	**1**	**2**
Total	**6**	**17**
17Number of non-course resources (static resources, webinars)		
Static resource	**19**	**12**
Webinar/lecture	**6**	**2**
Expertise level		
Beginner	**17**	**19**
Intermediate	**0**	**3**
Advanced	**2**	**0**
All	**7**	**7**
Not specified / unclear	**5**	**2**
Main audience		
All audiences	**4**	**3**
All researchers / academics	**17**	**16**
Students	**1**	**6**
Doctoral/PhD students	**1**	**5**
Postdoctoral researchers	**0**	**0**
General public	**0**	**0**
Research support	**1**	**2**
Trainers/ teachers/ lecturers	**6**	**4**
Other	**1**	**0**
Learning outcomes		
Stated/implied in description	**5**	**18**
Access		
Open access	**31**	**24**



Characteristic	FAIR	RDM
Restricted access/Paid access	**0**	**7**
Rights and licences		
CC BY	**28**	**17**
CC BY-SA	**0**	**3**
CC BY-NC	**1**	**0**
Copyright	**1**	**5**
All other or unclear	**1**	**6**
Scientific domain		
Generic	**27**	**27**
Natural Sciences	**1**	**0**
Engineering & Technology	**0**	**0**
Medical & Health Sciences	**3**	**0**
Agricultural Sciences	**0**	**0**
Social Sciences	**0**	**2**
Humanities	**0**	**0**
Unknown/multiple	**0**	**2**
Primary language		
English	**28**	**25**
Others	Dutch version **1**; French **1**; German version **1** Italian **2**	Croatian **3**; Greek **1**; Hungarian **1**; Dutch version **1**; Turkish version **1;** English version **1**
Qualification		
Badge	**1**	**0**
Certification	**0**	**0**
Accreditation	**0**	**2**
ECTS	**0**	**2**
Other	**3**	**1**
None/unknown	**27**	**26**

Table 8. Characteristics of the mapped FAIR and RDM resources.

- Content themes of training available and any gaps

Table 9 and Table 10 summarise the areas and topics of training that are available. At first glance, all topics seem to be covered by one or more of the collected resources, with many addressing FAIR, data management and data archiving (>10 resources each). The content themes of RDM and FAIR data were the same at the point of data collection, and too generic to differentiate between these two complementary and, to a degree, overlapping topics.

Content themes	Number of training resources
FAIR	**14**
Data management	**27**
Data sharing	**10**
Data reuse	**5**
Data archiving	**14**
Data discovery	**7**
Quality assessment	**4**
Ethics	**7**
Open data	**6**
Open access	**5**
Open science	**8**

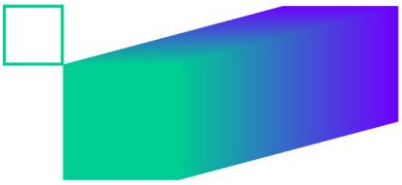
Table 9. Content themes in Research Data Management training and number of mapped training resources which include them.

Content themes	Number of training resources
FAIR	**8**
Data management	**16**
Data sharing	**3**
Data reuse	**2**
Data archiving	**2**
Data discovery	**0**
Quality assessment	**0**
Ethics	**2**
Open data	**3**
Open access	**1**
Open science	**5**

Table 10. Content themes in FAIR data training and number of mapped training resources which include them.

Indeed, the current set of content themes may be too generic to serve as a starting point for the curriculum and caters more to RDM than to the FAIR theme. Consequently, we have rephrased and expanded the current set of content themes, organising them by levels (beginner, intermediate and advanced) and categorised the resources based on target audience (see Appendix VII: Mapping and classification of FAIR data training resources).

In both the FAIR and RDM training collections, there are many resources that provide beginner and intermediate level information for students and researchers. However, there is a scarcity of advanced level training materials. These advanced



materials are likely needed for both the researcher and data steward communities to upskill on FAIR data Management. In particular, topics such as controlled vocabularies, metadata standards, file formats, interoperability processes, (trustworthy digital) repositories, and long-term curation need more comprehensive coverage to expand the training options for FAIR and RDM. Additionally, the resources targeting citizens are relatively limited.

To determine the significance of these gaps, we must first assess and map the needs of our pilot institutions. If there is substantial interest in advanced level materials, several options can be explored to fill these gaps. PATTERN could reuse and adapt the FAIRsFAIR data steward training curriculum. PATTERN could also approach other ongoing projects such as Skills4EOSC, which focus on training in these areas. It would also be important to liaise with these projects regarding the development of the data steward and researcher RDM training roadmaps, as well as the creation of training materials aimed at citizens.

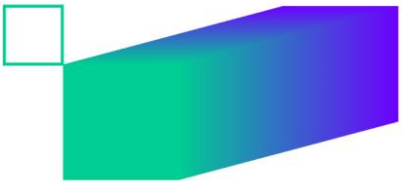
4.1.3 Citizen Science

For the Citizen Science training resources, PATTERN has added to the work of the two previous projects EU-Citizen.Science and Time4CS. The resources identified in these previous projects that are still accessible have been included in the PATTERN mapping (66 in total) and their metadata extended as required. PATTERN has also identified an additional 43 resources.

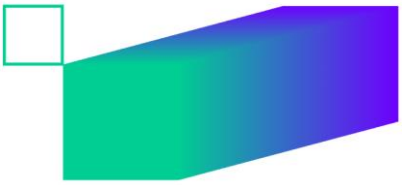
- Training resources mapped

Table 11 outlines the characteristics of the training resources for Citizen Science, totalling 54 for courses (e-learning, workshops) and 55 for non-course materials (static resources, webinars/lectures). The majority of course-type offerings are online (43), with eleven conducted in person. Non-course materials consist mostly of static resources (43), including toolkits, guides, handbooks, and short videos. Additionally, there are recordings of webinars/lectures (12). The course-type trainings gathered are mostly recent, primarily from 2021 to 2023. Some static resources, such as guides and handbooks, date back to 2012 but are still being disseminated and useful.

Characteristic	Citizen Science – Training resources	Citizen Science – Non-Course Materials
Number of training activities (e-learning, courses, workshops)		
Online	**43**	
Blended		



Characteristic	Citizen Science – Training resources	Citizen Science – Non-Course Materials
In-person	**11**	
Number of non-course resources (static resources, webinars)		
Static resource		**43**
Webinar/lecture		**12**
Expertise level		
Beginner	**28**	**10**
Intermediate	**13**	**4**
Advanced	**4**	**3**
All	**9**	**38**
Main audience		
All audiences	**15**	**17**
All researchers / academics	**14**	**24**
Students	**3**	
Doctoral/PhD students	**3**	
Postdoctoral researchers		
General public	**3**	**9**
Research support	**2**	
Trainers/ teachers/ lecturers	**8**	**3**
Other	**4**	**1**
Learning outcomes		
Stated/implied in description	**51**	**52**
Access		
Open access	**47**	**54**
Restricted access/Paid access	**7**	**1**
Scientific domain		
Generic	**38**	**23**
Natural Sciences	**13**	**31**
Engineering & Technology		**1**
Medical & Health Sciences	**1**	
Agricultural Sciences		
Social Sciences & Humanities	**2**	
Primary language		
English	**40**	**53**
Others	German **8;** Croatian **1**; Greek **1**; Hungarian **1**; Swedish **1**	Dutch **1**
Qualification		
Badge	**19**	
Certification	**6**	
Accreditation	**1**	



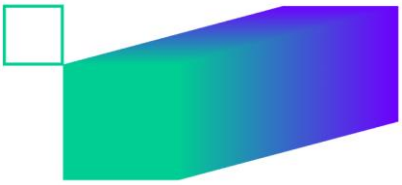
Characteristic	Citizen Science – Training resources	Citizen Science – Non-Course Materials
ECTS	**6**	
Other	**2**	
None /unknown	**6**	**55**

Table 11. Characteristics of the mapped Citizen Science training resources.

The majority of the course-type resources are for beginners (28) although the intermediate level is also well catered for (13). For static resources, the most common target is all levels (38), followed by resources aimed at beginners (10). Only a limited number of resources are directed towards advanced learners (four for course-type and three for static resources). Overall, the resources primarily target broad audiences and all researchers/academics, aiming to disseminate Citizen Science widely among potential participants, and project initiators and coordinators. The emphasis on introductory courses maybe also indicative of the maturity of the field and the stage of education that is needed. Additionally, there are courses tailored for trainers and educators (eight) and for 'Other' audiences, including Citizen Science project managers, librarians, and policy and decision-makers (four).

The learning outcomes for the resources collected tend to be well documented or can be easily understood from the resource descriptions. In some cases, learning objectives were provided rather than learning outcomes, but assuming that courses have been piloted and implemented, we expect a close match between the two and recorded them interchangeably. Most resources are open access and free. In some instances, there is the possibility of a paid upgrade, especially for Massive Open Online Courses (MOOCs) where additional benefits such as increased interactivity with tutors and peers, or certification may be available. Restricted courses (4) tend to be connected to formal education and/or targeted to early career researchers, for example Master level courses or summer schools aimed at PhD or post-doc level.

In terms of scientific domain, generic training and training aimed at the natural sciences are more prevalent, the latter reflecting many environmental and biodiversity-related Citizen Science projects, where public participation considerably extends the scale and societal impact of projects. Considerably fewer training options are available for the humanities, social sciences, engineering and technology, and medical and health sciences.



The primary language is predominantly English, although several course-type trainings are available in German (eight) and one each in Croatian, Greek, Hungarian, and Swedish. Some of the resources are translated to multiple languages (e.g. the Open Science Training Handbook) but this is not visible in Table 11 as they were not logged as separate entries, as already mentioned.

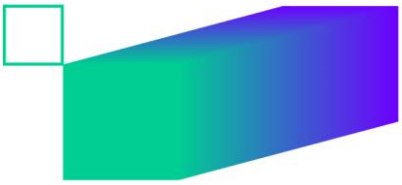
Most online course-type trainings provide badges of completion (24). Certificates of participation are classed in PATTERN under 'Other' and are fairly common (10). Five courses offer certificates of completion (four) or accreditation (one). ECTS are available in six instances where courses are linked to formal education.

- Content themes of training available and any gaps

The content themes for the Time4CS project were adopted to analyse training (Introduction to Citizen Science, Engagement, Communication, Best practices, Citizen Science stories, Data quality and standards, Project Management, Regulations and ethics, Research design and methods, Co-creation, Impact, Link with formal education, Empowerment, Evaluation of Citizen Science, Project sustainability, Reflections on science, Funding).[27] An additional 'Institutional change' was considered to reflect emerging trends in embedding Citizen Science in research institutions and organisations, which is the focus of the Time4CS project. The number of resources/trainings per content theme are shown in Table 12.

Content themes	Number of training resources
Introduction to Citizen Science	**62**
Engagement	**50**
Communication	**40**
Best practices	**39**
Citizen Science stories	**28**
Data quality and standards	**28**
Project management	**25**
Regulations and ethics	**23**
Research design and methods	**22**
Co-creation	**21**
Impact	**20**
Link with formal education	**17**

[27] Nielsen K.H. & Kragh G. (2022) D4.1 First version of the Description of TIME4CS training programs (Zenodo). https://doi.org/10.5281/zenodo.6906330, p. 11

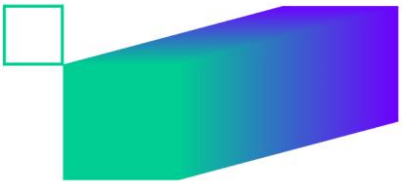


Content themes	Number of training resources
Empowerment	15
Evaluation of Citizen Science	12
Project sustainability	8
Reflections on science	8
Funding	2
Institutional change	1

Table 12. Content themes in Citizen Science training and number of mapped training resources which include them.

The most common themes include Introduction to Citizen Science (62), Engagement (50), Communication (40), Best practices (39), and Citizen Science stories (28). These themes contribute to raising awareness and interest in Citizen Science and tend to be part of the introductory training, as well as of all levels training, both of which are well represented. Next are themes that speak to those learners who are interested in actively engaging with Citizen Science, including Data quality and standards (28), Project management (25), Regulations and ethics (23), Research design and methods (22), Co-creation (21), Impact (20), Link with formal education (17), Empowerment (15), and Evaluation of Citizen Science (12). The content themes which have less than 10 resources/trainings are perhaps more specialised in nature and aimed at project leaders, namely: Project sustainability, including building sustainable communities of engagement; Reflections on science; Funding, and Institutional Change for embedding Citizen Science in organisations (e.g. Citizen Science policies and guidelines, fundraising).

The intersectionality between Citizen Science and diversity and inclusion appears to be a gap. Two static resources reported the outcomes of engaging young people with ASD (Autism Spectrum Disorder) and senior citizens as citizen scientists, creating lists of recommendations. Moreover, the integration of local and traditional knowledge and communication challenges and opportunities pertaining to traditional belief systems are not well represented in trainings collected. Training towards creating roadmaps for implementation of Citizen Science by research organisations (part of 'Institutional change') are an emerging theme being addressed by the recent Time4CS project. Further gaps identified in this project,



namely development of Citizen Science policies and guidelines and fundraising, remain.[28]

4.1.4 Research Integrity

- Training resources mapped

The data summary indicates a rich variety of both training resources and non-course materials available in the field of Research Integrity (Table 13). Training resources are predominantly offered online (10), and there is a good mix of static resources and webinars in the non-course materials category. Most resources cater for beginners, while also accommodating the needs of intermediate and advanced learners. Both types of resources are designed for a wide range of audiences, from students to established academics, with a larger portion being applicable across disciplines.

Characteristic	Research Integrity training activities	Research Integrity – Non-Course Materials
Number of training activities (e-learning, courses, workshops)		
Online	**10**	
Blended	**1**	
In-person	**4**	
Number of non-course resources (static resources, webinars)		
Static resource		**14**
Webinar/lecture		**3**
Expertise level		
Beginner	**7**	**2**
Intermediate	**4**	**3**
Advanced	**1**	**1**
All	**3**	**10**
Main audience		
All audiences	**2**	**12**
All researchers / academics	**5**	**4**
Students	**3**	**0**
Doctoral/PhD students	**3**	**1**
Postdoctoral researchers	**0**	**0**
General public	**0**	**0**
Research support	**0**	**0**
Other	**0**	**0**
Learning outcomes		
Stated/implied in description	**2**	**15**

28 Nielsen K.H. and Kragh G. (2022) D4.1 Description of TIME4CS training programs https://zenodo.org/record/6906330#.YujgMOzMJAc

Characteristic	Research Integrity training activities	Research Integrity – Non-Course Materials
Scientific domain		
Generic	**7**	**16**
Natural Sciences	**0**	**1**
Engineering & Technology	**0**	**0**
Medical & Health Sciences	**7**	**0**
Agricultural Sciences	**0**	**0**
Social Sciences	**1**	**0**
Humanities	**0**	**0**
Primary language		
English	**14**	**16**
Other(s)	Italian **1**	**0**
Qualification		
Badge	**3**	**0**
Certification	**9**	**3**
Accreditation	**0**	**0**
ECTS	**1**	**0**
Other	**0**	**0**
None/unknown	**2**	**13**

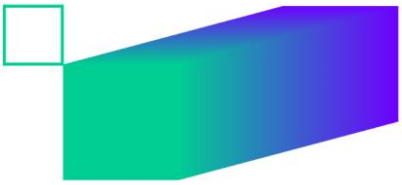
Table 13. Characteristics of the mapped Research Integrity training resources.

- Content themes of training available and any gaps

The content themes established for Research Integrity at the beginning of the mapping process (see Table 3) provide one possible framework for categorising the different training areas within the scope of Research Integrity (see Table 14). These include Responsible research and good scientific practice, Data practices and management, and Supervision and mentoring, each featuring more than 10 mapped trainings.

Similarly, areas such as research misconduct and questionable research practices, informed consent, and governance (covering implementation, assessment and evaluation, and management) are well-represented, with over 10 trainings each. Noteworthy emerging trends in Research Integrity training include research environment and research collaboration.

Furthermore, the research environment theme, as per the SOPs4RI project's taxonomy, tackles issues not explicitly addressed in prior Research Integrity courses. These relate to challenges like hyper-competition, harmful publication pressure,



detrimental power imbalances, and conflicts. On the positive side, it also encompasses aspects such as FAIR and inclusion.[29]

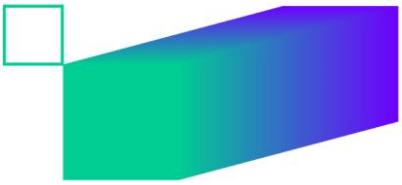
Content themes	Number of training resources
Research Integrity	**21**
Research ethics	**11**
Responsible Research and good scientific practice	**12**
Ethical review	**8**
Biomedical Ethics	**7**
Informed consent	**11**
Privacy and confidentiality	**4**
Data practices and management	**15**
Intellectual property and authorship [30]	**0**
Declaration of interests	**4**
Research misconduct and questionable Research practices	**13**
Governance	**13**
Vulnerable participants	**3**
Moral-compass: values-based trainings	**2**
Research collaborations	**0**
Research environment	**6**
Publication and communication	**4**
Open Science	**6**
Supervision and mentoring	**13**

Table 14. Content themes in Research Integrity training and number of mapped training resources which include them.

The novel training methodology of the 'Moral-compass: virtues-based trainings' covers the collegiality, openness, reflection, and shared responsibility as vital elements of the working environment. These topics are related to the overall research culture and researchers' well-being and are pro-actively being promoted by several training providers and EU-funded projects.[31]

Many trainings now address research ethics, biomedical ethics, and ethical review, indicating a growing interconnectedness of these areas. This reflects a shift towards addressing research ethics- and integrity-related topics holistically, rather than segregating them into specialised courses.

[29] See the taxonomy for RPOs: https://sops4ri.eu/wp-content/uploads/Guideline-for-Promoting-RI-in-RPOs-FINAL-2.pdf.
30 For the purposes of this mapping the 'authorship' was mostly defined as topics and issues related to 'copyright'.
31 See: https://embassy.science/wiki/Training.



However, it appears that there are potential gaps in several areas. Most notably, no courses covering Intellectual Property and Research Collaborations were identified, suggesting a significant shortage of training in these critical areas. [32] These topics are clearly important in maintaining Research Integrity. Therefore, they could be potential areas for further training activities by PATTERN.

In addition, there is limited training on privacy and confidentiality (four), vulnerable participants (three), and Open Science (six). Although these areas are not entirely omitted, the lower number of trainings compared to other areas suggests less comprehensive training.

Furthermore, it's worth noting that there could be additional omissions not captured by this overview if there are essential aspects of research integrity not reflected in the adopted content themes. For instance, artificial intelligence and emerging technologies, topics related to cultural competence in research, or addressing power dynamics in research collaborations, could be considered for inclusion to ensure comprehensive training in research integrity. Additionally, a more discipline-sensitive approach, especially by providing skills and resources for non-life and health sciences (non-biomedical sciences) is lacking and needed. It is also worth considering addressing the specific needs of groups, like citizen scientists.

4.1.5 Gender, non-discrimination, and inclusion in research

- Training resources mapped

The summary of the characteristics of the relevant training resources collected is presented in Table 15.

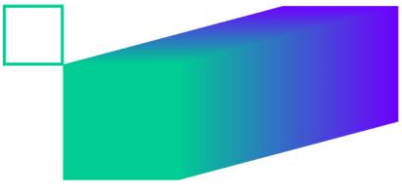
Characteristic	Gender – Training resources	Gender– Non-Course Materials
Number of training activities (e-learning, courses, workshops)		
Online/blended/In-person	**20**	
Number of non-course resources (static resources, webinars)		
Static resource; Webinar/lecture		**44**
Expertise level		
Beginner	**5**	**8**
Intermediate	**1**	
Advanced		**1**
All	**14**	**32**

32 However, note, that both themes are covered in the non-course materials.

Characteristic	Gender – Training resources	Gender– Non-Course Materials
Main audience		
All audiences	**7**	**18**
All researchers / academics	**6**	**23**
Students	**1**	
Doctoral/PhD students	**3**	**1**
Postdoctoral researchers	**2**	**1**
General public		
Research support		**1**
Trainers/ teachers/ lecturers	**1**	
Other		
Learning outcomes		
Stated/implied in description	**20**	**44**
Access		
Open access		
Restricted access/Paid access		
Scientific domain		
Generic	**17**	**35**
Natural Sciences		
Engineering & Technology	**1**	**2**
Medical & Health Sciences	**1**	**1**
Agricultural Sciences		
Social Sciences	**1**	**5**
Primary language		
English	**19**	**42**
Others	French **1**	Dutch **1**; Italian **1**
Qualification		
Badge		
Certification	**1**	
Accreditation		
ECTS	**1**	**1**
Other		
None /unknown	most	most

Table 15. Characteristics of the mapped Gender, non-discrimination and inclusion in research training resources.

The majority of the resources collected are static documents and webinars. They often offer good quality overviews and summaries on how to approach diversity issues in OS and RRI-related training. While these resources are typically not updated after publication or sharing, many remain informative, especially regarding



guidelines for creating Gender Equality Plans (GEPs) in organisations interested in securing EU research funding. Other resources are more interactive and have greater replication potential, thus attracting more participants in the long term.

Regarding the expertise level, the primary focus is on ‘all’ levels (14 for course-type training and 32 for non-course materials), followed by ‘beginners’ (five and eight respectively). The categories of ‘intermediate’ (for trainings) and ‘advanced’ (for non-course material) are less common with only one resource each.

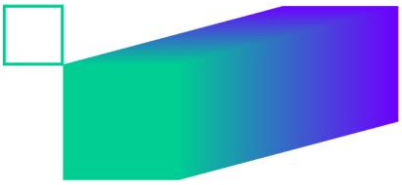
Similarly, in terms of the main audience criteria, 'all audiences' is the most prevalent group (seven for trainings and 18 for non-course materials), followed by 'all researchers/academics' (six and 23, respectively). Other audiences are less common and include 'doctoral/PhD students' (three and one), 'post-doctoral researchers' (two and 1), 'students' (one for trainings), 'research support' (one for non-course materials), and 'trainers/teachers/lecturers' (one for trainings). This trend may stem from institutions and trainers aiming to make their activities accessible to a broader audience and disseminate knowledge widely.

Regarding learning outcomes, 20 trainings and 44 non-course materials either clearly specify or make their outcomes easily identifiable from the content. This facilitates a clear understanding when selecting a training activity.

Most resources adopt a generic approach, with specific scientific domains being seldom the focal point. One or two trainings or non-course materials address engineering and technology, medical and health sciences, and social sciences. However, natural sciences, humanities and agricultural sciences were not explicitly mentioned.

English is the primary language for most trainings and non-course materials (19 and 42, respectively), with French, Dutch, and Italian were present once. The prevalence of English at least in part reflects the mapping exercise's limits, as mappers searched in languages they understood. But many of the training resources mapped have been developed by EU funded projects and are therefore in English.

The great majority of collected resources do not specify qualifications (16 for trainings, 43 for non-course materials), except for one or two mentioning certification or ECTS.



- Content themes of training available and any gaps

According to the content themes identified during the mapping exercise, 12 content themes were tracked (Table 16).

Content themes	Number of training resources
Gender Equality	53
Diversity	35
Intersectionality	19
Inclusion	22
Gender Equality Plan	30
Gender Budgeting	10
Gender-Based Violence	5
Gender Dimension in Research	31
Gender Sensitive Research	24
Organisational Culture	4
Gender+	3
Intercultural Communication	3

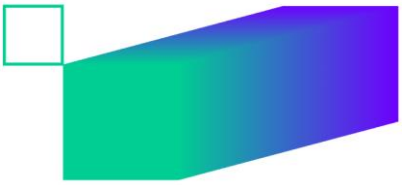
Table 16. Content themes in Gender, non-discrimination and inclusion in research training and number of mapped training resources which include them.

An umbrella Gender Equality theme is predominant (53), addressing the fundamental human right to equal access to resources and opportunities. It advocates for valuing diverse behaviours, aspirations, and needs equally, irrespective of gender.

Additional facets of gender, including gender equality plan (30), gender budgeting (10), combatting gender-based violence (five), gender dimension in research (31), gender sensitive research (24), and gender+ (three), are also important content themes within the training. These are covered either in-depth training activities or as part of more broadly formulated curricula addressing diverse aspects of gender equality. The interest in the GEP topic is tied to the EU requirement for organisations seeking EU funding to adopt such institutional level plans. Consequently, it is of interest to researchers and other relevant groups.

The collected resources can be categorised as follows in terms of content:

- Integration of gender perspective in research contents, research projects, agreements, and design of research output.



- Supportive activities and initiatives, encompassing counselling, awareness-raising, legal aid (particularly in case of gender-based violence), funding, and dissemination activities that can contribute to strengthening gender sensitive research.
- Gender equality in research teams and environment, to strengthen women's leadership in research projects, ensure equal distribution of power positions, as well as equitable access to resources and to scientific prestige.

Simultaneously, the emergence of dedicated training content on intersectionality (19), diversity (35), inclusion (22), organisational culture (four), and intercultural communication (three), signals a shift away from an exclusive focus on gender. Indeed, the EU now promotes GEP as 'Inclusive Gender Equality Plan', reflecting a broader understanding that non-discrimination transcends gender and covers dimensions such as social status, age, religion, disability, cultural differences, and others. The goal of training is to instigate transformative changes in mindset, organisational culture, attitudes, and behaviours.

Some gaps and shortcomings could be identified at this stage:

- The vast majority of the materials are static resources and webinars. Their replication potential and adaptability are limited given their lack of continuous update, considerable length (in the webinars' case) and insufficient outreach.
- Inclusion topics, other than GEPs, are not sufficiently covered, especially gender-based violence which remains one of the major problems.
- The materials available are designed mostly for all audiences and all levels of expertise. Many of them are quite basic but necessary for awareness-raising purposes. However, to facilitate cascading provision of knowledge, there is a growing need for more targeted and advanced-level training materials tailored for trainers, teachers, and lecturers. Examples of advanced level training topics include monitoring and evaluation the implementation of GEPs at the institutional level, along with assessing tangible impacts of GEPs, such as decrease in gender-based violence and increase in the representation of women in senior positions.
- A stronger focus on qualification issues is desirable to both motivate greater participation in training and ensure more effective knowledge acquisition and subsequent application.

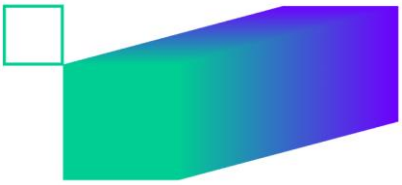
4.1.6 Dissemination and Exploitation of Results

- Training resources mapped

Twenty-one training resources (e-learning, courses, workshops) and 14 non-course training materials (static resources, webinars / lectures) were collected (see Table 17). Eleven resources are common to the Science communication training area.

Course-type training offers are both online (nine), in-person (nine), and blended (four). Non-course training materials included static resources (six) and webinars/lectures (seven).

Characteristic	Dissemination and Exploitation – Training resources	Dissemination and Exploitation – Non-Course Materials
Number of training activities (e-learning, courses, workshops)		
Online	**9**	
Blended	**4**	
In-person	**9**	
Number of non-course resources (static resources, webinars)		
Static resource		**6**
Webinar/lecture		**7**
Expertise level		
Beginner	**17**	**7**
Intermediate	**1**	
Advanced	**1**	
All	**3**	**6**
Main audience		
All audiences	**4**	
All researchers / academics	**7**	**9**
Students	**4**	
Doctoral/PhD students	**7**	**1**
Postdoctoral researchers		
General public		
Research support		**3**
Trainers/ teachers/ lecturers		
Other		
Learning outcomes		
Stated/implied in description	**17**	**11**
Access		
Open access	**2**	**9**
Restricted access/Paid access	**18**	**4**
Scientific domain		



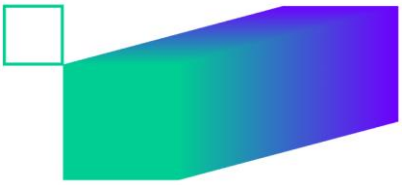
Characteristic	Dissemination and Exploitation – Training resources	Dissemination and Exploitation – Non-Course Materials
Generic	**15**	**12**
Natural Sciences	**4**	
Engineering & Technology	**1**	
Medical & Health Sciences	**2**	
Agricultural Sciences		
Social Sciences		**1**
Primary language		
English	**14**	**7**
Others	German **2**; Italian **6**	Italian **6**
Qualification		
Badge		
Certification	**10**	
Accreditation		
ECTS	**5**	
Other	**1**	
None /unknown	**6**	**13**

Table 17. Characteristics of the mapped Dissemination and Exploitation training resources.

The majority of the course-type resources are suitable for beginners (17). Similarly, the static resources are aimed at beginners (seven) and all levels (six). There is a clear shortage of resources that target the intermediate and advanced learners. In terms of audience, resources cater primarily to all researchers/academics and doctoral/PhD students and learning outcomes tend to be stated. Some static resources are targeted at research support staff (three).

While most of the static resources are open access (nine), most of the course type trainings are paid access (13). Both types of training resources collected tend to be generic, but some of the courses target the natural sciences (four), engineering & technology (one), medical and health Sciences (two). The primary language is predominantly English, followed by Italian, reflecting once again the languages of the PATTERN partners that contributed to the mapping.

Several course-type trainings provide a completion certificate (10) and some ECTS (five). This indicates that they are part of formal education. Other course-type trainings do not provide a qualification (six).



- Content themes of training available and any gaps

The number of resources/trainings per content theme are shown in Table 18. The most common content themes tended to be related to dissemination, namely scientific and technical writing (12), multimedia (eight), tools for presentation (seven). However, content themes linked to Exploitation of Research Results, such as intellectual property and business plans were also well represented with seven resources each.

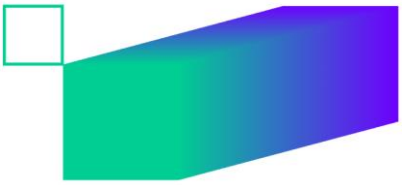
Content themes	Number of training resources
Scientific and Technical Writing	**12**
Multimedia	**8**
Intellectual property; Copyright	**8**
Tools for Presentation	**7**
Business plans	**7**
Public Speaking	**5**
Strategy	**5**
Social Media & Digital Communication	**4**
Business/Go-to-market	**4**
Social and economic impact	**4**
Technology transfer	**3**
Investments and funding	**3**
Entrepreneurship	**3**
Regulatory Affairs	**2**
Industry collaborations	**1**
Market analysis	**1**
Proof-of-Concept experiments	**1**
Team creation	**1**

Table 18. Content themes in Dissemination and Exploitation training and number of mapped training resources which include them.

Within the collected materials, there are notable gaps in the representation of certain themes, particularly those related to exploitation. It is worth acknowledging that this might be reflective of a comparatively lower mapping effort in this thematic area compared to some other PATTERN themes. Additionally, while 'social and economic impact' were assessed together, the limited focus on social impact, with only one specific resource collected, indicates a gap in this aspect.

4.1.7 Science Communication (towards media and policy makers)

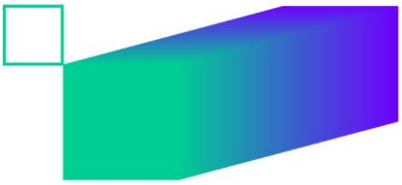
- Training resources mapped



This is the result of mapping the state of the art of science communication training activities in Europe, adding on the work previously done by two other projects (QUEST and GlobalSCAPE).

We have found 114 training activities in Science Communication (towards media and policy makers) active in Europe now: 99 are training courses (courses, workshops and e-learning modules) and 15 are non-course materials (webinars, lectures and static resources) (see Table 19). Courses are mainly designed for students at a beginner level and most activities have paid access.

Characteristics	Science Comm. – Training resources	Science Comm. – Non-Course Materials
Number of training activities (e-learning, courses, workshops)		
In-person	**66**	
Blende	**11**	
Online	**22**	
Number of non-course materials		
Static resources		**4**
Webinars or lectures		**11**
Target group		
All audiences	**15**	**2**
All researchers/academics	**14**	**8**
Doctoral/PhD students	**5**	**3**
Postdoctoral researchers	**1**	**0**
Students	**66**	**0**
Other	**1**	**1**
Expertise level		
Beginner	**92**	**10**
Intermediate	**6**	**3**
Advanced	**1**	**0**
Access		
Open access	**21**	**8**
Restricted/Paid access	**75**	**3**
Learning outcomes		
Stated/implied in description	**43**	**3**
Scientific domain		
Generic	**79**	**15**
Medicine and Health	**11**	**0**
Engineering and Technology	**4**	**0**
Natural Sciences	**4**	**0**
Humanities	**1**	**0**



Characteristics	Science Comm. – Training resources	Science Comm. – Non-Course Materials
Primary language		
English	**63**	**9**
Other(s)	Croatian **1**; Finnish **3**; French **7**; German **7**; Italian **9**; Norwegian **1**; Portuguese **3**; Spanish **5**	Croatian **1,** Finnish **1,** German **2;** Italian **2**
Qualification		
Accreditation		**0**
Badge	**2**	**0**
Certification	**64**	**2**
ECTS	**12**	**1**
None /unknown	**14**	**6**
Other	**1**	

Table 19. Characteristics of the mapped Science Communication (towards media and policy makers) resources.

The large differentiation in target audience and level of experience in training activities is explained by the fact that many of the science communication training activities are master's courses, one- or two-year teaching programmes designed for students with little or no experience in the field. They are therefore complete educational programmes to train people for a career as a science communicator. Science Communication is a discipline, with its own history and recognition. Master's courses are therefore different from other training activities, which are shorter and addressed to researchers.

In terms of main scientific domain, most of the programmes are generic. They deal with science from several points of view and then offer specific courses on different topics and disciplines. There are also some trainings in communication in specific fields.

- Content themes of training available and any gaps

Table 20 below shows the content themes of the available training in Science Communication (towards media and policy makers).

Content themes	Number of training resources
Science Journalism	**39**
Multimedia	**38**

Content themes	Number of training resources
Social Media & Digital Communication	**37**
Science Communication Theory	**29**
Science Museums & Science Centres	**22**
Health communication	**19**
Media Training	**16**
Institutional Communication & Public Relations	**15**
Environmental communication	**13**
Science Policy	**11**
Risk Communication	**11**
Communication with Policy Makers	**7**
Publishing	**5**
Event Organisation	**5**
Communicating Artificial Intelligence	**3**

Table 20. Content themes in Science Communication (towards media and policy makers) training and number of mapped training resources which include them.

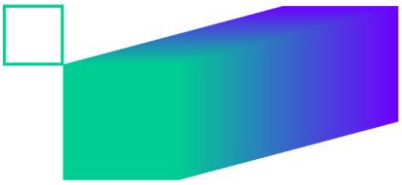
Many of the topics relate to the digital world: most of the training includes courses on multimedia (such as video or audio editing, podcasting) and on social media and digital communication. Many activities remain linked to science journalism and address a theoretical part on science communication. It is certainly worth mentioning that many courses have a stronger theoretical part, others a practical part, but most cover both.

There is increasing focus on health communication and communication related to the environment and climate change. Courses in museums and science centres are present, but not widespread.

At the institutional level, there are courses on institutional communication, media relations, and media training. The latter one is aimed at training researchers to interact with the media, with a different purpose from science journalism.

Some training courses on science communication also cover the theme of 'Dissemination and Exploitation': for example, how to prepare a presentation, public speaking, technical writing.

Some gaps that have been identified:



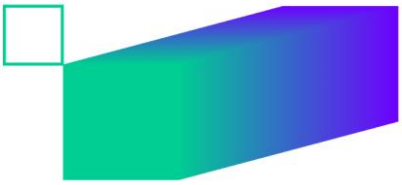
- Most courses are aimed at beginners and cover different topics at an introductory level. They are not only courses for researchers but for target audiences with different learning objectives.
- How to engage with policy makers is rarely covered in courses. This can be explained by the fact that this type of audience is not institutionalised in all countries. This is an issue that needs to be strengthened.
- Communicating Artificial Intelligence will be increasingly important in the future, but it is still a topic that needs to be developed.
- Science Communication courses related to transversal topics covered by PATTERN, such as diversity and inclusion, are not yet widespread.
- It is increasingly crucial to teach how to communicate the uncertainty of science and its limitations.
- Courses on data visualisation and graphics are missing.

4.1.8 Management and leadership

- Training resources mapped

The mapping of existing learning opportunities for researchers in Management and Leadership skills associated with RRI collected a total of 44 resources provided by 33 different institutions (see Table 21). These resources are classified into proper training activities such as courses, workshops, and e-learning modules (36 resources), as well as non-course training materials such as webinars and static resources (11).

Characteristics	Management and Leadership – Training resources	Management and Leadership – Non-Course Materials
Number of training activities (e-learning, courses, workshops)		
In-person	**10**	
Online	**15**	
Blended	**8**	
Total	**33**	
Number of non-course materials		
Static resources		**3**
Webinars or lectures		**8**
Total		**11**
Target group		
All audiences	**2**	**7**
All researchers/academics	**9**	**3**
Doctoral/PhD students	**7**	
Postdoctoral researchers	**7**	



Characteristics	Management and Leadership – Training resources	Management and Leadership – Non-Course Materials
Students		
Research support	**8**	
Trainers/teachers/lecturers	**1**	
General public		**1**
Other	**2**	
Expertise level		
Beginner	**12**	**1**
Intermediate	**8**	**2**
Advanced	**8**	
All	**8**	**8**
Learning outcomes		
Stated/implied in description	**30**	**4**
Scientific domain		
Generic	**31**	**11**
Medicine and Health	**2**	
Engineering and Technology	**1**	
Natural Sciences	**1**	
Social Sciences	**1**	
Primary language		
English	**30**	**11**
Other(s)	French **2**; German **2**; Italian **2**	
Qualification		
Accreditation		
Badge	**1**	
Certification	**11**	
ECTS	**1**	
None /unknown	**1**	**11**
Other	**1**	

Table 21. Characteristics of the mapped Management and Leadership training resources.

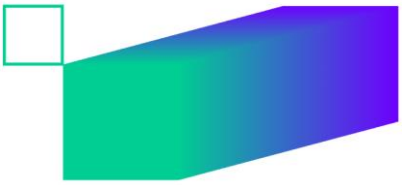
Out of the 36 training activities identified, 15 were delivered online, eight in a blended modality, and 10 were provided in person. 12 resources were available for beginners, and eight each for intermediate learners, advanced learners, and all expertise levels. The main audience for the training activities collected varied greatly: while two targeted all audiences, others focused on specific groups such as researchers/academics (nine), doctoral/PhD students (seven), postdoctoral

researchers (seven), and research support staff (eight), Trainers / teachers / lecturers (one) and other audiences (two). In terms of access rights, 18 courses required a fee to access the content, and 12 training activities had restricted access, being available exclusively to students affiliated with the organising institution. Only five of them were published as open access. Regarding the scientific domain covered, the majority of the resources (31 courses) were categorised as generic. The remaining courses had a more specific domain, with one training in engineering and technology, two in medical and health sciences, one in natural science and one in the social sciences. English was the dominant language for accessing these materials, with 30 resources. Additionally, there were training activities conducted in French, German, and Italian, with each language accounting for two courses. Regarding the qualifications provided upon completion of the courses, only 11 courses provided certifications, one ECTS and one offered a badge.

In addition to the training activities, the mapping also collected a total of 11 non-course training materials, with three being static resources and eight being webinars. These include, in terms of the expertise level required, one beginner-level resource, two intermediate-level resources, and eight resources available for all expertise levels. The majority of non-course training materials were designed for a broad audience (seven resources for all audiences and one for the general public), while only three of them were specific to researchers and academics. All non-course training materials are classified as generic and are provided exclusively in English. None of them provided certification.

- Content themes of training available and any gaps

Almost all the identified topics are covered by one or more resources, with many of them presenting overlaps between different themes (Table 22). A significant group of courses deals with the skills required to be an effective research leader (16), with a considerable number focusing on inclusive leadership and strategies to address pressing issues such as racial and gender discrimination, as well as the underrepresentation of staff and students with minority ethnic backgrounds (five promote inclusion and diversity; nine, empowerment). Similarly, great emphasis is placed on personal well-being and stress-related problems among researchers, with eight resources for coping with pressure, 10 for self-organisation, and seven for



managing performance. Trainings on project management are also well represented with 14 resources. These courses mostly deal with the administrative and financial aspects of research projects. However, they do not seem to sufficiently address the topic of Resource Management which is covered by only three courses.

Content themes	Number of training resources
Team development	11
Conflict resolution	2
Coaching, Supporting and Leading Change	7
Managing Performance	7
Leadership	16
Communication styles and strategies	4
Problem solving	5
Recruitment,	8
Empowerment	9
Project management	14
Resources management	3
Project sustainability	1
Cope with pressure	8
Self-organisation	11
Strategic thinking	8
Promote inclusion and diversity	5
Build mentor-mentee relationships	3
Networking	0
Career development	5

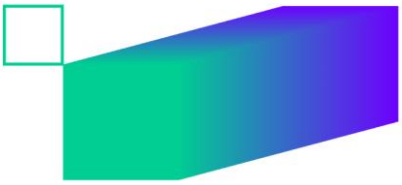
Table 22. Content themes in Management and Leadership training and number of mapped training resources which include them.

Courses on two key themes seem to be lacking. Firstly, more resources are required for mentor-mentee relationships. Secondly, additional materials to help researchers connect with peers, mentors, and industry professionals could help to fill the existing networking gap.

4.1.9 Collections Catalogues Platforms

- Mapping results

The mapping of the collections, catalogues and platforms for Open Science activities, education, training and support in Europe resulted in the following findings. A compilation of 19 platforms was identified, offering tools or materials



beneficial for various aspects of Open science training, both in a general context and within specific domains and disciplines.

These platforms provide resources for learning on Open Science subjects/themes, with 14 of them offering online training courses. These courses cover areas such as FAIR data, RDM, and the practical application of Open Science principles. There are also six platforms that specialise in specific scientific domains, like social sciences, arts, humanities, and archaeology.

- Training available and any gaps

Most of the platforms have materials on RDM (10) and general Open Access/Open Science (10), some include training on FAIR Data (eight), Dissemination and Exploitation of Results (seven), Research Integrity (seven), and Science Communication (four), with a few with content on Citizen Science (three). There seems to be a lack of training materials on Management and Leadership in Open Science practices.

Nine platforms primarily offer an extensive array of courses, e-learning modules, or workshops, whereas eight others predominantly provide static resources. Within these platforms, some records include materials or plans for organising courses or training sessions related to various aspects of Open Science. The target audiences for these resources are typically implied and depend on the subject or scientific field covered in the training.

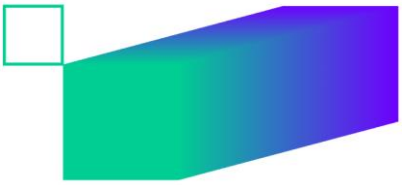
The records are mostly in English, but there are also resources in Dutch, German, Spanish, Hungarian, Slovak, French, and Slovenian.

4.1.10 Open Science and general RRI training

During the mapping exercise we came across some potentially useful resources that overarched the eight themes of PATTERN. These were best described as Open Science or general RRI resources and are presented here for completion.

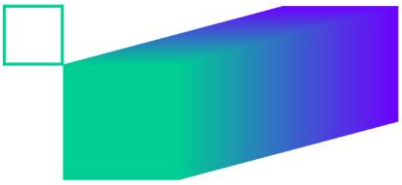
- Training resources mapped

Fifty-one training resources on 'Open Science' were collected, of which 24 were course-type trainings (e-learning, courses, and workshops) and 27 were non-course training materials (static resources, webinars / lectures) (Table 23). The course-type



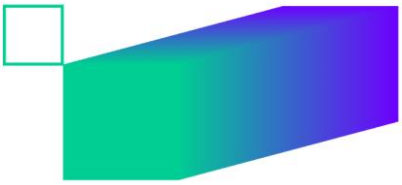
trainings were mostly online (20) and aimed at the beginner level (11) or all levels of expertise (seven), but three were suitable for advanced learners. Similarly, static resources were for beginner (nine) or all levels of expertise (14) and four were suitable for the intermediate level. The main target audience was in both cases researchers and academics (nine for courses, 21 for static resources) and all audiences (five and three, respectively), with some courses also aimed at PhD students (four) and other audiences (five). The latter included the private sector, civil servants, developers, etc. Most of the training resources were open access, domain independent, and in English. Only a few resources were in other languages, such as French, German, Italian, Portuguese, and Greek.

Characteristic	Training resources	Non-Course Materials
Open Science training		
Number of training activities (e-learning, courses, workshops)		
Online	**20**	
Blended	**2**	
In-person	**2**	
Total	**24**	
Number of non-course resources (static resources, webinars)		
Static resource		**21**
Webinar/lecture		**6**
Total		**27**
Expertise level		
Beginner	**11**	**9**
Intermediate	**3**	**4**
Advanced	**3**	
All	**7**	**14**
Main audience		
All audiences	**5**	**3**
All researchers / academics	**9**	**21**
Students	**1**	**1**
Doctoral/PhD students	**4**	**2**
Postdoctoral researchers		
General public		
Research support		
Trainers/ teachers/ lecturers		
Other	**5**	
Access		
Open access	**19**	**25**



Characteristic	Training resources	Non-Course Materials
Restricted access/Paid access	**5**	
Not specified	**2**	**2**
Scientific domain		
Generic	**23**	**24**
Natural Sciences		
Engineering & Technology		
Medical and Health Sciences		
Agricultural Sciences		
Social Sciences and Humanities	**1**	**3** (Social Sciences)
Primary language		
English	**20**	**21**
Others	French **2**; German **1**; Greek **1**	French **1;** Italian **4**; Portuguese **1**
RRI training		
Number of training activities (e-learning, courses, workshops)		
Online	**8**	
Blended		
In-person	**1**	
Total	**9**	
Number of non-course resources (static resources, webinars)		
Static resource		**6**
Webinar/lecture		
Total		**6**
Expertise level		
Beginner	**11**	**9**
Intermediate	**3**	**4**
Advanced	**3**	
All	**7**	**14**
Scientific domain		
Generic	**8**	**4**
Natural Sciences and Engineering & Technology	**1**	
Engineering and Technology		
Medical & Health Sciences		**2**
Agricultural Sciences		
Social Sciences and Humanities		
Primary language		
English	**9**	**6**

Table 23. Characteristics of the mapped training resources overarching Open Science and RRI.



In the 'General RRI' spreadsheet, T1.1 collected 15 training resources, namely nine course-type materials (e-learning, courses, and workshops) and six non-course training materials (static resources, webinars / lectures). All were in English and most were domain independent. There were some examples for natural Sciences and engineering and technology (one e-learning module) and two static resources for medical and health Sciences.

- Content themes of training available and any gaps

The number of resources/trainings per content theme are shown in the tables below for respectively general Open Science (Table 24) and general RRI (Table 25). The most common content themes reflect the broad interest in the content theme, whereas the least common themes may be indicative of more specific training.

Content theme	Number of training resources
Open Data	**41**
Open Access	**31**
Open Science tools	**23**
Open reproducible research	**20**
Open Science definition	**19**
Open Software/Open Source	**18**
Open Science evaluation	**17**
Open methodology	**14**
Open Science guidelines	**14**
Open Science policies	**14**
Open Notebooks	**11**
Citizen Science	**10**
IPR and legal skills	**10**
Open Peer Review	**9**
Open educational resources	**9**
Open Science projects	**8**
Train the trainer	**4**
Research Integrity and OS	**2**

Table 24. Content themes in general Open Science training and number of mapped training resources which include them.

Content theme	Number of training resources
Implementing RRI	**10**
Research Integrity	**10**

Content theme	Number of training resources
Science Communication	8
Open Access	7
Citizen Science	7
Open Science	7
Gender	7
Governance	5
FAIR data and RDM	5
Dissemination	4
organisational support for OS	4
Diversity and Inclusion	3
Reproducibility in research	2
Exploitation and IPR	0

Table 25. Content themes in general RRI training and number of mapped training resources which include them.

4.2 Survey

The survey provided an additional 48 training resources to the mapping workbook. This was one of the main aims of the survey, as well as collecting information regarding training needs and preferences. The overall results have been published in Zenodo.[33]

The survey gathered 135 completed responses and an additional 248 partially completed responses. Moreover, it reached more than twenty countries, the great majority of which were located in Europe, but a few responses were from North America, Asia, Africa, and Australia. Around two thirds of the respondents were based in public research institutes or universities. However, those working in other sectors also took part, namely associated with private research institutes (9%), corporations (13%), non-profit sector (9%), and other (5%), e.g. freelancers. The majority of respondents (73%) came from the natural sciences, medical sciences, agricultural sciences, and engineering and technology.

The respondents covered a range of professional activities (Figure 6). Research managers and principal investigators (24%) made up the largest group of respondents, followed by research support staff (16%), administrators/managers of research institution or organisation (15%), researchers (14%), other (such as librarians, project managers, business consultants, technologists, etc.) (14%), trainers/educators

33 https://zenodo.org/records/10285420

(9%), research funders (2%), postdoctoral researchers (4%), PhD students (4%), and Master students (1%). Thus, early career researchers do not appear to be well represented (9% in total only).

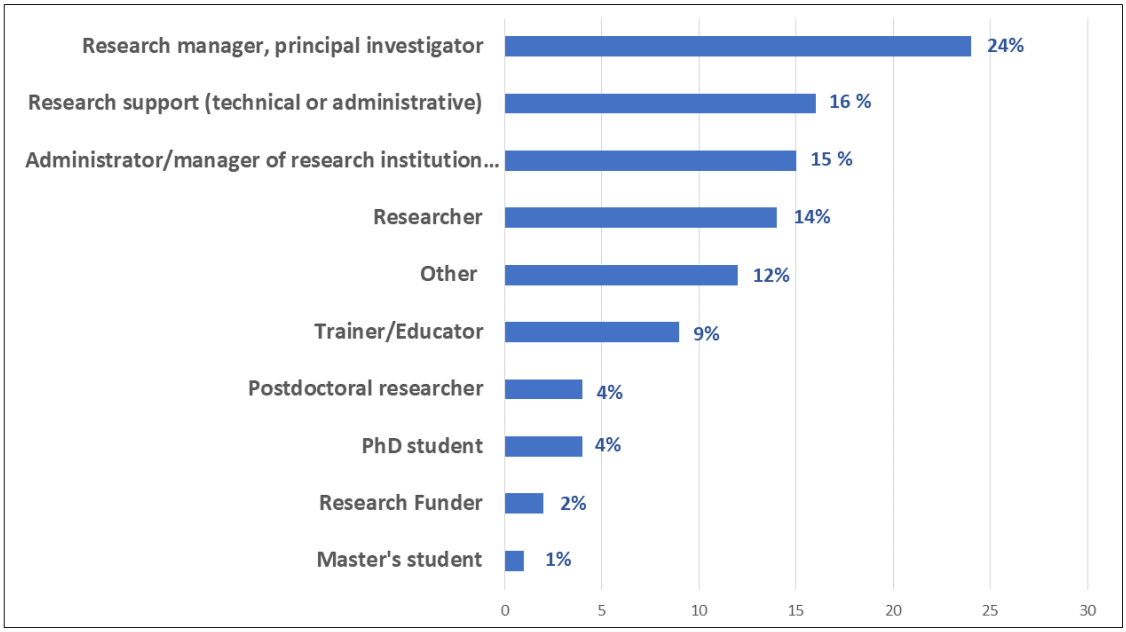


Figure 6. Current professional activity of survey respondents. Responses to the question: 'Which of the following best describes your current activity?'

- Training needs and preferences

The survey respondents felt that trainings in the various Open RRI areas were needed at their organisations. Considering together 'highly needed' and 'needed' replies, training in FAIR data was in most demand (73%), followed by Science Communication towards media and policy makers (69%), Leadership and Management (66%), Research Integrity (61%), Citizen Science (56%), Dissemination and Exploitation (55%), and Open Access (53%) (Figure 7).

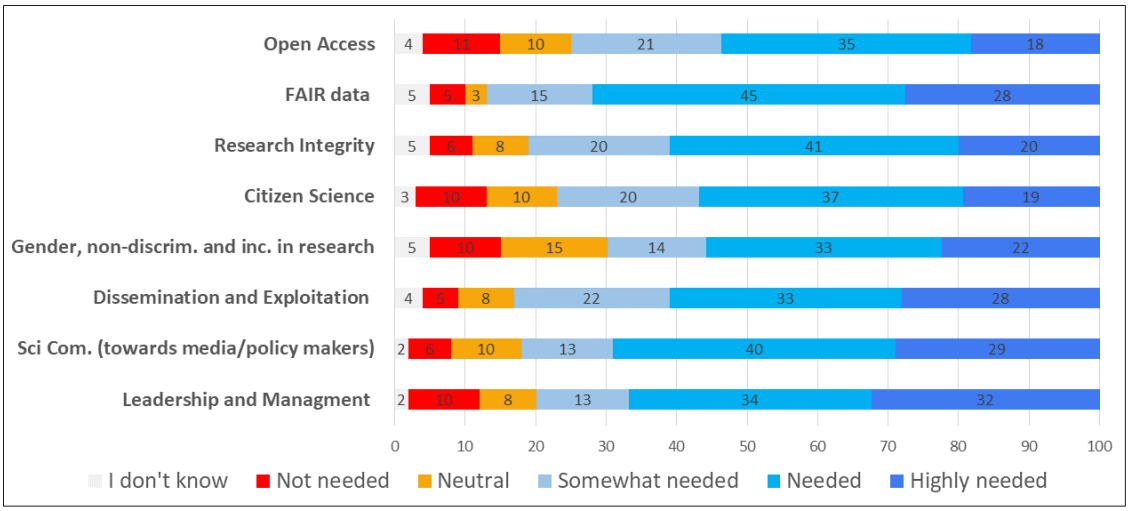


Figure 7: Additional training needed at the respondents' organisation. Percentages of responses to the question: 'What extra training programmes and resources for Open RRI are needed in your organisation?'

The topmost important characteristics of training were content and learning objectives (87% of respondents considered it very important or important), knowledge exchange opportunities with others (81% of 'important' and 'very important' responses), expertise level of trainings (74%), and who provides the training (70%) (Figure 8). This was followed by subject specificity (i.e. relating to a particular domain or field of knowledge) (61%), being freely available online (60%), pedagogical approaches (56%), duration (50%), accreditation by a professional association or community of practice (46%) and being instructor-led (40%). Respondents felt less strongly about whether trainings were self-paced or in-person (35% and 32% of 'important' and 'very important' responses, respectively).

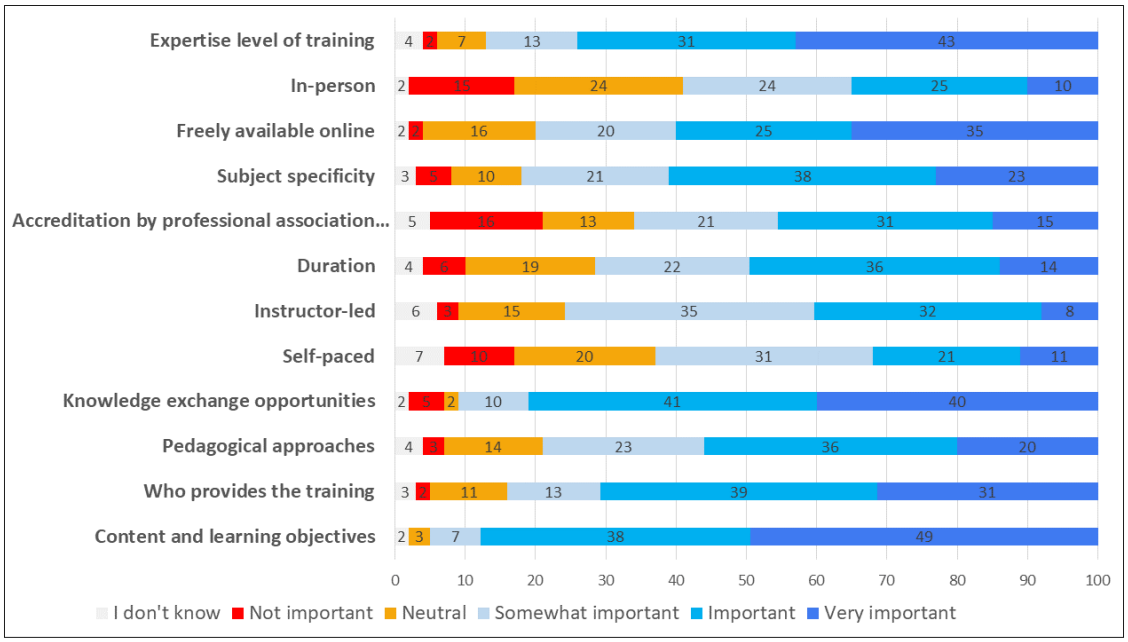


Figure 8: Relevance of training characteristics. Percentages of responses to the question: 'in considering Open RRI training activities, how important are the following to you?'

The preferred types of training were courses, onsite or blended (56% of responses), onsite instructor led workshops (53%), and webinars (51%) (Figure 9). Online training modules (42%) and online instructor led workshops (39%) were also popular.

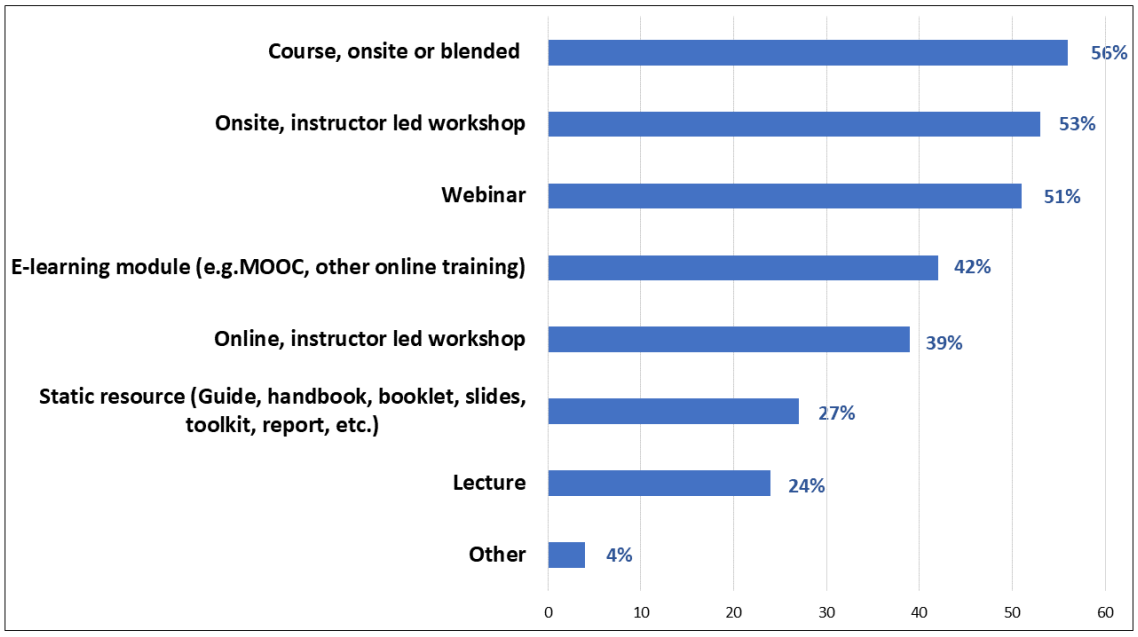
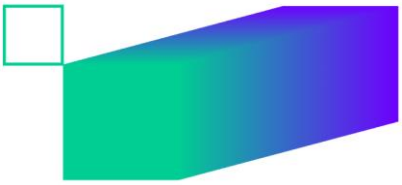


Figure 9: Types of training preferred. Responses to the question: 'what types of training in Open RRI work best for researchers?' (multiple choice allowed)



- Personal experiences and perceptions of trainings

The question 'Think of an Open RRI training activity you participated in. Can you list three best things about it? Have you used any of the skills and knowledge from the training in your work?' generated a wealth of insights (Appendix VIII: Experiences of survey respondents of training in Open RRI).

Many put focus on engagement, the exchange of information and knowledge with colleagues across disciplines and across the world, as well as reflexivity. This is exemplified here:

'The most important is engagement, the ability to give space to people to express their own experiences and to synthesise'.

'I began to link the promotion of RRI practices and the development of research directions that truly have societal impact beyond pure academic publication metrics'.

In terms of pedagogical approaches, active approaches with case studies, project work and exercises, leading to finished products were valued, especially when related to the participants specific projects. Interactivity was also mentioned:

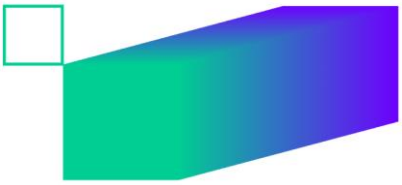
'Trainings which are not only frontal, but where trainers interact with the trainees or where trainees interact with themselves'.

In online trainings one way of achieving this was with break out rooms.

There were expressions of preference for 'short training formats where applicable tools are provided rather than reading lists', 'good materials for consultation after the course', in person events, and 'small group format, facilitating open, relaxed debate', and the 'standing offer to follow up, by phone, email, zoom, in person, etc.'

The establishment of communities of practice across organisations was also talked about especially in connection with FAIR data to support knowledge sharing between research offices, libraries, IT infrastructure, and research groups, as well as training resources.

Several respondents indicated that they used the teachings from the trainings, for example improving communication skills, interdisciplinary cooperation, version



control, preregistration, application of FAIR principles and standing up for Research Integrity.

As further comments, several respondents mentioned:

- 'This kind of training should BE mandatory at PhD level and in some courses at Master level, such as psychology, medicine, and other that require human participants'.
- 'Open RRI should be embedded in all programmes funded by public money'
- Or specific to FAIR data Management:
- 'F and A in FAIR are relatively easy but I and R take a long-term commitment and investment'.

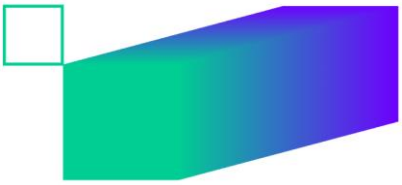
4.3 Interviews

The interviews generated rich material regarding training needs or trends in several of the PATTERN themes. Some key insights are summarised below, with exemplifying quotes:

1. Fostering a culture of reusability of data. Making data FAIR is essential but not sufficient, the ultimate purpose is data reuse and training should create interest in this area. Repositories have a big role to play here.

> *'[Except for certain domains] there is a lot of hesitation to reuse existing data. We should now move, we as at the larger community, from focusing almost strictly on making data more open and FAIR to, hey, we also need a culture to use the data that's out there (...) I think funders could do much more to sensitise everyone. Hey there is a rich variety of data across the world in all these 3000 - 4000 data repositories'.*
>
> *'We notice umm let's say some misconceptions about repositories (...) [Archiving] is not just for bringing data and leaving it there to die, but it's very much a place where data live on until the next user takes something out of the repository to reuse and to give it a new life.(...) That is something which we should keep highlighting in all kinds of trainings because it will help researchers, for instance, to write a better data management plan at the start of the project (...) I would say a bit of promoting repositories, not just for the sake of repositories, but very much for the sake of keeping the ball rolling and seeing Open Science as a continuous process'.*

2. Data sensitivity training is still in demand, especially in connection with GDPR regulations, in spite of the existence of national and international rules and legislation. Sensitive data is a broader topic that includes also IPR and national security, for example.



'We've been involved as an organisation (…) in developing our own training (…) for data stewards, people in research data support, and in the evaluation there was, of course, the question what would you need next? And a typical answer was, I want to know more about how to deal with personal data, sensitive data. There is a lot of concern which I think is also perhaps increased with the whole GDPR development. (…) I sometimes get annoyed by having this question again and again because there is already so much knowledge out there'.

'I think it's a shame when sensitive data is reduced to just personal data. I mean, there can also be commercial data commercial data that is sensitive or secure. I'm pretty sure that people at Defense Academy or the police Academy also deal with sensitive data, which is not necessarily about personal stuff or IPR, but probably security related'.

3. Intersectionality between Research Integrity and other topics is not well covered in training, namely in connection with Open Science, inclusion, climate change and environment, financial and social consequences of research misconduct.

'If you think about the research integrity also in terms of inclusion, diversity, climate change, environment, supervision, there are gaps because there are no modules or (…) specific training, addressing diversity, inclusion, the research environment, environment, especially for lab related research. Not to waste your solvent down the sink and uh but try to be more environmental friendly. (…) and [for] financial, for instance, social consequences of research misconduct (…) And yeah, also in terms of Open Science'.

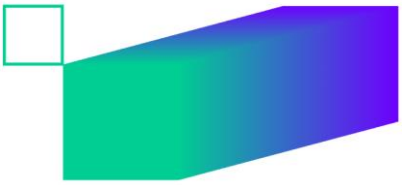
4. The current trend in Research Integrity training is for generic training that fosters critical thinking which enhances adaptability to varied contexts, even though most of the case studies are domain specific. Moreover, the case studies provide an opportunity to keep the training updated.

'The majority of the case studies are in relation to biomedical science and because it's easier because there are cases already out there but is not really so focused on the discipline. So, you can use the same training for training people coming from social sciences or the humanities, or the engineering or natural sciences. There is no problem at all because the main issues are the same'.

'Nowadays there is the tendency to not to think in terms of discipline but mainly to think in terms of what kind of skills researchers have to develop, so critical thinking, of course they need basic knowledge about the topic, but of course they need to be able to think about the precise issue and to solve it or to deal with the precise issue that can be related to or to [authorship] or other topics'.

'Nowadays there is the need [to] develop training on, for instance, artificial intelligence and how to use chat box or other software like chat box. (…) Or if you are using case studies, to keep the case studies updated, in order to follow the new trends and new tendencies'.

5. In terms of non-discrimination, dimensions to Diversity and Inclusion beyond gender and consideration of intersectionality among the different dimensions need



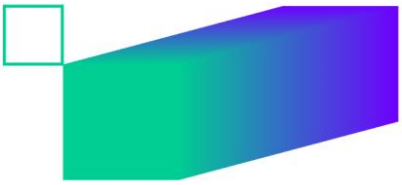
to be addressed, requiring training materials to enhance self-awareness of bias/privilege, as well as action tools and theoretical foundations (around critical race theory, decolonial practice, and social identity theory).

> *'I think in organisations today it's the gender agenda as you know well. But even within gender (…) there's so much within gender, we're simply overlooking, right? Gender when it interacts with race and religion and ethnicity, what happens then, right? What happens when it interacts with sexual orientation? We pay attention to binary gender identities. And quite frankly, it depends where we are in the world (…) In the in the European context, we're paying attention primarily to white women, right? And the 13 percent, 10% of populations that are from non-white ethnic background? Citizens who are non-white ethnic backgrounds are often really overlooked. Disabilities, 15% of our populations around the world are disabled. Living with some form of visible or invisible disability. Most of the organisations I work with you will not find a single [visibly] disabled person in'.*
>
> *'It's about the assessment of, uh, the subjective assessment of bias. So, we researchers (…) are usually used to rely very much on [our] judgment. [Researchers] trust their intuitions because they're used to the (…) fact that they study and information and so on. So, among all the humans in the world, they seem very unwilling to become aware of what (…) bias and prejudice are. The attitude is always as if we were talking about the problem that it would not concern them (…) It would concern these other bad people who are like very prejudice and very biased and so on and so forth. And I think that one huge issue in respect to this is instead acknowledging and recognising that we all suffer from all sorts of biases. Including gender biases, whether we're men or women or non-binary people. And I think this is like a piece of this puzzle that is typically missing. And I guess (…) the way to add the missing piece is probably not just to tell people that that's the case because that can also be (…) either perceived as non-cooperative or challenging or threatening. But maybe there could be ways to let people realise their own prejudice.'*

6. Inclusivity is a 'hot topic' in Science Communication. Understanding who we are not reaching in science communication, how to reach them and engage with them.

> *'Another key topic that I think has been coming through in more recent years is around inclusivity in our sector [Science Communication]. Where are the underserved groups and communities that are or aren't reaching in our activities and work? I think that's a key element. And that we now see coming through again and again'.*
>
> *'When we talk about more participatory approaches, how do we bring in those communities who haven't been able to participate? I think that could be a bit of a focus'.*
>
> *'It's not just about saying, 'well, (…) we have to reach out (…) we also have to understand the values that those different groups have and understand what are the ways that we can work with them in ways that don't violate our principles about what science is. Inclusion sounds like a great thing, but it turns out to have (…) challenges and contradictions'.*

7. Communicating effectively implies negotiating a number of challenges such as how to convey uncertainty and current limits of scientific knowledge accurately. It is important for researchers to understand the concepts of news, misinformation,



disinformation, and pseudoscience and how these hinder communication, as well as other basics of science communication. Namely, there is still a need to train people beyond the deficit model, moving towards more dialogical approaches.

'One challenge is translating complex messages, translating uncertainty for example, into (...) as simple as possible message while maintaining accuracy because of course it's always easy to, you know, to translate the message, but if you lose accuracy, if you oversimplify it, then it's a problem'.

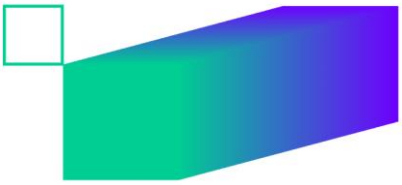
'One challenge that I focus on is what is called the infosphere. Infosphere is the world of information (...) a technical term invented really quite recently. All the information that surrounds us, it can be TV advertisements on the street, social media. The infosphere has changed very significantly in the past 20-30 years. It's a very noisy environment. So, communicating science means getting a message across a very noisy environment. And more specifically, the problem that I look at is the existence of pseudoscience and pseudoscientific messages in this very noisy environment. (...) Scientific disinformation is a very special kind of disinformation, and often it originates in pseudoscience (...) and it's something (...) that presents itself as scientific without actually having gone through the extremely rigorous and, you know, time consuming method of scientific research. Now this kind of noise is very special because to the lay public, to the non-experts it looks like it's reliable information'.

'Not everyone is a Richard Feynman, who you know was really good scientist, an amazing communicator. I mean it's rare. So I think it would be good to make all scientists aware of the challenges of communication, make them aware of the existence of pseudoscience. Because maybe sometimes scientists believe a little bit in a bubble where they think that whatever they come up with will immediately reach the audience in an unadulterated way'.

'The biggest need is for [training for] those occasional to science communication to be available, maybe not even available, required. For the occasional science communicators that don't expect every scientist to become a science communicator. That's not what they're interested in, and many of them are not very good at it and should not do it. But I think every scientist should be exposed to science communication and should know what some of the principles are and what some of the basics are, because they will never know when they suddenly have to be involved in it'.

'There's one trend and I'm here - supposing rather than knowing for sure - and that is that there would be more attention given in recent years to the ideas of two way communication; engagement, it's called in some cases; dialogue, it's called in other cases and so it's not just about how do you sell and market your message or your topic or your project, but also how do you listen to what people are interested in, what their concerns might be?'

8. Training is needed on how to use social media in Science Communication, including search engine optimisation and analytics, as well as data visualisation (i.e. graphics) in digital and social media communication.



'Some of the key things that we've seen coming through recently are aspects like social media use, misinformation, disinformation'.

'That's another gap, clearly, social media, electronic visual communication issues. Well, I'll put visuals separately. I'll call it social media. We have some people who are very good at it, but don't know that we have trainings for it that are more than someone's personal experience. "This is how I do it. This is what I think is best". We certainly don't have science training that pays attention to search engine optimisation or to analytics and things like that. Visual communication is another one where we know that in the modern world visual communication is key'.

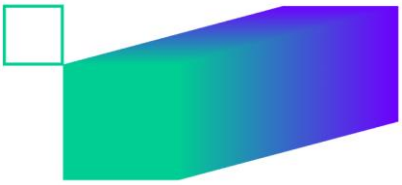
'I know that the people in advertising know a lot about social media and about what works and what doesn't work, and about how to do analytics and about how to tweak social media based on what the analytics tell you. And we should be doing that in science communication as well. But we are not teaching how to do that. (...) And then the visual: it's just that again, because so many of us came out of a writing world or journalism, or something. Not as many of us come out of the photography world or the fine art world (...) or graphic design'.

9. Theoretical dimensions of science communication (e.g. science in society, communication theory) are essential in even short duration training.

'If I were to write the curriculum, I would try to ensure that even in the shortest course, there is something about the social context, the ideological context. We're not just about selling science or advocating for science and something about communications theory and based on the long running discussion about science, communication models and so on'.

'I think the relationship between science and society and is a core issue in science communication to consider before you start to think about any practical aspects of science communication delivery, I think an understanding of that relationship is really important. The various different mediums and mechanisms for communicating and engaging with the public, I think that's something you will always see coming through in training programs and also elements around research and evaluation. So how do we actually assess and understand the outcomes and impacts of the work that we're involved in?'

Some transversal issues across the different themes appeared, namely related to quality and sustainability, inclusivity, the predominance of the English language training, the aspiration that materials and platforms will be reused, and the need to better understand the impact of training, to create incentives and rewards for open and responsible science, and to engage the research funders. Gaps and needs will be further presented below in sections 5.2.1, 5.2.3, and 5.3.7. The interviewees also suggested several projects which PATTERN could follow and engage with, and these will be related in section 4.5.3 when discussing opportunities for PATTERN.



4.4 Mutual Learning Events

In the following section, we provide a summary of the principal findings from the MLEs, with a focus on the second and third. The first MLE primarily complemented the mapping activities and provided a forum for discussion of quality criteria (section 3.5.1). The results will be presented in relation to the six key areas discussed: the recognition of general trends influencing education and training, technological trends, pedagogical trends concerning early career researchers and late-career researchers, the definition and evaluation of relevant learning outcomes, and strategies to ensure the sustainability and impact of the training.

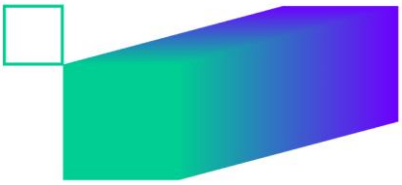
4.4.1 General trends influencing education and training

Participants identified key trends covering the impact of the COVID-19 pandemic, the integration across disciplines and alignment of training content, the role of late-career researchers, and an increased emphasis on criteria and evaluation.

The COVID-19 pandemic catalysed a shift in learning methodologies, driving the widespread adoption of online and asynchronous formats. This digital transition enabled flexible remote engagement, fostering a trend towards interactive and learner-centric approaches. In addition, this allowed for a stronger flexibility and personalisation of training formats whereby contents can be adapted to accommodate individual interests and learning needs. However, concerns persist regarding accessibility, with English-language dominance and limited dissemination channels posing challenges for diverse outreach.

A second notable trend involves the integration of topics across disciplines to promote interdisciplinary perspectives and application of knowledge in diverse contexts. In tandem, emphasis has been placed on aligning training strategies with the existing needs and training frameworks in Research Performing Organisations (RPOs), to impart transferable skills and competences, including ethical reflection, critical analysis, and responsible decision-making.

Thirdly, academic supervisors and late-career researchers have gained prominence in Open Science training. Their mentorship supports early career researchers, enhancing learning experiences. Late-career researchers are now a target group for training, necessitating consideration of factors such as time constraints, incentives, and tailored communication.



Finally, there is a trend towards a stronger focus on specific quality criteria and the evaluation of training programmes. Criteria for successful or effective training initiatives include reusability, adaptability, regular updates to reflect current trends, accessibility to a wide audience, integration within organisational frameworks, and appeal to learners. Regular evaluation ensures quality, ongoing relevance, and alignment with evolving needs.

4.4.2 Technological trends

Emerging technologies and digital, mobile devices offer new possibilities for training formats, such as online, in-person, blended, and asynchronous sessions. Technological trends significantly impact the conceptualisation and implementation of training, as evidenced by the comprehensive and extensive contributions by MLE participants.

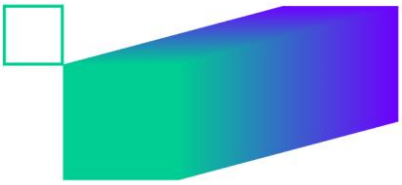
The concept of customised learning paths is gaining traction, catering to varied learning styles and accommodating individual preferences for slower or accelerated routes. Guided self-learning is increasingly valued, combining coaching and facilitation to address challenges in self-directed learning, effectively blending the principles of andragogy and heutagogy.[34]

Participants also underscored the success of online mentoring and its potential for new formats of learning. Leveraging online connections for coaching and mentoring facilitates open discussions, idea exchange, and the cultivation of new concepts.

Recordings are increasingly used for enhanced content accessibility, incorporating quizzes for active learning. Interactive engagement tools gain prominence, fostering meaningful interaction and collaborative learning experiences. Participants stressed that involving learners in decision-making regarding preferred learning formats ensures alignment with their needs and expectations.

Recognising the diversity of learners and their devices, a focus on varied training material formats ensures accessibility and accommodates a wide range of devices, including smartphones. Messenger tools like WhatsApp emerge as effective communication platforms, particularly in African science groups. Shared sketchpads

[34] Developed by Malcolm Knowles in 1968, Adult Learning Theory or andragogy is the concept or study of how adults learn and how it differs from children. Andragogy is the facilitation of learning for adults, who are self-directed learners. Heutagogy is the management of learning for self-managed learners.



can be useful for virtual collaborative learning environments, fostering joint problem-solving and enhancing the sense of connection among learners.

Moreover, participants highlighted the importance of repurposing learning resources, thereby promoting sustainability, adaptability, and creativity. Collaboration with e-learning communities is acknowledged as a means to collectively and innovatively address challenges and cultivate a culture of continuous improvement. Comprehensive supporting materials, including assessment designs, are considered essential for effective comprehension and application of the training in real-life situations. A dedicated resource repository is recommended for trainers to organise, save, and share resources, allowing for local adaptation and broader dissemination.

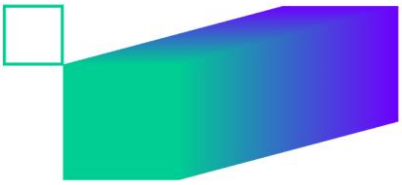
Finally, participants highlight adherence to FAIR principles (findability, accessibility, interoperability, and reusability) and suggested the implementation of an Educational Management Plan, akin to a Data Management Plan, to ensure alignment with these principles.

4.4.3 Pedagogical trends for early career researchers (ECRs)

Incorporating current pedagogical trends, three key recommendations have been developed to enhance the effectiveness of training aimed at early career researchers (ECRs).

The initial recommendation centres on involving Principal Investigators (PIs) or academic supervisors in ECRs' training. The support of these senior researchers can significantly enhance the effectiveness of ECRs' training. However, some PIs/Supervisors may show some resistance towards training in Open Science and RRI aspects. This resistance can be overcome through explicit endorsement from research funders. Furthermore, organisational level adoption of the Open Science and RRI agenda can be instrumental, establishing norms for the implementation of training. ECRs can also exert influence on their PIs/supervisors, creating a drive for change.

The second recommendation advocates for the inclusion of tangible examples in training sessions or materials. Interactive formats where ECRs and late-career researchers engage allow for the sharing of previous experiences. This adds credibility and increases the appeal of the training. Trust was identified as a crucial



element for these interactive formats to succeed, emphasising the importance of creating ‘safe spaces’ for honest discussion.

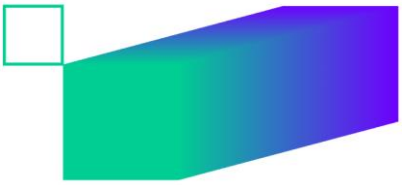
The third recommendation suggests considering formal accreditation for courses and training programmes. Formal accreditation can facilitate the wider adoption of Open Science and RRI training. However, accreditation may present challenges due to variations in national agencies and specific criteria. Additionally, institutions may be less inclined to support openly available resources. Establishing a positive reputation for PATTERN trainings is crucial in this context. Accrediting ECTS could serve as a competitive advantage for ECRs in PhD programmes.

4.4.4 Pedagogical trends researchers at a later career stage

For researchers at a later career stage, several considerations have emerged. Firstly, they are often under stringent time constraints, an important factor to bear in mind when devising and disseminating training initiatives. Secondly, there is a perceived lack of top-down engagement at both national and institutional levels, coupled with a lack of supportive mechanisms for implementing Open Science/RRI initiatives. Thirdly, late-career researchers may not readily engage with initiatives labelled as 'training'; hence, alternative terms such as 'conversations,' 'networking,' or 'colloquium' could reshape perceptions and encourage participation among this group.

Given these factors, the following recommendations have been formulated:

- Sharing relevant success stories that align with the specific areas of interest for trainees creates a relatable context, enhancing the learning experience.
- The promotion of PATTERN trainings can benefit from strategically selecting champions or ambassadors from the same field as potential trainees. This approach authentically conveys the benefits of Open Science within the context of the trainees' areas of interest.
- The incorporation of mentorship programs and one-on-one meetings for personalised support should be a key aspect of the strategy. Individualised guidance can significantly contribute to a deeper understanding of Open Science principles and commitment to their adoption.
- Alignment between academic requirements and Open Science/RRI establishes a foundation for support and enthusiasm towards open and responsible practices among the academic community, particularly late-



career researchers. Endorsement by funders and recognised champions can play an important role in this.

4.4.5 Defining and assessing relevant learning outcomes

When assessing learning outcomes and training impact, it is essential to conduct an analysis of both the target group and individual participants before and after the sessions. Specifically, when evaluating PATTERN pilots, a comprehensive gap analysis is needed in each topic area. This should be coupled with the formulation of precise learning outcomes that cater to various levels of expertise within the target audience. Additionally, it is important to establish a maturity model specific to each topic. This involves the development of formal learning progressions for structuring training, similar to those already published for RDM[35] and Science communication.[36]

In terms of evaluating project activities and training, it is beneficial to remain attentive to new developments and to trial open and innovative solutions as they emerge.

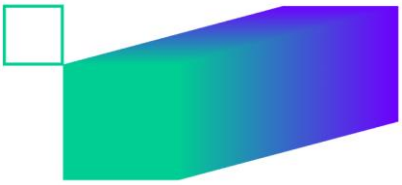
Lastly, incorporating inclusiveness into the training strategy requires the use of open communication channels and ensuring open access to resources. The strategy should encompass a diverse array of learning materials and tailored options. Importantly, inclusiveness goes beyond catering to a mixed audience; it involves creating specific offerings that address the unique needs of different user segments.

Structured discussion methodologies[37] are being proposed to facilitate inclusive discussions that lead to the achievement of learning outcomes. This approach makes room for diverse and local perspectives, which is especially important within global groups.

4.4.6 Strategies for sustainability and impact

It is imperative to incorporate the project's vision and sustainability considerations right from the outset. This involves mapping stakeholders, identifying their needs, reflecting on available resources, and devising methods to ensure reusability, promotion, and sustained interest from the intended audiences. Long-term thinking

35 Qin J., Crowston K., and Kirkland A. (2014). A Capability Maturity Model for Research Data Management. Syracuse, NY: School of Information Studies, Syracuse University.
https://surface.syr.edu/cgi/viewcontent.cgi?article=1191&context=istpub
36 Bruce V. Lewenstein and Baram-Tsabari A. (2022) How should we organize science communication trainings to achieve competencies?, International Journal of Science Education, Part B, 12:4, 289-308, DOI: 10.1080/21548455.2022.2136985
37 https://etrp.wmo.int/mod/book/view.php?id=8628&chapterid=1582



extends beyond specific training activities to encompass broader digital tools such as knowledge hubs, platforms, and websites within the project's ecosystem.

Designing an active engagement strategy is crucial, involving the participation of established communities of trainers like OpenAIRE, CoP, FORRT, and others. Granting ownership to these communities over specific curricula aspects ensures the maintenance of training material quality over time.

To ensure the FAIRness of Open Educational Resources, there is a need to address version control, licencing, metadata, and more. Creating an Educational Management Plan that prioritises FAIRness and ongoing sustainability of learning resources is therefore a good idea.

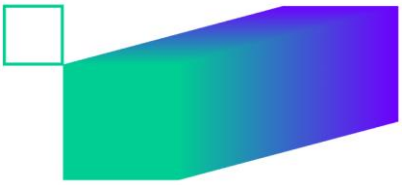
Considering accessibility and inclusion is crucial, ensuring coverage of diverse social groups, including individuals with disabilities such as those with low vision, to foster an accessible and inclusive learning environment.

Creating editable content and facilitating the sharing of training resources and associated metadata forms an effective strategy for sustainability and impact. Placing metadata in a central catalogue or platform with an open licence enhances discoverability. Exploring the potential of integrating version control within the Moodle community contributes to reinforcing the e-learning community. Additionally, ensuring content is reusable, for example, by promoting video resources through platforms like YouTube or designing a 'facilitator's guide,' supports training activities and enables other trainers to tailor content and formats according to their requirements, including language preferences.

Lastly, engaging in clusters with other related projects through creating and sharing short project briefs can be instrumental for sustainability and impact. Disseminating these briefs among project consortia preparing new project bids opens avenues for integrating relevant content into their forthcoming projects.

4.4.7 Overall summary of the mutual learning events

In summary, the Mutual Learning Events have provided valuable insights into key trends in Open Science training, that can inform the next steps of PATTERN. These events highlighted that the development of training is currently influenced by the aftermath of the COVID-19 pandemic, a growing alignment and interdisciplinary



integration of training content, the involvement of late-career researchers, and a heightened focus on evaluation and quality criteria.

Main recommendations advocated embracing online and asynchronous formats, and leveraging the opportunities presented by technological advancements. It is also suggested to integrate training topics across disciplines, aligning them with RPOs strategies, while promoting versatile skills and ethical reflection. Engaging academic supervisors and late-career researchers is encouraged, along with tailoring content to accommodate varying learner needs.

Furthermore, the importance of assessing learning outcomes through innovative methods is emphasised, ensuring inclusivity and accessibility to diverse learners. To develop long-term effectiveness, fostering collaboration with established communities is recommended.

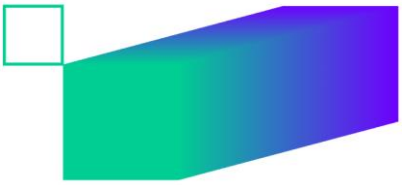
4.5 Quality Assessment

Around 250 training resources that were relevant for training researchers in each of the PATTERN themes were subject to quality evaluation. Inclusion in the quality assessment exercise was primarily based on the critical criterion of accessibility, as outlined in section 3.5.2. Our emphasis was on digital resources that offer free and straightforward access.

4.5.1 Resources with low priority for reuse in PATTERN

Recordings of synchronous training events or webinars are not likely to be valuable for PATTERN except perhaps for identifying training topics and potential speakers, particularly those from 2022 and 2023. These recordings tend to have a narrow focus, lack of high-quality production, including frequently poor audio, prolonged duration, and a lack of interactivity in an asynchronous format. Furthermore, pinpointing specific information within recorded videos can prove challenging. Reusing such recordings would likely require extensive editing and potentially re-recording in useful lengths. It may also be difficult to assess the material's timeliness after the recorded event.

Another important criterion is the target audience. Resources designed for an overly broad audience may lack engagement value for researchers, who often prioritise training which addresses the specific challenges they are facing. Conversely, training



tailored specifically for secondary school teachers (for example some trainings in Citizen Science) might also fall short of delivering value.

Referring to Citizen Science resources as an example, there are numerous resources based in the USA that, while of general interest, incorporate elements tied to the USA legal context or framework. This renders them less user-friendly, relevant and engaging beyond the USA, necessitating adaptation for use in training elsewhere.

In our selection, it was also important that resources are available for reuse. Many resources can be freely accessed as courses or reading materials, but their copyright status or reuse terms (licence) are often unclear, leading us to assume copyright. While such resources may prove valuable for PATTERN as 'additional resources', they cannot be directly incorporated into the development of training materials.

4.5.2 Training resource strengths and desired features, with examples

When examining a range of courses and learning resources, certain desired features emerge consistently across various offerings. These features, when combined with relevant and up-to-date content, contribute significantly to the overall quality of training.

Diverse Training Materials: Diversifying training materials caters to different learning styles and preferences, enhancing the learning experience for a greater range of learners. Diversity can be ensured through:

- Utilising various formats and media, including text, diagrams, figures, infographics, images, drawings, short videos, podcasts, and more.
- Incorporating flow charts to represent processes and timelines.
- Including quizzes, practical exercises/assignments, case studies, and practical examples.
- Conducting interviews with relevant experts.
- Providing tools, guidelines, and best practice recommendations.

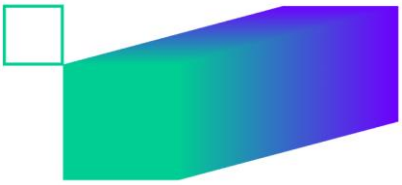
Examples of training that did very well in this aspect were:

- Citizen Science

'Citizen Science Skilling for Library Staff, Researchers, and the Public '

'Citizen Science in the (Digital) Arts and Humanities '

- Gender, non-discrimination and inclusion in research



'Creating a Gender Sensitive Institution Online Course'

Interactivity and knowledge exchange opportunities: Fostering interactivity in training cultivates a dynamic and collaborative learning environment, motivating learners to complete training and apply their newly acquired or consolidated knowledge. Strategies to promote interactivity and knowledge exchange include:

- Balancing 'lecture-style' videos or presentations with other types of content.
- Incorporating reflection questions.
- Offering opportunities for participant exchange and feedback through forums or comments sections.
- Providing feedback from mentors or course instructors.
- Establishing discussion groups on social media platforms.
- Incorporating quizzes and polls and showing poll results.
- Facilitating access to communities of practice, such as Citizen Science groups and associations.

Examples of highly interactive training courses are:

- Citizen Science

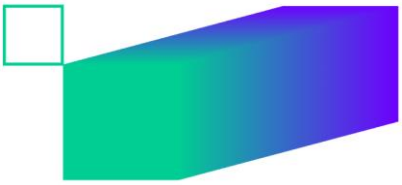
'Citizen Science Projects: How to Make a Difference'
'Citizen Science and Scientific Crowdsourcing: an Introduction

- Gender, non-discrimination and inclusion in research

'Creating a Gender Sensitive Institution Online Course'

Orientation towards practice: Tailoring training to the expectations, needs and expertise level of learners prepares them to effectively apply what they have learned. Making training more applicable to real-life situations can involve:

- Providing step-by-step guidance, breaking down each stage into manageable steps.
- Disseminating relevant and easily accessible tools and resources.
- Incorporating reflective questions and problem-solving exercises using real or simulated scenarios (problem-based learning).
- Discussing case studies and examples relevant to the audience.



- Sharing information about previous and ongoing projects and communities of practice.
- If useful, providing a section with 'frequently asked questions'
- If applicable, providing information about project funding sources and how to find project partners.
- Offering additional resources for further learning.
- Providing a means of demonstrating training completion, such as badges and certificates.

Some examples of trainings that are well oriented towards practice are:

- Citizen Science

'Leading a 'Train the Trainer' workshop'
'Citizen Science Projects: How to Make a Difference'
'Communication in Citizen Science. A practical guide to communication and engagement in Citizen Science'
'Community Planning Toolkit'
'Citizen Science Skilling for Library Staff, Researchers, and the Public'

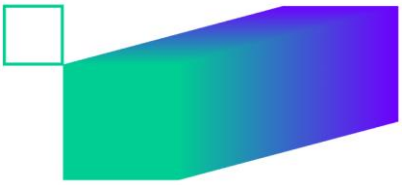
Inclusivity: Inclusivity encompasses various dimensions, including technical such as accessibility of training and resources, and social like appropriate representation of gender and minorities of any kind. Guidelines for inclusivity include:

- Providing content in multiple languages, subtitles for videos, or transcripts that can be used with automated translation applications.
- Adding descriptive image captions with alt-text.
- Ensuring balanced gender portrayal in training materials.
- Customising training to meet the needs of communities and underrepresented social groups and minorities.
- Engaging with the local or domain knowledge of participants, such as local populations and patient groups.
- Using approachable language devoid of technical jargon.

Training resources that actively consider inclusivity are for example:

- Citizen Science

'Research Integrity, ethics and the SDGs within the context of Citizen Science (RIECS)'



'Communication in Citizen Science. A practical guide to communication and engagement in Citizen Science'
'Community Planning Toolkit'
'The Science of Citizen Science'
'ERC grantee Sue Black on Citizen Science'

- Gender, non-discrimination and inclusion in research

'Equity in Informal STEM Learning: Using the Equity Compass'
'Gender Equality Audit and Monitoring in Research and Innovation - GEAM tool'
'Lesson Plan 9: Diversity and inclusion in open science'

- Science communication (towards media and policy makers)

'Science Communication MOOC'

Clear structure: A well-organised structure is crucial for educational resources, as it facilitates easy navigation and logical progression for learners. Key elements contributing to a clear structure include:

- A course landing page that presents the course's content, objectives, methods, and practical information.
- Introduction of trainers to learners through "get to know your trainer/professor" videos.
- Clear articulation of learning outcomes at the beginning of each section.
- Summaries provided at the end of relevant sections.
- The use of symbols and colour coding to differentiate various content types (e.g., tools, videos, text, etc.).
- Expandable sections accessible through simple clicks for deeper learning.
- Incorporation of images and diagrams with explanatory value to break up text blocks.
- Provision of sources and supplementary learning materials.
- Availability of contact and feedback sections.

Training courses and material with an excellent structure encompass:

- Citizen Science

'Citizen Science in the (Digital) Arts and Humanities '
'Participatory Science Toolkit against Pollution'

'Citizen Science Switzerland' and 'Citizen Science Austria' websites.

- Gender, non-discrimination and inclusion in research

'Creating a Gender Sensitive Institution Online Course'

- Science communication (towards media and policy makers)

'Media skills for scientists'

- Management and Leadership

'Career Management & Entrepreneurial Mindset Course'

Clear and engaging language: Clear and engaging language enhances comprehension and facilitates unambiguous translations into other languages. To achieve this, consider the following:

- Employing a conversational tone, addressing the learner directly.
- Use relatable language that demonstrates your understanding of the questions and practical issues that trainees encounter.
- Avoiding unnecessary formality and technical jargon.
- Clarifying topic-specific terms in a glossary.
- Explaining essential concepts in an accessible manner.
- Using the active voice over passive sentence construction.
- Keeping sentences concise and straightforward.

Good examples of this are:

- Citizen Science

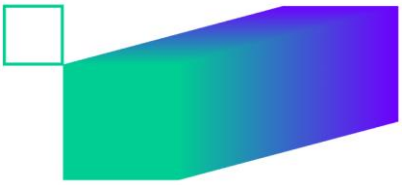
'Leading a 'Train the Trainer' workshop'
'Communication in Citizen Science. A practical guide to communication and engagement in Citizen Science'

- Science communication (towards media and policy makers)

'How to give a brilliant media interview about your science | 'Talking Science' Course #9' and other videos in 'Greg Foot's Sci Com series '
'SciComm4all video series'

Ease of implementation and adaptation: Ensuring training materials are user-friendly and adaptable is essential for quality training. Some of the trainings achieved this through:

- Indicating the time commitment for each module or unit.



- Making training materials available through licences that allow open access and content adaptation.
- Organising content for easy navigation, following a chronological and logical sequence.
- Enabling the downloading of materials for offline use.
- Including accompanying slide presentations for videos.
- Modular lesson packages for flexibility.
- Encouraging in-depth discussions on specific topics, especially those identified as gaps.
- Clearly distinguishing between optional/supplementary and "obligatory"/essential learning content and activities.
- Providing easy to follow instructions for both trainers and learners on how to effectively use the material. Possibly including examples of how it has been used previously.
- Establishing quality standards for implementing training.
- Fostering opportunities for trainee feedback, which is crucial for long-term adaptation and sustainability.
- Outlining the learner evaluation process and evaluation criteria.

Examples of courses which prioritise ease of implementation and adaptation include:

- Citizen Science

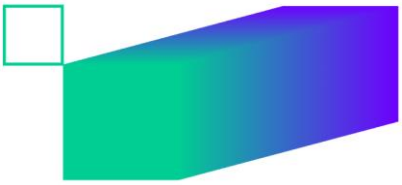
'Training programs to build capacity for collaborative innovation processes'
'Training materials. Ready to use materials for Citizen Science initiatives'

- Gender, non-discrimination and inclusion in research

'RRI and Gender Equality'

Addressing knowledge gaps and emerging issues: This involves a wide spectrum of theory and practice, covering:

- New methodologies and technologies.
- Multidisciplinarity and cross-disciplinarity.
- Providing a comprehensive theoretical framework, including societal aspects and historical context.
- Demonstrating connections to policy.
- Addressing intellectual property rights (IPR) in Open Science.



- Engaging with local knowledge systems.
- Addressing community issues.
- Tackling ethical concerns.

Training resources that demonstrate some of these features are:

- Citizen Science

'Research Integrity, ethics and the SDGs within the context of Citizen Science (RIECS)'

'Forest Service Citizen Science Toolkit'

'Doing Citizen Science as open science: what, why and how'

4.5.3 Opportunities for reuse of training in PATTERN

Upon completion of our evaluation, this section highlights both course-type trainings and static resources. Some of the latter could be effectively repackaged for training by annotating learning outcomes and proposing lesson plans. In general, resources that involve problem-based and active learning with opportunities for interactivity tend to be more engaging and therefore more appealing for reuse.

Of note, some of the courses and materials evaluated under 'Open Science' and 'General RRI' have elements that are of interest to multiple of the PATTERN themes and this is indicated here. When appropriate, we also refer to projects that are currently developing training in the PATTERN transferable skill areas.

4.5.3.1 Open Access

The most apparent examples of resources that could be adapted for PATTERN's purposes are those from the FOSTER and FIT4RRI projects, which produced a comprehensive set of learning resources at the time. They are somewhat outdated, for example they predate Plan S and the Horizon Europe framework, but are currently undergoing updating, as overseen by OpenAIRE, with a view to republishing on OpenPlato. They are easy to update and integrate into other learning platforms given that they are published in the Shareable Content Object Reference Model (SCORM) format and carry non-restrictive Creative Commons licences.

Among the static resources, some stand out as being well structured, useful, and with licences that allow for reuse.

'S-LéGAMI!" Open Access- User Manual for Researchers' (in Italian) is a detailed document that touches on all Open Access issues under the umbrella of Open Science. It contains very accurate and up-to-date information that could be translated and presented in a more interactive way by PATTERN. There is also an opportunity to complement this resource by demonstrating results achieved by some projects.

'The Contemporary Open Access Ecosystem: The Good, The Bad and The Ugly' covers the basics in OA, using plenty of practical examples. It explains the issues related with predatory journals well, which is one of the needs identified in our analysis (see section 4.1.1).

Similarly, the 'EuroDoc - Ambassador Training M2 - Open Access' covers the essential topics and provides context by presenting the history of scholarly communication and concerns related to research assessment.

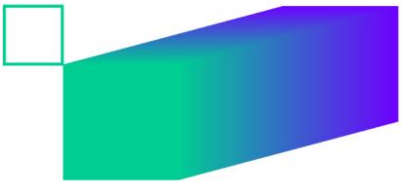
The 'Open Science Training Handbook - Open Access to Published Research Results' is a resource of reference, intuitive and easy to navigate, with many practical examples. However, it needs updating to include all Open Science related developments since 2018 when it was published.

Moreover, some useful resources for researchers have been developed by project RETAIN (SPARC Europe). They were not identified in time to be put through quality assessment, but we recommend that they are looked at in the next stages of PATTERN.[38]

It is also worth considering other sources of information, not traditionally seen as training, such as the annual Open Access Week, a well-established global event. Additionally, various 'guides' independently produced by institutions, such as Jisc[39], although not exclusively focusing on OA, are valuable resources covering aspects related to Open Science.

Finally, the EU projects EHRI3 and Blue-Cloud 2026 are developing and implementing training modules in OA, adding to the pool of resources available.

38 Checklist for researchers: 6 steps to retain your rights https://zenodo.org/records/8428057
Do you speak rights retention and open licensing? https://zenodo.org/records/10208763
39 https://beta.jisc.ac.uk/guides/an-introduction-to-open-access



4.5.3.2 FAIR data and Research Data Management

There are a large number of training resources on Research Data Management (RDM) and FAIR data, many of which are of high quality, and, probably because of their subject matter, are reusable at least in terms of licencing. Training resources focused on Open Science often contain parts relevant for RDM and FAIR data, and training sessions often cover all these topics, for example highlighting the differences and commonalities between FAIR and Open. We only include resources below which are free to access, and generally (though not exclusively) confirmed as available for reuse.

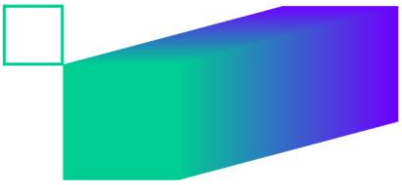
As previously mentioned in the Open Access section, the FOSTER platform offers numerous high-quality, reusable courses (see also the sections 4.5.3.9 and 4.5.3.10, respectively for OS and RRI). Examples relevant to RDM and FAIR data include 'Open and FAIR Research Data' and 'Managing and Sharing Research Data'. There are also courses focusing on more specific sub-topics, like 'Open Licencing'. The courses typically feature text with images and, in some cases, videos (or links to videos) and are generally suitable for the beginner level.

A number of projects have been identified which are developing or implementing training in FAIR data and RDM, including SKILLS4EOSC, FAIRbyDESIGN, FAIRIMPACT, BY-COVID (Course), EHRI3 (module), EOSC FUTURE (module), and BlueCloud 2026 (Course). These are worth liaising with to make sure the identified gaps in training are covered (as detailed in sections 4.1.2 and 5.3.2).

Research Data Management (RDM)

There are many high-quality RDM resources available. University libraries, for instance, often provide online information and other resources aimed at their researchers and students. Information on RDM is also normally contained within Open Science courses. We highlight some examples of good RDM training resources below, but this is not an exhaustive summary.

The 'OpenAIRE Open Science training materials' based on the OpenAIRE Open Science bootcamps (refer to 4.5.3.9, Open Science section), cover several relevant topics in RDM (as well as Open Access), like Data Management Plans or and data archiving. These materials are available under a CC BY licence and include slide decks and recordings. While some slides are only available as PDFs, considering that many of the original authors are in the PATTERN project and OpenAIRE is a project

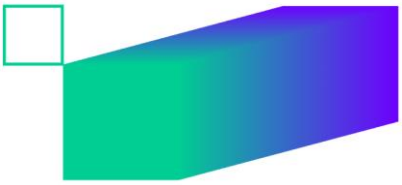


partner, they can perhaps be made available as editable slides as part of this project. Although the course primarily targets data stewards, the materials could be readily adapted for a course aimed at researchers. The same holds for several other good self-paced online courses that also contain basic information on RDM topics, such as the 'EOSC Synergy and FAIRs FAIR Data Stewardship moodle', available under a CC BY licence. Two other high-quality self-paced courses which, however, cannot be easily reused because the reuse licence is unclear (in both cases the 'terms of use' buttons are not clickable), are the 'DocEnhance Data Stewardship MOOC' and the 'RDNL Essentials 4 Data support' course (but for the latter, PATTERN partner DANS is one of the RDNL partners).

The 'eLearning course about the importance of good research data management (RDM)' is specifically designed for researchers.[40] It only contains three videos (1. Introduction, 2. FAIR principles, 3. Data Management Plans, plus an introductory video), so it is probably less suitable for direct reuse, but it has a CC BY licence and possibly snippets or ideas can be reused. The PARTHENOS e-learning course 'Manage, improve, and open up your research and data' also contains RDM aspects, like Data Management Plans, and is CC BY licenced. The information is mostly brief and consists of relatively a lot of text (but also some images and video links), and is aimed at the cultural heritage discipline, but it may be useful for partial reuse, nonetheless.

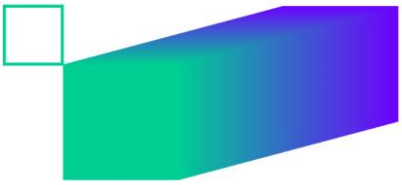
The suite of courses and lessons available through data.europe.eu also contains a few good-quality, relevant content. While some lessons and courses are better suited for repository managers, data managers, or developers, lessons like 'Why do we need to license?' and 'Choosing the right format for open data' contain information and videos that could be integrated into or referred to in PATTERN materials. The content is available under a CC BY licence.
Non-course resources that are useful for obtaining and reusing information, as well as images where permitted are the 'Turing Way Guide for Reproducible Research – Research Data Management section' (text and images, open source and CC BY licences) and the 'CESSDA Data Management Expert Guide' (text and images, focused on the social sciences but of general interest, CC BY-SA licence).

40 Holmstrand K.F., den Boer S.P.A., Vlachos E., Martínez-Lavanchy P.M., and Hansen K.K. (Eds.) (2019). Research Data Management (eLearning course). doi: 10.11581/dtu:00000047



FAIR

The FAIR principles or how to make your data FAIR are often part of RDM courses, discussed above, but there are also resources dedicated to FAIR principles. Several examples are highlighted below. Additionally, to identify current gaps are in available (high-quality) training materials, we have mapped the training materials to a standard FAIR training curriculum based on user level (beginner, intermediate, advanced) and per audience type (student, researcher, trainer, infrastructure / support, citizens). The relevant and high-quality English-language resources on FAIR data, identified in the mapping exercise, have been classified according to this framework (see

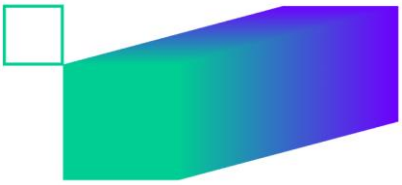


Appendix VII: Mapping and classification of FAIR data training resources). It's worth noting that this framework will be updated, as part of PATTERN WP2, with resources that have come to our attention more recently.

An especially useful (static) resource is 'How to be FAIR with your data: A teaching and training handbook for higher education institutes' (Engelhardt *et al*., 2022)[41], available under a CC BY licence. It provides background information on training on FAIR data and comprehensive lesson plans, complete with the basic information of the lesson, audience(s), learning outcomes, summary of tasks/actions, needed materials or equipment, and a reference list. It also provides lists of pertinent tools, useful links, and examples. In short, everything a teacher or trainer, or indeed the PATTERN project, needs to develop training. While the focus may be on synchronous training, the resource is also beneficial for creating self-paced learning resources. It is important to note that the handbook primarily offers information, lacking actual materials like slides and providing only a few images. Additional work is required to develop the specific materials, or to find reusable materials in the references section and beyond.

There are also some full, self-paced courses already available. A good-quality example is 'How to FAIR'[42], with all materials available under a CC BY licence on Zenodo. This well-written and clear course uses practical examples and incorporates a mix of text, video content, and a quiz. The topics covered are not as exhaustive as those in the handbook or the curriculum we propose in the Appendix VII, but they provide a comprehensive overview of the main FAIR principles. Particularly for beginner-level researchers or students, this course proves to be very useful.
There are a few additional resources that are worth mentioning, acknowledging that inevitably there will be other valuable ones not covered here. The 'FAIR data basics course' has got recordings and slide decks available for reuse under a CC BY licence. The 'EARTHCUBE FAIR training resources' contain useful examples of how to adapt a course for a specific discipline, particularly focusing on the geosciences. It is, however, not clear if the materials can be reused. The 'FAIR cookbook' contains

41 Engelhardt C. (2022). How to be FAIR with your data. https://doi.org/10.17875/gup2022-1915, Chicago
42 Deutz D.B., Buss M.C.H., Hansen J. S., Hansen K. K., Kjelmann K.G., Larsen A.V., Vlachos E., and Holmstrand K.F. (2020). How to FAIR: a Danish website to guide researchers on making research data more FAIR https://doi.org/10.5281/zenodo.3712065



'recipes' for making research objects FAIR and serves as an informative resource for developing intermediate and advanced training or as a useful reference.

4.5.3.3 Citizen Science

There are many high-quality trainings, tools, and resources, most of which are accessible through the continuously updated eu-citizen.science platform, which is the platform of reference for Citizen Science in Europe. They have been subject to moderation and quality criteria [43] and many would be suitable for reuse. Some are highlighted below. It would also be important to establish the skill needs of advanced learners and ensure that training targets these.

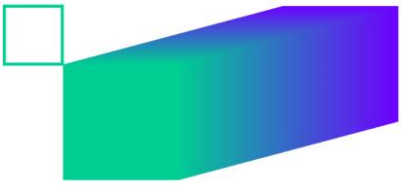
The 'Citizen Science in the (Digital) Arts and Humanities' is a very comprehensive course, at intermediate level. It is amenable for adaptation, with a CC BY licence, instructions for trainers and slide decks for download. Elements of interest could be customised for PATTERN's needs and further improved by inclusion of quizzes or reflective questions for learners.

'Doing Citizen Science as open science: what, why and how' covers a good range of content including Citizen Science projects, platforms and apps for Citizen Science and refers to further learning resources. Moreover, the course covers copyright and legal considerations in OS and Citizen Science which has been identified as a gap. Videos are archived on the Internet Archive https://archive.org/ making it easier to reuse material.

The course 'Storytelling for Citizen Science' provides an engaging introductory/intermediate training on the theme, with our human connection with storytelling discussed by writers, academics and an illustrator. The course provides several tools which are easy to adapt to different training activities, including self-reflection and creative writing exercises, and a storytelling slide deck for downloading.

Other courses are not suitable for adaptation given their licencing but provide a comprehensive curriculum that could serve as inspiration and provide open access tools that could be reused. They may also be useful further learning resources for mentioning in PATTERN. Among these are 'Citizen Science and Scientific

43 Fraisl D., Hager G. and See L. (2020). Framework Report Describing Criteria and Rationale for Sharing and Selecting State of the art Citizen Science Resources https://zenodo.org/record/3716236#.ZKvIc3ZBw2w



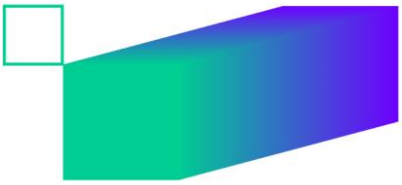
Crowdsourcing: an Introduction' by UCL and 'Citizen Science Projects: How to Make a Difference' by the University of Dundee and WeObserve.

Moreover, the course 'Research Integrity, ethics and the SDGs within the context of Citizen Science' covers the intersectionality between Citizen Science, Research Integrity, and sustainability, with an interesting case study based in Africa. The course promotes inclusivity, respect for diversity, and methods for drawing on the local knowledge of participants. Of note is the section about Tools and techniques for ethical research: 'river of life', 'knowledge café', and 'participatory mapping' which may be interesting for reuse. The theoretical side of the course feels somewhat superficial given the many dimensions to cover within a limited time (e.g. feminist philosophy, social justice, decentralisation, science as a public good, SDGs, anthropocentrism, etc.).

The trainings developed by the Time4CS project have just been made available for reuse, including the MOOC 'Supporting Sustainable Institutional Changes to Promote Citizen Science' and the detailed 'Training Program Description', covering topics of Citizen Science Research and Methodology, Citizen Science Education and Awareness-raising; Citizen Science Support resources and infrastructures; and Citizen Science Policy and Assessment. They have not been evaluated here but they address known gaps.

Among the non-course training materials, the 'Citizen Science Skilling for Library Staff, Researchers, and the Public Part of the four part book series: Citizen Science for Research Libraries - A Guide' (CC BY-SA licence) is an excellent practical toolbox to help run a Citizen Science project, put together by members of the research library community and extensively peer reviewed. It is useful for researchers who are committed to Citizen Science and for beginners, being a step-by-step guide that is easily implemented. It is a very good 'learning package' in project planning, communication, RDM, data policies, data standards, resource planning, and acknowledging citizen scientists in research outputs including IPR. Of note, provides links to a very good intro to 'RDM in Citizen Science' (three videos of approximately 20 min each), as well as to further materials and references.

The short video by 'ERC grantee Sue Black on Citizen Science' provides a lucid and engaging explanation of participant engagement as a 2-way dynamic relationship and considers inclusivity.



'Citizen Science: the involvement of citizens in research through the lens of the TeRRIFICA project' is an informative and engaging video that could be presented to showcase the value of Citizen Science.

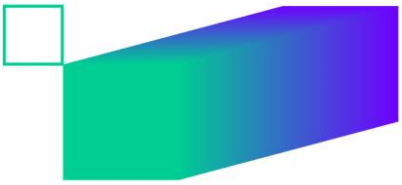
The 'Participatory toolkit against pollution' by the SwafS ACTION project is applicable in more contexts than pollution and provides guidelines for implementing Citizen Science projects and addressing their policy impact and sustainability, breaking down each stage into steps to consider. It has a very good structure and format, with case studies and thirteen easily accessible tools. The Citizen Science project checklist and Participatory Science Life Cycle Figure are good resources for reuse. Moreover, it addresses known gaps such as data visualisation tools and ensuring diversity in the group of participants. However, its licence is not shown, therefore it is not clear whether it can be adapted.

In addition, there are a number of open access copyrighted resources that are of interest for training or as further learning materials. The Citizen Science Best Practices Guide from the UK Centre for Ecology and Hydrology is an excellent resource for implementing environmental Citizen Science projects. The 'Community-based participatory research: A guide to ethical principles and practice' contains very useful sections at the development stage of a Citizen Science initiative, namely Ethical principles and Practice Principles and Guidelines. It also includes a list of useful websites and web-based resources.

The 'Communication in Citizen Science. A practical guide to communication and engagement in Citizen Science' is a resource that is oriented towards practice and is succinct, informative, and addresses inclusivity. It is also visually engaging and has a good bibliography list.

'The science of Citizen Science' is a comprehensive overview of the different aspects of Citizen Science and the current debates in a single book, including of Citizen Science policies and inclusivity. Provides scholarly insights and also practical tools for capacity building; technical aspects; ethical issues; and relevant communication, inclusion, and evaluation matters.

The portals 'Citizen Science Sweden', 'Citizen Science Switzerland', and 'Citizen Science Austria', while not training materials per se, are worth looking at for their elegant and easy to navigate structure. They give access to continually updated information about Citizen Science in the respective countries, training and learning



resources, projects, tools, communities of practice, funding opportunities, etc. They are closely linked to the European counterpart eu-citizen.science already mentioned.

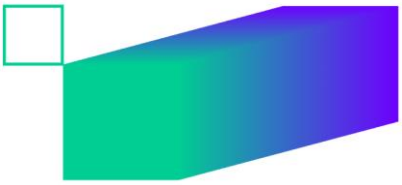
4.5.3.4 Research Integrity

Within the collection of resources evaluated, some well-designed resources stand out as potentially valuable for reuse in WP2.

The 'Dilemma Game' offers a versatile, engaging and dynamic approach to learning about research integrity and ethics. Contents are clear and accurate, based on established best practices and guidelines, and kept up-to-date. The App can be downloaded to a phone and used in a variety of learning environments and contexts. It is best embedded in training sessions (rather than individually) to foster discussions and allow further explanations of concepts. Moreover, the Dilemma Game covers some of the gaps identified in our mapping, including Research Integrity in the context of Open Science, authorship in research collaborations, power dynamics in research collaborations and supervision, and privacy and confidentiality.

The 'Moral-compass: virtues-based trainings' are worth considering, too, as a novel, interactive and self-reflection approach. These courses are designed for trainers (train-the trainer) and are well-suited for diverse groups, including senior researchers, leaders, and teams with members from various disciplines and career stages. The programme is carried out via a blended-learning approach, incorporating an e-learning course and face-to-face sessions. The VIRT2UE toolbox is completely open source and is available on The Embassy of Good Science.

The 'Embassy of Good Science' is itself a platform of reference for Research Integrity, containing guides, materials and a community that support training on research integrity and ethics. The platform's wiki functionalities allow for high flexibility. For instance, trainers can access the training material directly online, suggest changes, build new modules and share them with a community of trainers. The modules can be downloaded as SCORM packages, enhancing reusability. platform's wiki functionalities allow for high flexibility. For instance, trainers can access the training material directly online, suggest changes, build new modules and share them with a community of trainers. The modules can be downloaded as SCORM packages, enhancing reusability.



'The Lab' is a valuable resource for immersive learning, allowing users to understand the challenges and pressures faced by stakeholders in academia, including PhD candidates, postdoctoral researchers, Principal Investigators, and Research Integrity Officers. Developed by the U.S. Department of Health and Human Services (HHS) and the Office of Research Integrity (ORI), the course is available in English, Spanish, Chinese, and Japanese. Despite its focus on STEM, it addresses gaps in training related to scientific misconduct and power dynamics in research collaborations and supervision. The content is copyrighted but freely accessible.

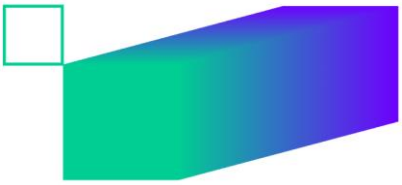
A number of static resources offer substancial content and useful guidance.

'Guidance for implementation of ethics and integrity training' is an excellent resource for trainers, providing a checklist for training development and many good examples of training in key themes in RI. providing a checklist for training development and many good examples of training in key themes in RI.

The 'Toolbox for Research Integrity' is a very useful resource for institutions (RPOs and Research Funding Organisations) planning, implementing or reviewing research integrity plans and regulations. It covers the areas that should be addressed, namely data management, training, infrastructures, environment, collaboration, dissemination, breaches of RI, and supervision and mentoring. The content is easy to navigate but offers limited opportunities for learners to engage with the material beyond reading and referencing. It could be used to deliver an interactive tool. . It could be used to deliver an interactive tool.

The 'Upright webbased educational tool' is a very comprehensive tool with good coverage of intellectual property, authorship, research collaborations, power dynamics in research collaborations and supervision and privacy and confidentiality. Provides links to further learning resources. A dynamic version is available for download and can be hosted on a Moodle server or on an online Moodle hosting server. However, the tool has not been updated since 2018 and is copyrighted.

Still worth mentioning as good sources of information are 'The TRUST Code - A Global Ethics Code to promote Equitable Research Partnerships' and COPE's 'Core practices'. The first resource includes coverage of sensitive ethical issues, ethics dumping, power dynamics in research collaborations and supervision, privacy and confidentiality in the context of global research collaborations. Whereas the second



is very useful for understanding publication ethics, covering peer review processes, intellectual property, data and reproducibility, misconduct, as well as conflicts of interest, authorship and contribution.

Moreover, a number of projects are currently developing, piloting or revising training in Research Integrity, and EARMA can serve as a liaison:

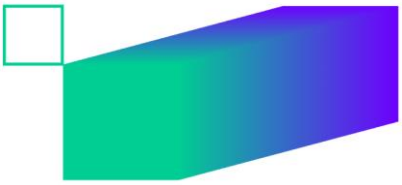
- IRECs The project is developing training materials for researchers regarding new and emerging technologies and internationalisation of research. Training will take place onsite and online, and materials will be available in a modular format. The first version of training materials will be completed in 2024.
- ROSiE The training materials will cover the research ethics and integrity aspects of OS and will be available in early 2024. Additionally, the project's MOOC is being developed and will be hosted on the EU Academy website.
- ENERI The ENERI project produced materials targeting research integrity advisory boards, research ethics committees (RECs), research integrity offices (RIOs), and experts/officers in EU bodies, including a boot camp for REC and RIO members, the ENERI classroom, and the ENERI Decision Tree. The revision of the ENERI Decision Tree and ENERI classroom is ongoing, and the resources will be updated.

Other EU projects mentioned in the interviews, or by the PATTERN thematic leaders, as being of interest for research integrity were PREPARED, GoEQIPD, and the already concluded ERASMUS+FAITH.

4.5.3.5 Gender, non-discrimination and inclusion in research

Among the resources collected, some stand out as potentially adaptable to PATTERN needs. These materials are replicable, relevant, accessible, up-to-date, clear, comprehensive, and some include a strong interactive component.

The online course 'Creating a Gender Sensitive Institution' (TCD, SAGE SwafS project) is action-oriented, addressing institutional gender equality, unconscious bias, and the gender dimension in research. Paying attention to pedagogy, it guides learners through introduction, preparation, studying, applying, reflecting, recalling, and knowledge extending sections, making it user-friendly and easy to navigate. The course offers diverse resources and references and incorporates interactivity through quizzes, reflections, and exercises. However, it lacks a focus on



intersectionality between gender and other dimensions of discrimination or exclusion.

The Gender Equality Audit and Monitoring in Research and Innovation 'GEAM tool' (ACT project) e-learning module is available in multiple languages. Primarily a monitoring tool (questionnaire), it is easily implementable and adaptable to various organisations. While not a training tool, it could be integrated into training by fostering reflection and discussion, along with a glossary. A supporting literature review report is also available for training development.

The GEAM tool goes beyond gender, incorporating an intersectional outlook. It covers institutional situations (bias, prejudice, and organisational culture), gender-based violence (microaggressions, harassment, or bullying), and aims to understand individual situations beyond sociodemographic characteristics. Thus, it addresses important training gaps in Gender, non-discrimination and inclusion in research.

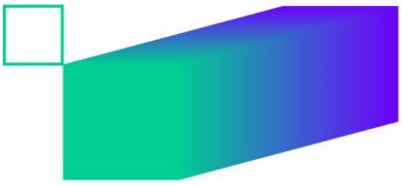
The 'Gender Equality Academy training resources' (GE Academy project) provide access to asynchronous online training on gender equality plans and gender related topics for different audiences. It also provides informative handouts and a variety of templates that can be adapted and reused, including a Quality Standards booklet, detailing standards for trainers and all phases of gender training.

The compilation of 'Tools and resources in gender sensitive teaching methods in higher education', primarily focused on STEM but applicable beyond, encourages teaching staff in higher education to integrate the gender dimension into their teaching. In various formats, including videos, curricula, guidelines, and didactic principles, the materials connect to different projects and institutions. Some consist of reading materials, but others are interactive and updated regularly.

FORRT's 'Lesson Plan 9: Diversity and inclusion in Open Science' is a community-built resource that introduces an inclusive approach, promoting diverse, critical, and inclusive voices within open science. It leads to a platform, feminist voices, offering many resources, teaching guides, archives, oral history, projects etc.[44]

The 'UniSAFE Ending Gender-based Violence in Research and Academia Toolkit' is a comprehensive and high-quality resource that has become recently available

44 https://feministvoices.com/



(September 2023). It is effective in raising awareness of the concepts involved, as well as providing an effective framework for action in RPOs.

Finally, some resources pose challenges for adaptation due to licencing restrictions or the need for significant effort to enhance their pedagogical value. These resources can be referenced as they are or used as sources of information. For instance, the 'Equity in Informal STEM Learning: Using the Equity Compass course' (UCL) introduces the Equity compass tool, accompanied by a very good animation video but relies on video content without accompanying slides for ease of adaptation.

The 'Gender Equality in Academia and Research' GEAR tool (GENDERACTION project) offers practical guidelines for GEPs tailored to the organisational context and aligned with the Horizon Europe requirements but lacks interactivity. Nevertheless, it addresses some of the gaps identified in our analysis, such as evaluating the impact of GEPs, targeting gender-based violence, and recognising gender intersectionality and diversity.

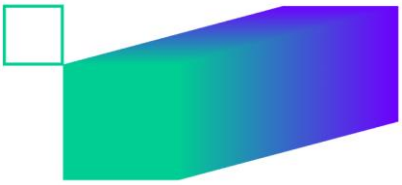
The 'SUPERA - Supporting the Promotion of Equality in Research and Academia' project website provides a range of materials and practical examples that are detailed and address different institutions (universities, research agencies, regional authorities), contexts, and countries. It suggests participatory approaches to developing a GEP and provides a toolkit for tackling structural resistance to gender equality. However, no consideration is given to intersectionality or other marginalised communities.

As for the 'RRI and Gender Equality' (RRI Tools project), it forms part of a broader toolkit for RRI training, offering entry-level content on Gender, non-discrimination and inclusion in research. There is room for improvement in the structure and for a broader discussion of systematic inequality and reflection on participants' own experiences or the specific situation in their institutions.

In addition, PATTERN may want to consider engaging with EOSC FUTURE and Blue-Cloud 2026 which are implementing, respectively, a training course and a training module in gender and inclusion.

4.5.3.6 Dissemination and Exploitation of Results

A difficulty in this thematic area is that access to many of the course type materials mapped is paid, restricted, or copyrighted. Consequently, our quality evaluation focused only on two courses and nine static resources. While we cannot recommend



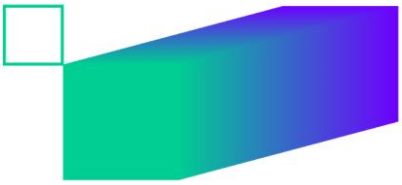
any of the courses for reuse, several interesting open access static resources are suitable for reuse, provided all the information reused is up-to-date.

The 'Toolkit for researchers on legal issues' addresses a known gap of IPR in Open Science and is more like an e-learning module given that it is regularly updated. It provides guidelines and check lists for researchers and institutions on copyright of data, datasets, and databases, IPR (including patents, trade secret and copyright), and personal data protection, with the aim of facilitating the opening of data while remaining compliant with the legislation. Moreover, it provides good coverage of the theoretical framework.

The 'Dandelion- Promoting EU funded projects of inclusive, innovative, and reflective societies. D5.3 Guidelines for good dissemination and valorisation strategies and practices' outlines the needs of different audiences (general public, policy makers, media, and academia) with clear guidelines for effective communication. It covers needs assessment, challenges, motivation, pre/post-result communication, do's and don'ts, as well as channels, activities, and tools to reach the audience, and impact (p. 10 to 18). These guidelines are a valuable resource for tailoring communication strategies to meet specific audience needs and expectations. The section on crafting a one-page summary for each audience is also very useful.

The 'Successful valorisation of knowledge and research results in Horizon Europe: boosting the impact of your project through effective communication, dissemination and exploitation' is a valuable guide for researchers (and support staff) seeking Horizon Europe funding. Its relevance to the RRI context and references to additional guidance materials enhance its usefulness. The document covers key topics, such as the EU's knowledge valorisation policy, distinctions between communication, dissemination, and exploitation activities (p. 11), contractual rights, Dissemination and Exploitation plan contents (p. 12), and Open Science practices (p. 15). However, some issues for improvement have been identified. Links to relevant factsheets lead to a general portal where they are not readily found, presenting a navigational issue. Additionally, there is reliance on extensive text and information could be presented in a more user-friendly toolkit format.

The document 'From ideas to social enterprise. A guide to utilising university intellectual property for the benefit of society' addresses a recognised gap and is oriented towards practice, featuring many useful guidelines and case studies. While



primarily focused on the UK context and copyrighted, the fact that one of its main authors is associated with the PATTERN project raises the possibility of obtaining permission for adaptation. The document includes insightful discussions on various aspects, such as the distinctions between traditional 'for-profit' business models and social enterprises (p. 9), types of IPR in the UK (p. 15), and legal structures for social enterprises (p. 20; pp. 44 - 45). It also provides links to additional resources, including 'The Four Lenses Strategic Framework. Toward an Integrated Social Enterprise Methodology', which addresses social impact as a form of exploitation and is licenced under CC-BY-SA.

Furthermore, the document offers practical tools for measuring social impact (p. 18), preparing a social enterprise business plan (pp. 21 - 22), and facilitating meetings between academics and technology/knowledge transfer representatives (p. 23).

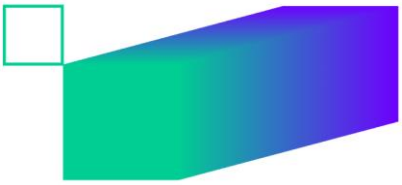
In terms of EU projects for PATTERN to follow or liaise with, BY-COVID, is currently developing training in this area.

4.5.3.7 Science Communication (towards Media and Policy Makers)

This theme is more amenable to face to face training formats, therefore there is a shortage of resources for reuse by PATTERN. The well recognised UWE Bristol: 'Science Communication: Masterclass' stands out as a well-recognised course in Science communication and has traditionally been run in-person. However, during the covid pandemic it was successfully held online. The course is not suitable for reuse by PATTERN but could provide inspiration for the curriculum.

In terms of format, PATTERN could take further inspiration from 'Science Communication and Public Engagement', created by the University of Torino and the Universidad Autonóma de Madrid on the online platform FutureLearn. The course is open access, but certification is paid for.

The 'SciComm4all' initiative offers a series of 10 short useful, easily accessible, videos which introduce some of the key concepts in science communication, including the preparation for a video interview. Yet, it is missing a general introduction on the media logic and how this differs from the scientific one. Providing this is an opportunity for PATTERN. The videos carry a CC BY-ND licence, therefore they cannot be modified but can be distributed. 'SciComm4all' initiative also provides further reading resources.



The 'Greg Foot's Science Communication training' course offers relatively short, very good quality videos (5 to 20 min in length) covering the basics of Science Communication. One of the lessons is on how to give a media interview. The course is open access through YouTube and not adaptable, but in principle some of the videos could be used as part of training or as further study materials.

The Quest project 'Educational Toolkits for Science Communication' has a good range of formats and choice of topics for researcher training, including social media and artificial intelligence, that could be reused. The project is now closed but project COALESCE will carry over from QUEST and will create a competence centre for Science Communication in Europe and PATTERN could liaise with this project in relation to Science Communication training.

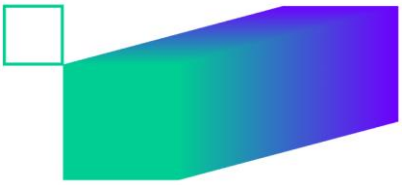
Finally, to equip researchers with competences PATTERN could make curriculum decisions based on the Science Communication competence frameworks of the RETHINK project[45] and Lewenstein and Ayelet Baram-Tsabari (2022).[29]

4.5.3.8 Management and Leadership

One challenge in this thematic area is that access to many of the course-type materials mapped is either paid or restricted. Open access resources often provide static content with limited information about their applicability beyond the context of production. Moreover, they are often designed for broader audiences and have limited relevance for RRI purposes. Therefore, there is a shortage of useful materials for reuse in WP2.

The 'Career Management & Entrepreneurial Mindset Course' offers a good introduction to the significance of developing transversal skills applicable both within and outside academia. Tailored for doctoral students and early career researchers, it provides practical insights and resources to navigate the job market and identify entrepreneurial opportunities. It includes many diverse learning resources and practical examples, featuring interviews with various experts. Moreover, the course refers to the European Entrepreneurship Competence Framework (EntreComp) developed by the Joint Research Centre (JRC).[46]

45 https://www.rethinkscicomm.eu/resources/rethink-scicomm-training-navigator/
46 Bacigalupo M., Kampylis P., Punie Y. and Van Den Brande L. EntreComp (2016). The Entrepreneurship Competence Framework. EUR 27939 EN. Luxembourg (Luxembourg): Publications Office of the European Union; JRC101581. Available at https://publications.jrc.ec.europa.eu/repository/handle/JRC101581



The course includes clear instructions for local adaptation in research organisations. Ideally, the contents should be complemented by local implementation and examples of how the course has been delivered in past editions are provided.

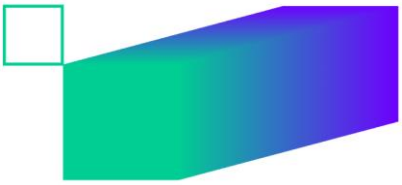
Developed by the Horizon Europe project Doc Talent4EU, the course 'Personal Effectiveness and Leadership' aims to equip doctoral candidates with essential skills and knowledge needed to enhance their self-awareness, productivity, and resilience while developing strong teamwork and leadership qualities. Despite the limited target audience, the course is well-organised with practical information, such as the length of each lesson, the corresponding ESCO SKILLS covered, and the division into single modules. This structure should make its adaptation and implementation for future activities easier.

The 'Researcher Management and Leadership Training' on COURSERA, created by the University of Colorado, is extensive, both in terms of the quantity of resources offered (over 13 hours of video) and the depth of the topics covered. The course is fully accessible online but is copyrighted and certification is provided exclusively to paying subscribers.

The course is well structured, spanning six weeks, and addresses a broad spectrum of topics relevant to principal investigators, including effective mentorship skills (a gap identified by PATTERN), financials, reporting, and administrative obligations. While not amenable to adaptation, it can serve as inspiration for curriculum development or be promoted as a further learning resource.

Resources excluded on the basis of poor accessibility include the training programs offered by The University of Edinburgh, namely 'The Edinburgh Leader', 'The Aspiring Manager', and 'Equality and Diversity Essentials', as well as 'Research Management and Leadership Curriculum' by IREX and 'Leaders in Research Management' by EARMA. These courses, despite being excluded, are well-structured, provide useful toolkits and presentations and are tailored to the professional experience of the intended audience. They may serve as inspiration for the upcoming development phases of PATTERN's training.

In terms of static resources, some may prove useful for PATTERN but require substantial adaptation efforts. The Vitae 'Leadership development for Principal Investigators' offers a valuable overview of management and leadership concepts, supported by concrete examples; however, its structure is not intuitive. Among its



resources, the 'Researcher Development Framework' (RDF) stands out as a very useful planning tool, articulating knowledge, behaviours and attributes of successful researchers at all stages of their careers.

Finally, it is worth mentioning that Project BEYOND is developing useful training material for supervision and mentoring, using the approach of gamification, as reported to us in an interview.

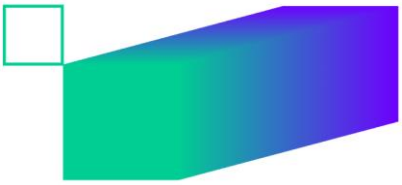
4.5.3.9 Open Science

Many training resources are geared toward Open Science (OS) in general and cover more than one of the eight topics on which PATTERN focuses. In total, 15 of such resources have been identified and evaluated. The most relevant resources for PATTERN are discussed below.

Courses to highlight:
'La Science Ouverte' is a free Open Science MOOC developed by Sorbonne University. It consists of 6 modules: (1) Open Access, (2) Open Data, (3) Research Evaluation, (4) Citizen Science, (5) Science & Society, (6) Career perspectives. The MOOC is self-paced and aims mainly at PhD students with little prior knowledge of OS and has a total workload of 5 – 8 hours. Each module consists of short video's (7-8 min), short texts and a quiz. All content is licenced CC-BY. The content is of high quality, albeit at a basic level. Videos are in French, with English subtitles and texts are provide in French and English. This course is relevant to other PATTERN topics, namely Open Access, Open Data, Citizen Science, Management and Leadership.

The MOOC 'Open Science: Sharing Your Research with the World' is a 4-week course, developed by TUDelft. It is a course you can enrol in with a cohort of students (paid), but the materials are also available for free (CC-BY-NC-SA) for self-paced learning. The first three weeks focus on (1) Introduction to Open Science, (2) Research Data Management, (3) Publishing Open Access. In the last week, students can choose to focus on one of three topics: FAIR research software, increasing your research visibility, or Citizen Science. The course consists of video's, text and quizzes (in English), all of which are of high quality. This course is relevant to other PATTERN topics, namely Open Access, Open Data, and Citizen Science.

'Faces of Open Science' is a compelling format and method developed by Utrecht University, focusing on the bigger picture, rather than on practical tools and skills. This exercise guides students and staff in reflecting on the different roles and



motivations that academics play in shaping OS, starting with a debate on the role of universities in society. It describes 11 roles in the form of personas (e.g. Critic, Opportunist, Architect, …) based on interviews with OS experts. The exercise, which takes about 8 hours, involves personal reflection on one's motives and role, fostering an understanding of the roles of others within the context of shared larger goals.

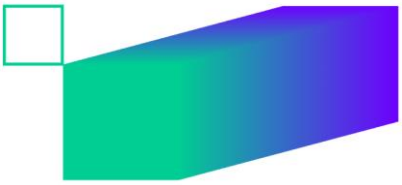
'Introduction to Open Science' is one of the courses developed and maintained by FOSTER. The self-paced course (workload 2-3 hours) offers a general introduction to OS. It includes video's, text and quiz questions. The materials are of high quality. Apart of this introduction, FOSTER offers dedicated courses on various aspect of OS, which are highly relevant for the PATTERN project.

OpenAIRE's 'Open Science Train-the-Trainer bootcamp' and resources thereof on OpenPlato. While focused on trainers (data stewards, librarians), this course contains very useful resources that could be reused by PATTERN (CC BY licence). Basic OS, Open Access, and RDM topics are covered, and taken further to the intermediate level, which is one of its strengths. Together with the inclusion of newer and cutting-edge topics like Diamond Open Access, preprints, and Artificial Intelligence.[47] This course is relevant to other PATTERN topics, namely Open Access, Open Data, RDM, FAIR, RRI, and citizen science.

Recommended resources on how to train on OS: Some of the courses or parts of courses are useful to PATTERN pilot organisations, particularly in relation to the pedagogical aspects of training. The above-mentioned 'OpenAIRE OS bootcamp' contains materials on this, as does the 'EOSC Synergy Online Training Handbook', or the EOSC Future module 'Crafting your own training using EOSC resources' (all three open access, CC BY). The 'ORION Open Science Train-the-Trainer MOOC' is also useful in this respect, but it is not clear if content could be reused. In any case it can be referred to.

Non-course resources to highlight:
'FOSTER Open Science training handbook' (needs updating though).
'EOSC ice-breakers', a set of 30 discussion cards newly released, to support training in Open Science and EOSC.

47 Awareness training on 'Artificial Intelligence, teaching and research' was provided by Milica Sevskusic and Iryna Kuchma at the OpenAIRE train-the-trainer bootcamp (22-26 May 2023); see https://openplato.eu/view.php?id=59&lanh=en



Recently, several National level guides have been published to introduce Open Science to early career researchers. These guides give a general introduction to several Open Science topics and provide links and guidance to implement the corresponding practices. These guides consist of short chapters and are visually appealing, making them valuable sources to reuse in PATTERN.

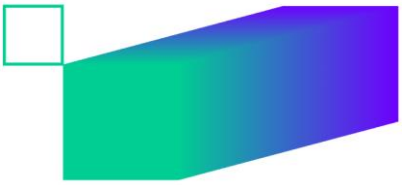
- France: 'Passport for Open Science – A practical guide for PhD students'
- The Netherlands: 'Open Science: A practical guide for early-career researchers'
- United Kingdom: 'Open Science – a practical guide for PhD students'

4.5.3.10 General RRI training

Concerning general training resources on Responsible Research and Innovation (RRI), eight training courses or modules were put forward during the landscaping exercise, and six static resources. A further course and two static items were added during quality assessment. During the assessment process, one of the course links became inactive, so that only eight courses were fully assessed and are available for potential reuse. Therefore, in total eight courses and eight static resources were assessed.

The seven training courses on RRI assessed were all high quality. The structure was clear, learning outcomes were given, clear language was used, and attention was paid to formatting. Most of these resources were developed as part of the FIT4RRI (2017-2020) and RRI Tools (2014-2016) projects, implying that the materials will need some updating, particularly in the latter case. The adaptability is not always perfect; for example, original slides are not always available for editing. However, in most cases, reproducing the materials will be straightforward, provided permission is granted. Regarding the courses on the FOSTER portal, as mentioned in the Open Access section, these are available under CC-BY licences and as SCORM packages.

Content-wise, the courses are mostly introductory (beginner level). They could be a useful part of a broader PATTERN course (e.g. part of an introductory lesson on RRI in an OS course or serve as the starting lesson(s) for a more detailed RRI course). Most relevant to this end are the FIT4RRI courses 'Openness in Science and RRI' (also relevant to the Open Science theme) and 'Introduction to Responsible Research and Innovation', both available through the FOSTER portal. A third FIT4RRI-FOSTER course 'Engaging the Public in Responsible Research and Innovation' is a useful



more in-depth introduction to public engagement, while 'Research and Data Ethics' is a good introduction to this RRI aspect. These courses were developed between 2017 and 2020 and are sustainably available through the FOSTER platform. Some content and linked resources will need updating. The courses can be improved by inclusion of practical examples of RRI in research as well as in addressing societal challenges. Moreover, interactive elements beyond quizzes would be beneficial.

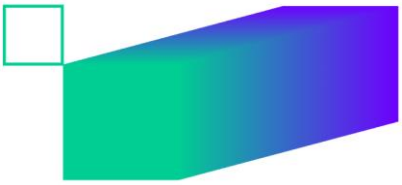
A very useful resource for PATTERN is the RRI Tools 'RRI Toolkit', particularly its dedicated training resources section. It offers three training modules in the form of slide decks, videos, activities, and guidance. There are also additional training materials tailored to different audience types. While the materials are primarily designed for synchronous and in-person training, the videos are well-suited for self-paced learning. These resources can be selectively utilised, such as choosing images, slides, and activities for reuse.

Some of the courses are less relevant for reuse. One of the courses ('Responsible Research and Innovation for Companies') targets companies and is less relevant for researchers / academic students. Another course, 'Responsible Innovators of Tomorrow', offers very relevant content, but relies extensively on copyrighted videos, limiting reuse without permission, as well as adaptability.

A high-quality and highly relevant course is the 'Try RRI! A guide for Responsible Research and Innovation' course from the University of Amsterdam (UvA), available through Coursera. It cannot be reused without permission, but PATTERN could potentially seek the required permissions.[48]

Focusing on the static resources assessed, they are generally more recent than most of the courses above and are, therefore, useful for updating course contents or informing their development. The 2023 'A Guide to Responsible Research' is a more detailed resource than the courses mentioned above and can be valuable for intermediate and advanced level students on the topic. The 'Practical Guide to Responsible Research and Innovation' dates to 2016 but can still form a useful source of information and/or a resource to refer students to, together with other elements of the RRI Toolkit. The 'RRI & Experiment Toolbox Toward Responsible Healthcare

48 One of the authors of the 'Try RRI! A guide for Responsible Research and Innovation' is currently part of the PATTERN project.

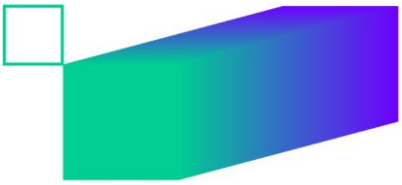


Ecosystems' is the least generically applicable, but useful for RRI examples from the healthcare sector.

When updating courses, the video 'Responsible Research and Innovation (RRI) at an Institutional Level' might be a good replacement for some of the older introductory videos, although it explains why RRI is important and not so much the basic concept of RRI. A recent PowerPoint presentation to introduce RRI will be available soon through OpenPlato 'OpenAIRE Open Science Train-the-Trainer resources'.

It is important to integrate interactive elements into the PATTERN training materials, independently of the mode of delivery (self-paced, synchronous online or in-person training). 'Cards for fostering sparkling RRI conversations', 'Roll the RRI dice', and the 'Dilemma Game' cards or app are useful examples of these.

To sum up, our recommendations for PATTERN RRI training are to update existing training courses, integrating activities and examples. Rather than focusing on one specific course, consider drawing materials from all the available courses for reuse, including Fit4RRI-FOSTER and RRI Tools courses, and potentially the UvA course if permitted. Use static resources to refresh older courses. Moreover, if there's demand in the pilot organisations, explore creating new, reusable materials for modules beyond the beginner level.



5 Overview of gaps and opportunities in OS and RRI training

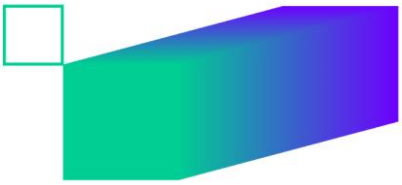
This section presents a gap and opportunity analysis in OS and RRI training. We've consolidated findings based on the evaluation of the resources' content themes, and insights from the MLEs, interviews, and survey. Here, we include findings applicable across all training areas, as well as those concerning each of the PATTERN transferable skill areas. We start by addressing some of the limitations we have encountered.

5.1 Challenges in characterising the training landscape

While the PATTERN approach has led to an impressive collection of high-quality resources, they do not offer an exhaustive list of the available offers which are continually being developed and therefore constitute a moving target. Additionally, the sharing of educational resources is not yet a common practice, potentially leaving valuable resources undiscovered or inaccessible. Despite these challenges, our results offer a good overview of current activities and resources, especially for online training. This establishes the ground for further mapping efforts, which could involve more extensive collaboration with other projects and continuous crowdsourcing, to continually provide a comprehensive understanding of the training landscape.

In-person trainings are likely underrepresented and more challenging to map and evaluate. Even when textual descriptions are available online, they often lack the necessary detail on learning outcomes and processes, and course materials and feedback from participants are rarely available. Furthermore, trainings by private providers were not systematically mapped due to time and methodological constraints. In many cases, without affiliation with the organising institution or payment, external users had limited access to information about the content, pedagogical approach, and quality of the training. This issue was prominent in several of the PATTERN transferable skill areas, namely Research Integrity, Science Communication (towards media and policy makers), Dissemination and Exploitation of Results, and Leadership and Management.

Language poses another consideration, as most mapped resources are in English. This may be attributed to English being the lingua franca in scientific communities, with national research organisations often connecting to English-language



resources. Moreover, resources developed by multinational consortia tend to be in English, which is also the predominant language in the PATTERN consortium. While resources in national languages may exist locally, identifying and accessing them is challenging unless the provider has made an effort to ensure easy accessibility (e.g., metadata are available in English).

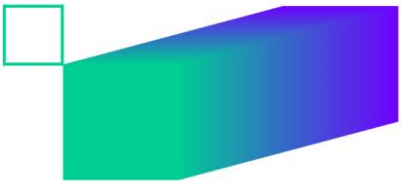
Some areas provided additional specific challenges. Citizen Science poses a challenge of terminology which added a layer of complexity to the mapping. It can be known by different names in addition to, or instead of, Citizen Science, for example Public Participation in Scientific Research (PPSR), community science, crowd science, civic science, and participatory monitoring to name but a few. Countries adopt these terms in their native languages and show different preferences for adopting 'Citizen Science' or 'participative science' as variants. For example, 'Citizen Science' is not considered inclusive in the USA as the common usage if the term 'citizen' excludes non-nationals.

5.2 Overarching gap and opportunity analysis

The gaps, opportunities, and needs in training that overarch all the PATTERN thematic areas mapped are summarised below.

5.2.1 Delivery, content, and audiences

- Languages other than English. Both the mapped resources and the testimonies of interviewees show a strong predominance of English. Training that uses local or locally appropriate languages may be a gap, depending on the audience for training and their needs.
- Intersectionality with Diversity and Inclusion, interaction with traditional belief systems and knowledge. Cultural competence of researchers. These are important themes that emerged in interviews. They are particularly relevant for Citizen Science and Science Communication (towards media and policy makers) given their public-facing aspects. But they are relevant in the context of other areas as well such as Gender, non-discrimination and inclusion in research, Research Integrity, Leadership and Management, etc.
- Multidisciplinarity and interdisciplinarity should be trained as valuable competences for researchers.
- IPR and Open Science. This topic was highlighted as a resource gap in the Open Science Capacity Building Index being put together by UNESCO.



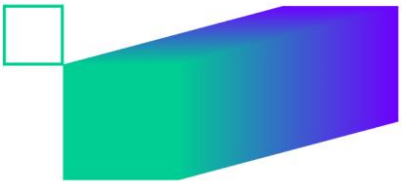
- Artificial intelligence. There is a need for training in this emerging topic, including the changes it will bring to professional practice.
- Current pedagogical approaches emphasise interactivity, knowledge exchange opportunities, and creating a sense of community in online learning.
- Learn-by-doing, with trainees bringing their own work to workshops and courses and co-creating curricula, results in good engagement. Integrating theory into practice also offers a richer experience for trainees.
- Advanced level trainings are lacking in many areas. Moreover, the needs of advanced learners and their institutions need to be better defined, considering their career stage, professional responsibilities, and motivation for learning. An important aspect that emerged is how to 'brand' training among late career researchers. It may be more effective to create opportunities to network and engage with OS and RRI champions, especially if in their field of interest.
- Continue to invest in 'Train-the-Trainer' courses, paying special attention to pedagogy. They provide a means of cascading knowledge faster within organisations and therefore create impact faster.

5.2.2 Implementation

- 'Meaningful badges' and certification. It was noted that there is a lack of a common understanding regarding the significance of badges and certificates awarded upon the completion of various training programs. Some interviewees expressed their wish for qualifications obtained through informal training and education to be recognised by an authoritative body, emphasising the importance of establishing clear standards and criteria for such credentials. Liaising with the European Council of Doctoral Candidates and Junior Researchers (EURODOC) may provide opportunities in this regard.[49]

- Creating incentives and rewards for open and responsible science is required to get buy in for trainings from both learners and their institutions. Research Funding Organisations can have a pivotal role in this context, leveraging their influence in policy implementation. Further downstream, at the level of

49 https://eurodoc.net/



RPOs, it is important to institute rewards for open and responsible science at key career progression checkpoints. An illustrative example shared in one interview highlighted a pilot scheme at US universities, specifically among HELIOS members.[50]

5.2.3 Quality, sustainability and impact of training

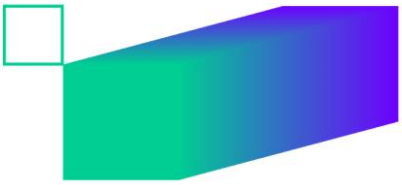
Our understanding of how to evaluate and promote quality, impactful training has been informed by our quality assessment, interviews, MLEs, and survey. In addition to key quality criteria such as relevance, ease of access, implementation and adaptation, possessing a well-structured format, clear description, using plain language, and ensuring good object quality [51], a set of recommendations to guarantee quality trainings has been formulated and is presented in section 4.5.2.

Concerning training impact, a common method to assess learning outcomes involves comparing learners' knowledge before, during, and at various points after the training (up to 6 months). However, this approach does not effectively evaluate the practical application of acquired knowledge. Maintaining contact with learners on LinkedIn or other platforms (e.g. OpenPlato) to monitor their professional development post-training has been proposed to assess the longer-term impact of the training. For example, in Science Communication, one gauge of training impact is tracking the number of trainees who become professional science communicators.

Several recommendations aimed at ensuring the sustainability of training have been outlined in section 4.4.6 and emerged from interviews. It is evident that promoting the reuse of training materials and platforms fosters ongoing sustainability. Suggestions for achieving this include ensuring the FAIRness of the resources, creating content that is both editable and unbranded to facilitate resource sharing, and designing a 'facilitator's guide' to assist users. Moreover, accessibility and inclusion for diverse social groups, including individuals with disabilities and neurodiversity must be considered during the planning stage.

The issue of funding was a common concern. Training in OS and RRI is strongly dependent on funded projects and there is a need to transfer knowledge and

50 Higher Education Leadership Initiative for Open Scholarship https://www.heliosopen.org/team
51 Fraisl D., Hager G. & See L. (2020) Framework Report Describing Criteria and Rationale for Sharing and Selecting State of the art Citizen Science Resources https://zenodo.org/record/3716236#.ZKvIc3ZBw2w



resources from one project to another. To enhance efficiency and sustainability, there is a need for increased coordination and collaboration between projects, particularly among project consortia preparing new bids. Furthermore, ensuring the successful adoption of training initiatives involves understanding and addressing the needs of stakeholders. One effective strategy mentioned in the MLEs is to establish connections with established training communities such as OpenAIRE, OS CoP, and FORRT. By empowering them to continually update the training content, there is a higher likelihood of meeting the evolving needs of stakeholders and maintaining the relevance and effectiveness of the training programs.

Moreover, sustainability solutions consistently raised in interviews and MLEs. included integrating the training into existing learning platforms and systems used by institutions (the SCORM format is useful in this regard), investing in additional 'Train-the-Trainer' courses for more effective knowledge dissemination, and regular revision to keep the training current, incorporating relevant case studies.

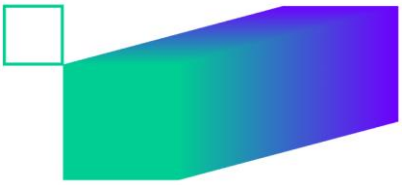
5.3 Gaps and opportunities by theme

5.3.1 Open Access

- Funders requirements, repositories and predatory journals. These themes are not well represented in the collected resources and would seem to be of immediate practical interest, especially to early career researchers. Nevertheless, among the general Open Science and RRI trainings collected some content is relevant for OA (see 4.5.3.9).
- Specific routes of OA such as gold, diamond, etc. and regional and European Commission-funded programmes.
- Promoting Plan S.

5.3.2 FAIR data and Research Data Management

- Controlled vocabularies, metadata standards, file formats, interoperability processes, (trustworthy digital) repositories, and long-term curation. Generic training in these topics is to some extent available, but discipline-specific training is missing for many disciplines and is required to make research data FAIR.
- Fostering a culture of reusability of data. Making data FAIR is necessary but not sufficient, training should promote data reuse, so that it is commonplace in more disciplines.



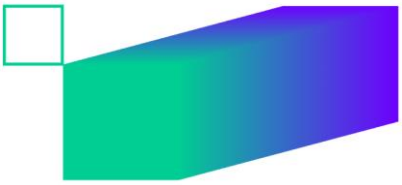
- Data sensitivity. There is still much demand for this type of training, not just related to GDPR regulations but also IPR, so commercially sensitive, or even sensitive data for reasons of national security.
- Training aimed at citizens. This may be of particular interest within the context of Citizen Science.

5.3.3 Citizen Science

- Development of Citizen Science policies, guidelines and fundraising.
- Roadmaps for implementation of Citizen Science by research organisations. This is an emergent topic promoted by the Time4CS project, that would benefit from continued attention.
- Accommodating intersectionality between Citizen Science and other areas such as Open Science/Access, Gender, non-discrimination and inclusion in research
- Specialised training for specific types of Citizen Science (different levels of engagement, or different scientific areas).
- Establishing clear and operational guidelines for the development of resources that are problem-based and provide active learning opportunities (interactivity).
- Engaging and potentially collaborating with private companies as stakeholders, actors, or service providers in Citizen Science projects.

5.3.4 Research Integrity

- Intersectionality between Research Integrity and: open science; inclusion; climate change and environment; social consequences of research misconduct.
- Intellectual Property, Research Collaborations, Power dynamics in research collaborations and supervision.
- Privacy and Confidentiality.
- Training (or at least case studies) for domains other than life, biomedical, and health sciences. These domains are already very well represented and form the basis of many case studies. The current trend is for generic training that fosters critical thinking which enhances adaptability to varied contexts.
- Emerging topics: Artificial intelligence and emerging technologies, cultural competence in research, needs of Citizen Scientists.



5.3.5 Gender, non-discrimination and inclusion in research

- Inclusion topics beyond Gender Equality Plans. One clear gap within gender is gender-based violence.
- Advanced level and materials addressed particularly to trainers/teachers/lecturers. Examples include monitoring and evaluation of GEPs implementation at institutional level and the assessment of whether GEPs have real practical consequences.
- Dimensions to Diversity and Inclusion beyond gender and consideration of intersectionality among the different dimensions, for example the integration of migrants and other vulnerable social groups. Theoretical foundations include critical race theory, social identity theory.
- Training materials to enhance self-awareness of bias/privilege, as well as action tools.

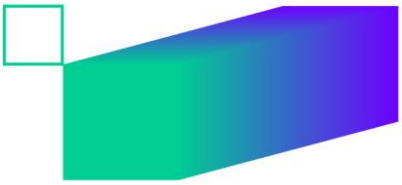
5.3.6 Dissemination and Exploitation of Results

Exploitation training is poorly represented in our mapping. However, further training might be found in some of the collections mapped and it is possible that this training is adequately covered by private providers. One concept and gap in training seems to be creating social impact as a form of exploitation of results.

5.3.7 Science Communication (towards media and policy makers)

In addition to the mapping analysis, the interviews conducted about science communication resulted in a rich list of topics highlighted as gaps, opportunities, and needs.

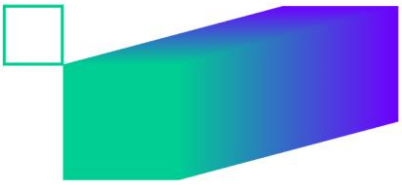
- Inclusivity is a 'hot topic'. Understanding who we are not reaching in science communication and how to reach them.
- Communicating uncertainty and current limits of scientific knowledge.
- Engaging with policy makers.
- How to use social media in Science Communication. Training also in search Engine Optimisation and analytics.
- Data visualisation (graphics) in digital and social media communication. There is a lack of dedicated courses, even introductory ones, on these important aspects.
- Fake news/Misinformation/disinformation/pseudoscience and how to get your message across in the noisy infosphere.



- Train every researcher in the basics of science communication. They never know when they will find themselves in a position to have to do it.
- Theoretical dimensions of science communication (i.e., science in society, not just social aspects but also political and ideological). These should be present in even short trainings.
- Science Communication as two-way communication. There is still a need to train people beyond the deficit model, moving towards more dialogical approaches.

5.3.8 Management and Leadership

- Mentor-mentee relationships.
- Addressing the networking gap. Training that enables researcher to establish connections with peers, mentors, and industry professionals.



6 Concluding remarks

This deliverable presents the results of the first work package of project PATTERN (WP1), dedicated to comprehensively mapping and analysing the state-of-the-art of learning opportunities in Open Science and RRI for researchers. Through a collaborative approach and leveraging the expertise of its project partners, PATTERN achieved its overarching goal of establishing a knowledge base essential for the subsequent development, piloting, and evaluation of training modules in forthcoming work packages.

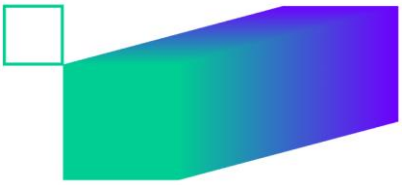
PATTERN mapped and analysed over 500 resources, comprising training activities, modules, materials, and platforms, and quality-assessed around half, focusing on those that were digitally available and open access. This process successfully transformed information from previous tasks into actionable knowledge, identifying gaps in training, strengths, weaknesses, and opportunities for reuse.

Our activities were supported by a survey, interviews, and three online Mutual Learning Events, engaging consortium members, guests from other projects and communities of practice, and experts from associated countries. These shed light on existing practices and emerging trends in RRI (and Open Science) training, providing valuable recommendations for the development of training, its curation, and sustainability.

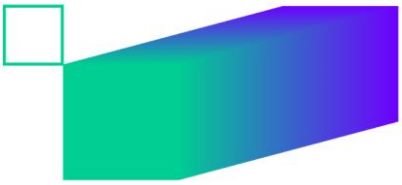
It is important to recognise that the findings are not exhaustive. Acknowledging the dynamic nature of the field, characterising the RRI training landscape demands continued vigilance and cooperation with training communities and other projects, especially those currently developing and piloting training.

Training to address gaps should be available, but also used. In this regard, it is crucial to liaise with Research Performing Organisations, creating interest in training and ensuring good alignment with institutional Open Science and RRI training needs. PATTERN will endeavour to adopt this approach through closely working with a number of pilot organisations in WP2.

In conclusion, the PATTERN project successfully consolidated existing knowledge, identified gaps, and presented actionable recommendations based on a thorough



analysis of the state-of-the-art learning opportunities in RRI. These outcomes lay the groundwork for the future work packages in our project aimed at contributing to the advancement of RRI training.



7 Appendices

Appendix I: Agreed definitions relevant to Responsible Research and Innovation

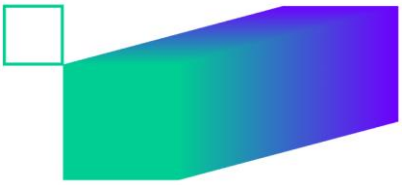
These definitions were collected and shared within the PATTERN consortium:

Open Access

- Open Access is the practice of providing online access to scientific information that is free of charge to the user and is reusable. EU definition: https://research-and-innovation.ec.europa.eu/strategy/strategy-2020-2024/our-digital-future/open-science/open-access_en
- Open Access refers to online, free of cost access to peer reviewed scientific content with limited copyright and licencing restrictions. About FOSTER | FOSTER (fosteropenscience.eu)
- Free availability of scholarship on the public internet, permitting any users to read, download, copy, distribute, print, search, or link to the full texts of these research articles, crawl them for indexing, pass them as data to software, or use them for any other lawful purpose, without financial, legal, or technical barriers other than those inseparable from gaining access to the internet itself' (Boai, 2002). Open access | FORRT - Framework for Open and Reproducible Research Training

FAIR data

- Research data should be 'FAIR', that is findable, accessible, interoperable and reusable. H2020 Online manual refers to: The FAIR data Principles – FORCE11
- Fair Principles: Describes making scholarly materials Findable, Accessible, Interoperable and Reusable (FAIR). 'Findable' and 'Accessible' are concerned with where materials are stored (e.g. in data repositories), while 'Interoperable' and 'Reusable' focus on the importance of data formats and how such formats might change in the future. FAIR principles | FORRT - Framework for Open and Reproducible Research Training
- FAIR (Findable, Accessible, Interoperable, Reusable): 'The FAIR data Principles are a set of guiding principles in order to make data findable, accessible, interoperable and reusable' (Wilkinson et al., 2016[10]). 'These principles provide



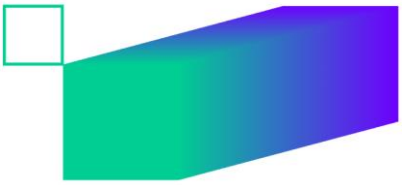
guidance for scientific data management and stewardship and are relevant to all stakeholders in the current digital ecosystem. They directly address data producers and data publishers to promote maximum use of research data' (Liber, 2017). Horizon Europe requires the projects it funds to make their research data FAIR. In 2018, the European Commission Expert Group on FAIR data published a comprehensive report: Turning FAIR into Reality. Source: Publications (eua.eu)

Citizen Science

- Citizen Science refers to the general public engagement in scientific research activities when citizens actively contribute to science either with their intellectual effort or surrounding knowledge or with their tools and resources. socientize_white_paper_on_citizen_science.pdf (europa.eu)
- Citizen Science refers to projects that actively involve the general public in the scientific endeavour, with the goal of democratizing science. Citizen scientists can be involved in all stages of research, acting as collaborators, contributors or project leaders. Citizen Science | FORRT - Framework for Open and Reproducible Research Training
- Citizen Science is a broad EU policy covering Open Science activities in which citizens participate in the scientific research process as: observers, funders, in identifying images or analysing data, or by themselves providing data. Publications (eua.eu)

Research Integrity

- There is no universally accepted definition of Research Integrity, although it is generally understood to relate to the performance of research to the highest standards of professionalism and rigour, in an ethically robust manner. The behaviours espoused by ethics and Research Integrity should ultimately ensure the accuracy and truth of the research record in publications and elsewhere. Luhmann called this 'system trust', which facilitates researchers, policy makers, educators and the public on to confidently draw from, and build on, the research results of others without needing to check their reliability before they use them. briefing_paper_research_integrity_web.pdf (scienceeurope.org).



- Research Integrity is defined by a set of good research practices based on fundamental principles: honesty, reliability, respect and accountability (ALLEA, 2017). Research Integrity | FORRT - Framework for Open and Reproducible Research Training. The European Code of Conduct for Research Integrity - ALLEA

Gender non-discrimination and inclusion in research

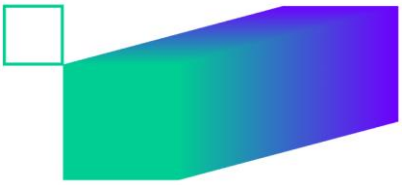
- The aim of non-discrimination law is to allow all individuals an equal and fair chance to access opportunities available in a society. This means that individuals or groups of individuals which are in comparable situations should not be treated less favourably simply because of a particular characteristic such as their sex, racial or ethnic origin, religion or belief, disability, age or sexual orientation. EUR-Lex - nondiscrimination_principle - EN - EUR-Lex (europa.eu)
- Inclusion, or inclusivity, refers to a sense of welcome and respect within a given collaborative project or environment (such as academia) where diversity simply indicates a wide range of backgrounds, perspectives, and experiences, efforts to increase inclusion go further to promote engagement and equal valuation among diverse individuals, who might otherwise be marginalised. Increasing inclusivity often involves minimising the impact of, or even removing, systemic barriers to accessibility and engagement. Inclusion | FORRT - Framework for Open and Reproducible Research Training

Dissemination and Exploitation of Results

- Dissemination means sharing research results with potential users - peers in the research field, industry, other commercial players and policy makers). By sharing your research results with the rest of the scientific community, you are contributing to the progress of science in general. Whereas exploitation is the use of results for commercial purposes or in public policymaking. Dissemination & Exploitation - Open Access - H2020 Online Manual (europa.eu)

Science Communication:

- Informing, promoting, and communicating activities and results with multiple audiences (citizens, media, and stakeholders). The aim of

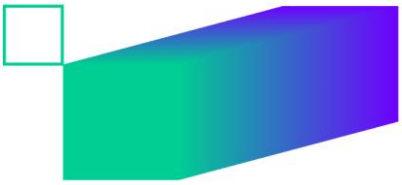


communication is to engage with stakeholders, attract the best experts, generate market demand, raise awareness of how public money is spent and show the success of European collaboration. Communication, Dissemination and Exploitation (rea)

- Science communication (SciCom) is defined as the use of appropriate skills, media, activities, and dialogue to produce one or more of the following personal responses to science (the AEIOU vowel analogy): Awareness, Enjoyment, Interest, Opinion-forming, and Understanding. Science Communication: A Contemporary Definition
- 'We recognise the recent advances in locating public communication of science as part of a continuous process, rather than as a terminal, residual stage of knowledge production. We believe no sharp distinction (even more so in the age of digital media and open science challenges) can be drawn between public and non-public communication of science communication of science, that is, communication within and between scientific communities. There is a rich variety and diversity of science communication, encompassing informal, pleasurable communication as well as that which is targeted and strategic.' Rethinking science communication as the social conversation around science

RRI

- Responsible research and innovation is an approach that anticipates and assesses potential implications and societal expectations with regard to research and innovation with the aim to foster the design of inclusive and sustainable research and innovation. [...] Responsible Research and Innovation (RRI) implies that societal actors (researchers, citizens, policy makers, business, third sector organisations, 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 society. European Commission (2018) The EU Framework Programme for Research and Innovation. Science with and for Society. In Schuijff, M. Dijkstra, A.M. (2020) Practices of Research and Innovation: A Review. Sci Eng Ethics 26, 533-574. Practices of Responsible Research and Innovation: A Review | SpringerLink.
  In this definition, the European Commission (2018) further stated that there



are five characteristics or dimensions of RRI, also labelled keys, which make RRI tangible: public engagement, open access, gender, ethics, and science education. Governance of the whole process is a sixth dimension, or key, which serves to integrate the other five. Schuijff, M. Dijkstra, A.M. (2020)

- RRI is a process where all societal actors (researchers, citizens, policy makers, business) work together during the whole research and innovation process in order to align its outcomes to the values, needs and expectations of European society RRI Tools | Ecsite

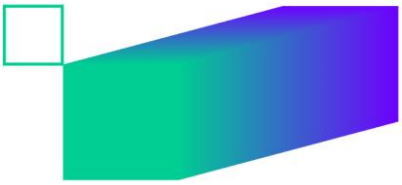
Gender equality

- Gender equality means women, men, boys, and girls in all their diversity are equal and should have equal opportunities to thrive and equal participation in our society where gaps have been identified in specific sectors including employment, pay, care, power, and pensions. By closing these gaps, gender equality would bring more jobs and higher productivity. Gender equality is a principle which also empowers women and girls since they are still facing challenges such as sexist hate speech, discrimination, violence, and harassment. The inclusion of a gender perspective in all EU policies and processes is essential to reach the goal of gender equality. Gender mainstreaming ensures that policies and programs maximise the potential of all – women and men, girls and boys, in all their diversity. The aim is to redistribute power, influence, and resources in a fair and gender-equal way, tackling inequality, promoting fairness, and creating opportunity. https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=CELEX%3A52020DC0152

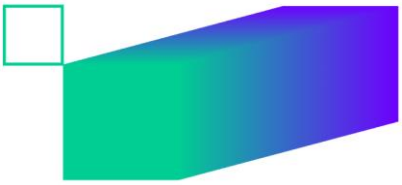
Appendix II: Controlled vocabularies used in training metadata

Metadata	Value	Description	Source (click for link)
Access rights	Open access	Open access refers to a resource that is immediately and permanently online, and free for all on the Web, without financial and technical barriers.	EOSC Future
	Restricted access	Restricted access refers to a resource that is available in a system but with some type of restriction for full open access.	EOSC Future
	Metadata only access	Metadata only access refers to a resource in which access is limited to metadata only. The resource itself is described by the metadata, but neither is directly available through the system or platform nor can be referenced to an open access copy in an external source.	EOSC Future
	Paid access	Paid access refers to the need to pay a fee to access the resource.	EOSC Future
Expertise level	Beginner		EOSC Future
	Intermediate		EOSC Future
	Advanced		EOSC Future
	All		EOSC Future
Target group /audience[52]	All audiences		
	All researchers / academics	Early career researcher in the doctoral stage	
	Students	Any higher education students (bachelor/master)	
	Doctoral/PhD students	Early career researcher in the doctoral stage	
	Postdoctoral researchers	Early career researcher in the postdoctoral stage	
	General public	Including citizen scientists	
	Research support	Research support at university and research institutes	Adopted from CESSDA/SSHOC's 'citizen scientist'; link

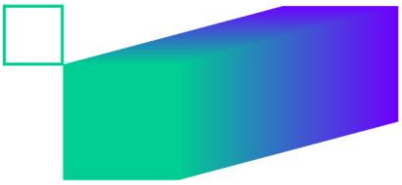
52 Note for target group audience: Different from EOSC categories (here: https://wiki.eoscfuture.eu/display/PUBLIC/B.+v4.00+EOSC+Resource+Profile#B.v4.00EOSCResourceProfile-ResourceTargetUsers)



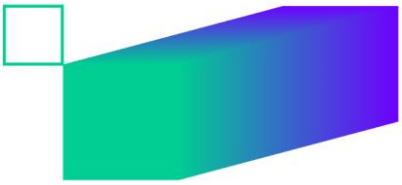
Metadata	Value	Description	Source (click for link)
	Trainers / teachers / lecturers	[Audience that will be re-disseminating this information]	CESSDA
	Other		CESSDA, EOSC
Learning resource type	Course	Program of study, or unit of teaching that typically lasts one academic term (academic course, educational course, class) (wikidata). / Sequence of one or more educational events and/or creative works which aims to build knowledge, competence or ability of learners (schema.org).	Time4CS; SSHOC; wiki; schema.org
	E-learning module	Asynchronous/self-paced online learning, for example a MOOC	Time4CS; SSHOC
	Static resource	For example, a guide, handbook, toolkit, book, slides, report	Time4CS
	Webinar / lecture	Online webinar or online/offline lecture	Time4CS; SSHOC
	Workshop	Training, active learning event	Time4CS; SSHOC
Training mode / Mode of learning	Online		EU vocabularies
	Blended	Hybrid	EU vocabularies
	In-person	Presential, onsite [note: op.europa.eu term is 'presential', changed here because 'in-person' more used in the community]	EU vocabularies
Learner assessment	Artefact assessment		EU vocabularies
	Continuous evaluation		EU vocabularies
	Group performance		EU vocabularies
	Level of attendance		EU vocabularies
	Marked assignment		EU vocabularies
	Oral examination		EU vocabularies
	Peer assessment		EU vocabularies
	Peer review		EU vocabularies
	Portfolio		EU vocabularies
	Practical assessment		EU vocabularies
	Problem based learning	Test of practical problem-solving skills	EU vocabularies
	Project work		EU vocabularies
	Quiz	Recall test based on multiple choice entries	EU vocabularies



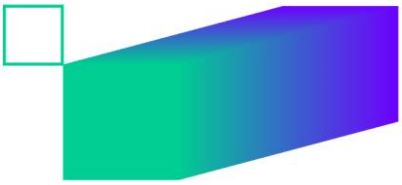
Metadata	Value	Description	Source (click for link)
	Written examination		EU vocabularies
	Self-assessment		PATTERN WP1
	None		PATTERN WP1
Scientific domain	Generic	Not targeting a specific domain	EOSC Future
	Natural Sciences	Any of the sciences (such as physics, chemistry, or biology) that deal with matter, energy, and their interrelations and transformations or with objectively measurable phenomena.	EOSC Future
	Engineering & Technology	The application of science and mathematics by which the properties of matter and the sources of energy in nature are made useful to people	EOSC Future
	Medical & Health Sciences	The science of dealing with the maintenance of health and the prevention and treatment of disease	EOSC Future
	Agricultural Sciences	Sciences dealing with food and fibre production and processing. They include the technologies of soil cultivation, crop cultivation and harvesting, animal production, and the processing of plant and animal	EOSC Future
	Social Sciences	A branch of science that deals with the institutions and functioning of human society and with the interpersonal relationships of individuals as members of society	EOSC Future
	Humanities	The branches of learning that investigate human constructs and concerns as opposed to natural processes (as in physics or chemistry) and social relations (as in anthropology or economics). Includes Art	EOSC Future
	Social Sciences & Humanities	Combining both of the above	EOSC Future
Licence	Public Domain	No copyright	



Metadata	Value	Description	Source (click for link)
	CC0	Creative Commons CC0 1.0 Universal: The person who associated a work with CC0 1.0 has dedicated the work to the public domain by waiving all of his or her rights to the work worldwide under copyright law, including all related and neighbouring rights, to the extent allowed by law. One can copy, modify, distribute and perform the work, even for commercial purposes, all without asking permission. Type of public domain licence.	Eu vocabularies
	CC BY	Creative Commons Attribution	Eu vocabularies
	CC BY-SA	Creative Commons Attribution Share Alike	Eu vocabularies
	CC BY-NC	Creative Commons Attribution Non-commercial	Eu vocabularies
	CC BY-NC-SA	Creative Commons Attribution Non-commercial Share Alike	Eu vocabularies
	CC BY-ND	Creative Commons Attribution No Derivatives	Eu vocabularies
	CC BY-NC-ND	Creative Commons Attribution Non-commercial No Derivatives	Eu vocabularies
	Clarin Academic En-User	Clarin Academic End-User Licence (ACA) 1.0: The copyright holder grants the end-user a free, non-exclusive and perpetual (for the duration of the copyright) right to use and make copies of the resource for educational, teaching or research purposes as such, as modified, or as part of a compilation or derived work.	link
	Copyright		
	Other open licence		
	Other non-open licence		



Metadata	Value	Description	Source (click for link)
Qualification	**Badge**		**EOSC Future**
	Certification		**EOSC Future**
	Accreditation		**EOSC Future**
	ECTS		**EC**
	Other	**e.g., Statement of Participation or statement of completion**	
	None		



Appendix III: Survey questionnaire

This appendix presents the introductory text and questions of the survey questionnaire used.

Survey on training in Open and Responsible Research and Innovation

You are kindly invited to take part in this survey on learning opportunities for researchers in Open and Responsible Research and Innovation (Open RRI). Open RRI aims to bring research closer to the needs and values of society. Your answers will help us to identify the best available training programmes and resources for researchers.

This survey is part of the PATTERN project funded under the Horizon Europe program (HORIZON-WIDERA-2022-ERA-01-44). The project will establish a platform for reuse and further development of training programmes, mutual learning and recommendations to authorities and institutions regarding Open RRI.

The survey includes 14 questions, should take approximately 10-15 minutes, and is anonymous.

Data handling: The primary data will only be shared among members of the PATTERN consortium. Aarhus University is the data controller and SurveyXact (by Rambøll Management Consulting) is the data processor. We will use the data analysis in future publications. The primary data will be stored for up to five years and then deleted.

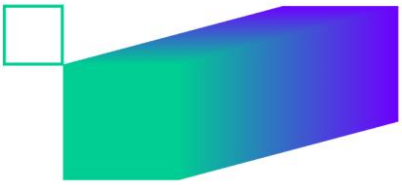
Your participation is voluntary. You may leave the study at any time. If so, we will retain and analyse already collected data up to the time of your withdrawal.

The survey has been reviewed by the Research Ethics Committee at Aarhus University. If you have any questions, please contact Kristian H. Nielsen, Aarhus University, Denmark, via email khn@css.au.dk.

By clicking NEXT below, you confirm that you voluntarily consent to participate in this survey.

Basic Information
Open and responsible research and Innovation (Open RRI) implies that all societal actors (researchers, citizens, policy makers, business, organisations, etc.) work together during the whole research and innovation process so as align its outcomes to the values, needs and expectations of society.

The PATTERN project identified 8 main areas of Open RRI training needed for researchers at all stages of their careers: Open Access, FAIR data Management, Citizen Science, Research Integrity, Gender, Non-discrimination and Inclusion in research, Dissemination and Exploitation of research results, Science Communication, Management and Leadership.



1. Do you understand the concept of Open and Responsible Research and Innovation (Open RRI)?

(1) ❑ Yes, I engage in Open RRI practices in my work

(2) ❑ Yes, but I don't knowingly engage in Open RRI practices in my work

(4) ❑ No, I am not familiar with the concept

(5) ❑ I don't know

2. Which of the following aspects of Open RRI training are offered to researchers at your organisation? (choose all that apply)

(1) ❑ Open Access

(2) ❑ FAIR DATA: Findable, Accessible, Interoperable and Reusable

(3) ❑ Research Integrity

(4) ❑ Gender, Non-discrimination and Inclusion in research

(5) ❑ Dissemination and Exploitation of research results

(6) ❑ Science Communication

(7) ❑ Leadership and Management

(8) ❑ None

(9) ❑ I don't know

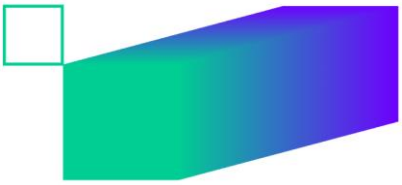
(10) ❑ Other, please specify _____

3. What are the titles of the training programmes in Open RRI at your organisation (in-person, online or asynchronous)? Kindly add publicly accessible hyperlinks and provide short descriptions (for example language, duration, open to all or restricted to staff and students, are any mandatory, etc.).

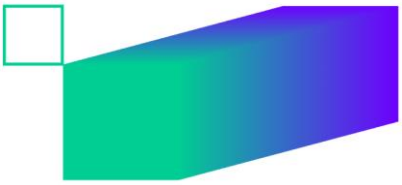
_____
_____
_____
_____
_____
_____

4. In considering these trainings, how important are the following to you?

	Not important	Neutral	Somewhat important	Important	Very important	I don't know



Content and learning objectives	(1) ❍	(2) ❍	(3) ❍	(4) ❍	(5) ❍	(6) ❍
Who provides the training	(1) ❍	(2) ❍	(3) ❍	(4) ❍	(5) ❍	(6) ❍
Pedagogical approaches	(1) ❍	(2) ❍	(3) ❍	(4) ❍	(5) ❍	(6) ❍
Knowledge exchange opportunities with others	(1) ❍	(2) ❍	(3) ❍	(4) ❍	(5) ❍	(6) ❍
Self-paced	(1) ❍	(2) ❍	(3) ❍	(4) ❍	(5) ❍	(6) ❍
Instructor-led	(1) ❍	(2) ❍	(3) ❍	(4) ❍	(5) ❍	(6) ❍
Duration	(1) ❍	(2) ❍	(3) ❍	(4) ❍	(5) ❍	(6) ❍
Accreditation by professional association or community of practice	(1) ❍	(2) ❍	(3) ❍	(4) ❍	(5) ❍	(6) ❍
Subject specificity (i.e. relating to a particular domain or field of knowledge)	(1) ❍	(2) ❍	(3) ❍	(4) ❍	(5) ❍	(6) ❍



Freely available online	(1) ❍	(2) ❍	(3) ❍	(4) ❍	(5) ❍	(6) ❍
In-person	(1) ❍	(2) ❍	(3) ❍	(4) ❍	(5) ❍	(6) ❍
Expertise level of trainings	(1) ❍	(2) ❍	(3) ❍	(4) ❍	(5) ❍	(6) ❍

5. Who typically leads the training in Open RRI? (choose all that apply)

(1) ❑ In-house staff

(2) ❑ External consultants

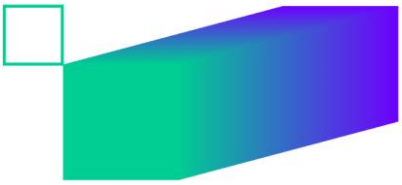
(3) ❑ Self-guided learning (e.g. an online module, self-study training materials, etc.)

(4) ❑ I don't know

(5) ❑ Other, please specify _____

6. What extra training programmes and resources for Open RRI are needed in your organisation?

	Not needed	Neutral	Somewhat needed	Needed	Highly needed	I don't know
Open Access	(1) ❍	(2) ❍	(3) ❍	(4) ❍	(5) ❍	(6) ❍
FAIR (Findable, Accessible, Interoperable and Reusable) DATA	(1) ❍	(2) ❍	(3) ❍	(4) ❍	(5) ❍	(6) ❍



Research Integrity	(1) ❍	(2) ❍	(3) ❍	(4) ❍	(5) ❍	(6) ❍
Citizen Science	(1) ❍	(2) ❍	(3) ❍	(4) ❍	(5) ❍	(6) ❍
Gender, Non-discrimination and Inclusion	(1) ❍	(2) ❍	(3) ❍	(4) ❍	(5) ❍	(6) ❍
Dissemination and Exploitation	(1) ❍	(2) ❍	(3) ❍	(4) ❍	(5) ❍	(6) ❍
Science Communication towards media and policy makers	(1) ❍	(2) ❍	(3) ❍	(4) ❍	(5) ❍	(6) ❍
Leadership and Management	(1) ❍	(2) ❍	(3) ❍	(4) ❍	(5) ❍	(6) ❍

7. What types of training in Open RRI work best for researchers?

(1) ❑ Course, onsite or blended

(2) ❑ E-learning module (e.g. Massive Open Online Course MOOC, other online trainings)

(3) ❑ Lecture

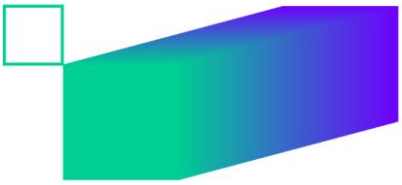
(4) ❑ Webinar

(5) ❑ Onsite, instructor led workshop

(6) ❑ Online, instructor led workshop

(7) ❑ Static resource (Guide, handbook, booklet, slides, toolkit, report, etc.)

(8) ❑ Other, please specify _____



8. Would you recommend any external Open RRI training resources, courses or programmes to researchers at your organisation? Please provide links.

_____
_____
_____

9. Think of an Open RRI training activity you participated in. Can you list three best things about it? Have you used any of the skills and knowledge from the training in your work?

_____
_____
_____

10. Is there anything else about training in Open RRI that you would like to share?

_____
_____
_____

11. Which of the following best describes your current activity? Please select one option from the following:

(1) ❍ Master's student

(2) ❍ PhD student

(3) ❍ Postdoctoral researcher

(4) ❍ Researcher

(5) ❍ Research manager, principal investigator

(6) ❍ Research support (technical or administrative)

(7) ❍ Administrator/manager of research institution or organisation

(8) ❍ Research Funder

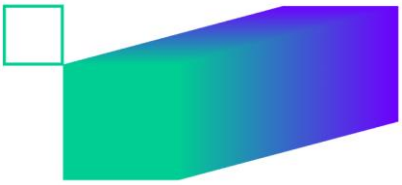
(9) ❍ Trainer/Educator

(10) ❍ Other _____

12. Where are you based?

(1) ❑ Public Research Institute or University

(2) ❑ Private Research Institute



(3) ❑ Company

(4) ❑ Non-profit

(5) ❑ Freelancer/self-employed

(6) ❑ Other

13. Which country or world region does the information you provided in this survey refer to?

_____

14. What is your general area of work or study?

(1) ❑ Engineering and technology

(2) ❑ Medical and health sciences

(3) ❑ Agricultural sciences

(4) ❑ Natural Sciences

(5) ❑ Social sciences

(6) ❑ Humanities

(7) ❑ Higher education and training

(8) ❑ No specific domain

(9) ❑ Other _____

Thank you for your time! Your input is extremely valuable to us.

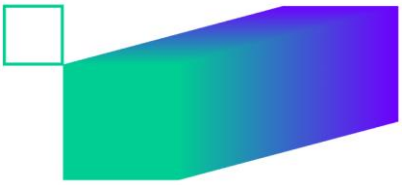
You can stay in touch with PATTERN through our website: https://www.pattern-openresearch.eu/
Please contact Cristina Lagido crclATcss.au.dk or Kristian H. Nielsen khnATcss.au.dk if you have additional feedback of interest to our project.

Appendix IV: Primary contacts for distribution of survey

This appendix presents the distribution channels used by PATTERN partners for the survey (Table 26).

Pattern partner	Survey Target Group/person	Date sent (YYYY-MM-DD)
AU	OpenAire CoP of Training Coordinators; ALLEA; Young Academy (Belgium, Spain, UK, Scotland, Hungary, Croatia); PCST, ECSA, and CSA listservs, NASA TOPS mailing list; Research librarian of Munster Technological University (Ireland); Elixir Europe; SPOT Nordic; SPARC (USA); DTU National RDM Network	2023-03-22 2023-03-27 2023-03-28 2023-03-30 2023-04-20
LPI	Open Science office at UCL, TIME4CS Lithuania contacts, former chair of the Open Science Policy Platform in Spain	2023-03-23
SISSA	NewsEra Project, Rethink Project, Concise Project, Alessandra Fornetti (for Quest Project and VIU)	2023-03-30 2023-04-04
EARMA	EARMA channels: ERION, Ethics and Integrity Network (approx. 450 registrants) and EARMA Open Science group (approx. 150 registrants) Social media: LinkedIn and Twitter; SOPs4RI and EUREC networks; ERION core group (12 active members, mainly RPO)	2023-03-23
OpenAIRE	Posted on personal page on LinkedIn	
UDebrecen	Relevant mailing lists	2023-03-28
HEAL-LINK	HEAL-link network; Greek branch of the ResBIOS	2023-03-28
SCI-LINK	Posted on personal page on LinkedIn and Twitter	2023-03-28
DANS	Data Stewards Interest Group in the Netherlands; University of Oxford (School of Archaeology) with request to distribute; DANS newsletter	2023-03-28
ZSI	ZSI internal mailing list (all staff), being involved in 75 research projects and supporting actions (including trainings); RRI platform Austria	2023-03-29 2023-03-29
IZTECH	Library Directors of 24 prominent universities in Turkey, asked to share with researchers, Masters's students, and Ph.D. students. IZTECH Shared with own Institute's researchers, Master's students, and Ph.D. students.	2023-03-29
UHelsinki	Shared with Finnish Data Training Working group https://wiki.eduuni.fi/pages/viewpage.action?pageId=108965106	2023-03-29
APRE	Shared with APRE network (weekly newsletter, social media and targeted mailing to our database)	2024-04-03
UniSR	Sharing with the Open Access Italia network – 700 members	2023-04-11
UMinho	Shared with Portuguese Community of Practice of trainers in OS and RRI and with the Portuguese RDM Forum	2023-04-11
RBI	Disseminated the survey among Croatian LIS specialists	2023-04-13

Table 26. Distribution of survey



Appendix V: Informed Consent for Interviews

Informed consent

You are kindly invited to participate in this interview on learning opportunities for researchers regarding open and responsible research and innovation. You are being asked to participate in light of your expertise.

This interview is part of the PATTERN project (Piloting open and responsible Activities and Trainings Towards the Enhancement of Researchers Networks), funded under the Horizon Europe program (HORIZON-WIDERA-2022-ERA-01-44). The project will establish a platform for further development of training, mutual learning and dissemination of recommendations to authorities and institutions.

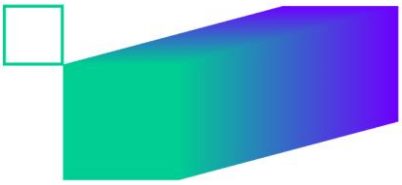
The interview will take about thirty minutes of your time approximately. We will record and transcribe the interview. In the transcription process, any personally identifiable information will be replaced by one or more artificial identifiers or pseudonyms, i.e. pseudonymisation.

The primary data will only be shared in the PATTERN consortium according to the consortium agreement based on the EU DESCA (Development of a Simplified Consortium Agreement) model agreement. Aarhus University is the data controller and data processor. We will analyse the data and use the analysis in future publications. We may use direct (but pseudonymised) quotations from the interview in our publications. The primary data will be stored for up to five years and then deleted.

Your participation is voluntary. We do not anticipate that there are any risks associated with your participation, and you may stop the interview and leave the study at any time. If you choose to withdraw from the study, we will discard already collected data.

The interview has been reviewed by the Research Ethics Committee at Aarhus University. If you have any questions, please let us know now or contact Kristian H. Nielsen, Aarhus University, Denmark, via email khn@css.au.dk.

Please confirm that you have understood the information provided and that you consent to participation.



Appendix VI: Interview guide

This appendix presents the interview guide used.

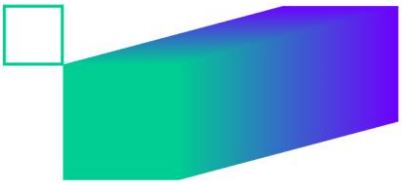
Interview Guide

- Introduce the Goals of PATTERN project
- Confirm consent for recording
- **State of the art of training**
  - Q- What are the current trends in [RRI area] training? (i.e. pedagogical and technological)
  - Q- What are the gaps/needs in [RRI area] training or other areas of open and responsible science that you are aware of? Which are most pressing?
  - Follow on Question- Do early career have different training needs versus late career researchers?
  - Follow on Question - Are there differences depending on the scientific domain/discipline?
  - Follow on Question - Are you aware of regional differentiation in Europe in terms of implementing training? Are there gaps in terms of languages as well?
  - Q - Who are the main actors in your opinion within Europe in [RRI area] training?
  - Q- What is needed for better awareness of good practice in [RRI area] or other aspects of Open and responsible Science? Is the availability of training a limiting factor? Are there any constraints in implementing training?
- **Current projects**
  - Q- Do you know of current projects that address current training gaps? Are there any that you recommend we follow or contact?
  - Follow on Question (optional)- What training format are these projects developing, online, blended, face 2 face?
- **Quality and sustainability**
  - Q- What feedback do you tend to receive from researchers about training?
  - Q- What makes for quality training in your view?
  - Q- How can we make training more reusable and make sure it continues to be used over time? Have you got guidelines on updating of training and sustainability?
- **Inclusion**
  - Q- how can training be made more inclusive?
- **The future (optional)**
  - Q –How do you envisage the future of Open and responsible research? What are the main challenges/opportunities ahead?

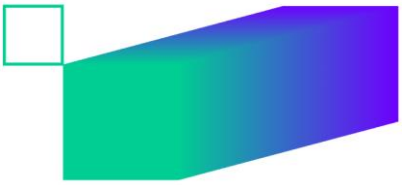
Appendix VII: Mapping and classification of FAIR data training resources

Overview of FAIR materials from spreadsheet, per topic (7) x audience (5) x level (3) (Table 27). Note only English language resources have been mapped here, because these formed the large majority of collected resources. A similar mapping could be done for other languages if participants of the project find and note the metadata of more resources in those languages.

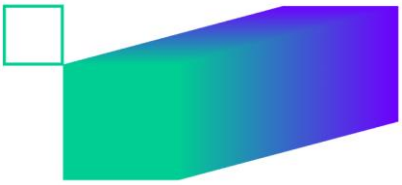
Topic	Students	Researcher	Trainer	Infrastructure / support	Citizens
Introductory level					
	10.17875/gup2022-1915 Appendix E, Chap 3		https://www.fairsfair.eu/competence-centre/training-library	https://osf.io/szxav	
What is FAIR?	10.17875/gup2022-1915 Lesson plan 1, Chap 2; https://the-turing-way.netlify.app/reproducible-research/rdm/rdm-fair.html https://fairaware.dans.knaw.nl/ -https://www.go-fair.org/fair-principles/ -https://fair-office.at/fair-prinzipien/?lang=en - https://www.jisc.ac.uk/guides/rdm-toolkit/fair-principles-in-research-data-management - https://www.fosteropenscience.eu/node/2820	10.17875/gup2022-1915 Lesson plan 1, Chap 2; https://the-turing-way.netlify.app/reproducible-research/rdm/rdm-fair.html https://fairaware.dans.knaw.nl/ -https://www.go-fair.org/fair-principles/ -https://fair-office.at/fair-prinzipien/?lang=en - https://www.jisc.ac.uk/guides/rdm-toolkit/fair-principles-in-research-data-management - https://www.fosteropenscience.eu/node/2820	10.17875/gup2022-1915 Lesson plan 1, Chap 2; - https://www.youtube.com/watch?v=LjRzIhnf9Ks https://fairaware.dans.knaw.nl/ - https://training.ni4os.eu/course/view.php?id=16 -https://www.go-fair.org/fair-principles/	10.17875/gup2022-1915 Lesson plan 1, Chap 2 https://fairaware.dans.knaw.nl/ -https://www.go-fair.org/fair-principles/ - https://www.fosteropenscience.eu/node/2820	10.17875/gup2022-1915 Lesson plan 1, Chap 2 - https://www.fosteropenscience.eu/node/2820
Why make data FAIR	10.17875/gup2022-1915 Chap 2 https://doi.org/10.5281/zenodo.6047083 - https://data.europa.eu/en/unlocking-benefits-open-data-dataeuropaeu	10.17875/gup2022-1915 Chap 2 https://doi.org/10.5281/zenodo.6047083 - https://data.europa.eu/en/unlocking-benefits-open-data-dataeuropaeu	10.17875/gup2022-1915 Chap 2 https://doi.org/10.5281/zenodo.6047083	10.17875/gup2022-1915 Chap 2 https://doi.org/10.5281/zenodo.6047083	10.17875/gup2022-1915 Chap 2 https://doi.org/10.5281/zenodo.6047083 - https://data.europa.eu/en/opportunities-and-challenges-citizen-generated-data



Topic	Students	Researcher	Trainer	Infrastructure / support	Citizens
FAIR vs Open	-https://ispas-project.eu/fair-data-management-training-course/ -https://fair-office.at/fair-data-vs-open-data/?lang=en -https://fair-office.at/offene-wissenschaft/?lang=en -https://data.europa.eu/en/what-makes-quality-open-data	-https://ispas-project.eu/fair-data-management-training-course/ -https://fair-office.at/fair-data-vs-open-data/?lang=en -https://fair-office.at/offene-wissenschaft/?lang=en -https://data.europa.eu/en/what-makes-quality-open-data			
FAIR as responsible research practice	-fair-data-austria -https://ispas-project.eu/fair-data-management-training-course/	-fair-data-austria -https://www.f-uji.net/ -Parthenos_FAIRify_DataManagement -https://ispas-project.eu/fair-data-management-training-course/	-https://www.f-uji.net/ -Parthenos_FAIRify_DataManagement	-fair-data-austria -https://www.f-uji.net/ -Parthenos_FAIRify_DataManagement	
Training / policy			10.17875/gup2022-1915 Chap 3 and 4 https://www.cessda.eu/Training-Resources/Resource-crd-3351 https://www.youtube.com/watch?v=LjRzlhnf9Ks https://www.eosc-synergy.eu/data-stewardship-course/	https://www.eosc-synergy.eu/data-stewardship-course/	
Discipline specific	HUM: https://4euplus.eu/4EU-273.html#11 09/05/2022 Geoscience: https://www.earthcube.org/fair-training-materials ELIXIR: -https://tess.elixir-europe.org/materials?q=FAIR -https://faircookbook.elixir-europe.org/content/home.html SSH: https://dmeg.cessda.eu/Data-Management-Expert-Guide	SSH: https://dmeg.cessda.eu/Data-Management-Expert-Guide			



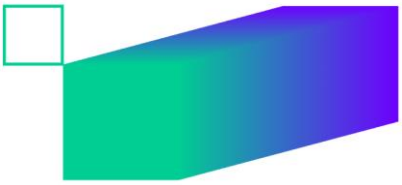
Topic	Students	Researcher	Trainer	Infrastructure / support	Citizens
Intermediate level					
Introduction to RDM and Data Management Plans (planning for FAIR)	10.17875/gup2022-1915 Chap 6, Lesson plan 2+15 https://doi.org/10.5281/zenodo.6047083 https://4euplus.eu/4EU-273.html#11 1/01/2022 https://4euplus.eu/4EU-273.html#11 07/03/2022 https://tess.elixir-europe.org/materials/data-management-planning-tips https://fair-office.at/dmp/?lang=en https://fair-office.at/fdm/?lang=en https://www.fosteropenscience.eu/node/2577	https://doi.org/10.5281/zenodo.6047083 https://4euplus.eu/4EU-273.html#11 1/01/2022 https://4euplus.eu/4EU-273.html#11 07/03/2022 https://tess.elixir-europe.org/materials/data-management-planning-tips https://fair-office.at/dmp/?lang=en https://fair-office.at/fdm/?lang=en https://www.fosteropenscience.eu/node/2577	https://doi.org/10.5281/zenodo.6047083	https://doi.org/10.5281/zenodo.6047083 https://4euplus.eu/4EU-273.html#11 1/01/2022 https://4euplus.eu/4EU-273.html#11 07/03/2022 https://tess.elixir-europe.org/materials/data-management-planning-tips	https://doi.org/10.5281/zenodo.6047083
Practical application (deeper dive)	https://www.youtube.com/watch?v=vSRXLMcFkQA - https://data.europa.eu/elearning/en/module11/#/id/co-01	https://www.youtube.com/watch?v=vSRXLMcFkQA - https://data.europa.eu/elearning/en/module11/#/id/co-01			
How to structure metadata	10.17875/gup2022-1915 Lesson plan 6 + more https://fair-office.at/metadaten/?lang=en - https://data.europa.eu/en/guidelines-data-and-metadata-quality	https://fair-office.at/metadaten/?lang=en - https://data.europa.eu/en/guidelines-data-and-metadata-quality	https://datasupport.researchdata.nl/en/start-the-course/iv-harvest-phase/data-archives/standardised-metadata	- https://data.europa.eu/en/guidelines-data-and-metadata-quality	
File formats	10.17875/gup2022-1915 Lesson plan 5 https://fair-office.at/fileformates/?lang=en -https://fair-office.at/publikation-von-daten/?lang=en - https://data.europa.eu/elearning/en/module9/#/id/co-01	https://fair-office.at/fileformates/?lang=en -https://fair-office.at/publikation-von-daten/?lang=en - https://data.europa.eu/elearning/en/module9/#/id/co-01	https://datasupport.researchdata.nl/en/start-the-course/iii-research-phase/data-formats https://datasupport.researchdata.nl/en/start-the-course/iv-harvest-phase/data-archives/preferred-formats		
Getting PIDs	10.17875/gup2022-1915 Lesson plan 8 - https://www.earthcube.org/_files/ugd/94f988_d7d1959d7b094ad29b938f1cc684101a.pdf -https://fair-office.at/pid/?lang=en	- https://www.earthcube.org/_files/ugd/94f988_d7d1959d7b094ad29b938f1cc684101a.pdf -https://fair-office.at/pid/?lang=en	https://datasupport.researchdata.nl/en/start-the-course/iv-harvest-phase/data-archives/pids-and-data-citation		https://www.earthcube.org/_files/ugd/94f988_d7d1959d7b094ad29b938f1cc684101a.pdf



Topic	Students	Researcher	Trainer	Infrastructure / support	Citizens
Selecting repositories	10.17875/gup2022-1915 Lesson plan 11 https://www.youtube.com/watch?v=DutWdCYZ45I - https://www.earthcube.org/_files/ugd/94f988_1895fcad872c4c05a2c498d82e4480da.pdf	https://www.youtube.com/watch?v=DutWdCYZ45I https://www.f-uji.net/ - https://www.earthcube.org/_files/ugd/94f988_1895fcad872c4c05a2c498d82e4480da.pdf	https://www.youtube.com/watch?v=DutWdCYZ45I https://www.f-uji.net/ https://datasupport.researchdata.nl/en/start-the-course/iv-harvest-phase/data-archives	https://www.youtube.com/watch?v=DutWdCYZ45I https://www.f-uji.net/ - https://www.earthcube.org/_files/ugd/94f988_1895fcad872c4c05a2c498d82e4480da.pdf	
Licencing and data access statements	10.17875/gup2022-1915 Lesson plan 9 https://www.earthcube.org/post/how-data-licenses-can-help-make-your-research-data-more-fair	https://www.earthcube.org/post/how-data-licenses-can-help-make-your-research-data-more-fair - https://www.fairpoints.org/fairpoints_resources/	https://datasupport.researchdata.nl/en/start-the-course/v-legislation-and-policy	- https://www.fairpoints.org/fairpoints_resources/	https://www.earthcube.org/post/how-data-licenses-can-help-make-your-research-data-more-fair
Citation	- https://data.europa.eu/en/data-citation-guide-best-practice	- https://data.europa.eu/en/data-citation-guide-best-practice	https://datasupport.researchdata.nl/en/start-the-course/iv-harvest-phase/data-archives/pids-and-data-citation		
Training / policy				10.17875/gup2022-1915 Chap 6	10.17875/gup2022-1915 Lesson plan 16
Advanced level					
Interoperability	https://www.youtube.com/watch?v=pnJ-wSlwTkk	https://www.youtube.com/watch?v=pnJ-wSlwTkk			
FAIR by design				https://www.go-fair.org/how-to-go-fair/	
Ontologies / semantic artefacts	10.17875/gup2022-1915 Lesson plan 7 + more	- https://data.europa.eu/en/dcat-and-dcat-ap-achieving-interoperability-through-data-modelling-and-standardisation			
Sensitive data	https://tess.elixir-europe.org/materials/ethics-elsi-considerations-from-fair-to-fair-data-sharing	https://tess.elixir-europe.org/materials/ethics-elsi-considerations-from-fair-to-fair-data-sharing			
'Retrofitting' FAIR to data					
Implementing FAIR research practices and infrastructures				10.17875/gup2022-1915 Chap 6	

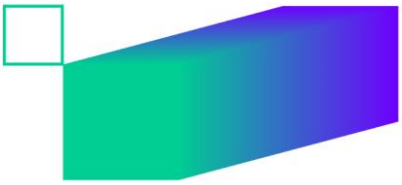
Topic	Students	Researcher	Trainer	Infrastructure / support	Citizens
FAIR software, training materials and other applications	10.17875/gup2022-1915 Lesson plan 14; e-Science centre?; https://www.library.universiteitleiden.nl/researchers/data-management/fair-data https://4euplus.eu/4EU-273.html#11 21/03/2022 -https://fair-software.nl/	https://4euplus.eu/4EU-273.html#11 21/03/2022 -https://fair-software.nl/	-https://fair-software.nl/		
Training / policy					

Table 27. Mapping of FAIR data training resources.

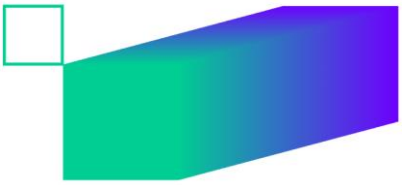


Appendix VIII: Experiences of survey respondents of training in Open RRI

9. Think of an Open RRI training activity you participated in. Can you list the three best things about it? Have you used any of the skills and knowledge from the training in your work?
regulatory related topics people from different industries common interest in circularity
information on data protection and IP
hands-on, connecting to other researchers, including practical exercises
exchange of experience with others
communication training coach training
Usually, trainings are informative but not exactly related to routine research work
Usability of content
Top of the useful training activities: - debates, online or on-site, on ethical aspects and on the legislation, involved by our teaching and research in education practice; - reflective activities starting from study-cases; - useful examples from practice like stimulus materials for reflective and narrative discussions
The sharing of information, websites and resources
The most important is engagement, the ability to give space to people to express their own experiences and to synthesise.
The concept is new to me. I may have come across some ideas but in truth, I heard about open RRI from this survey.
Sorry, I never use it
Slides and used sources Website
Sharing with experts; active pedagogical approach of the expert, with project work, yielding to a finished product (in my case, a qualitative review of the literature, that has been eventually pubblished in an Italian top pedagogical journal).

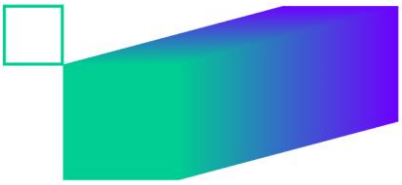


9. Think of an Open RRI training activity you participated in. Can you list the three best things about it? Have you used any of the skills and knowledge from the training in your work?
Self-consciousness Reflection on virtues and norms Reflection on dilemmas in science
Relative to content or to format? 1. I prefer short formats, therefore I always like short trainings - which is definitely not true for everybody 2. Trainings which are not only frontal, but where trainers interact with the trainees or where trainees interact with themselves 3. Trainings where applicable tools etc. are provided (rather than reading lists etc.) yes, I used any of the skills and knowledge from the trainings in my work.
OpenAIRE Open Science train-the-trainer bootcamp 1. it was online 2. it had exercises 3. we were able to talk with colleagues from different countries and with different experiences
Open Science Resources Guidelines to prepare DMP [Data Management Plan]
Managing conflicts and legal aspects, Ombud system, authorship, data management
I've always been a trainer, not a trainee. Direct, personal contact. Responsiveness to questions. Standing offer to follow up, by phone, email, zoom, in person, etc.
I participated in the MSCA Social Lab of the New HoRRIzon Project. 1. It was an empowering experience to develop critical facilities to assess the uptake of RRI practices. In my institutions, I have never had any other training in RRI otherwise. 2. I began to link the relation between RRI training and the further career development of researchers in non-academic careers. 3. I began to link the promotion of RRI practices and the development of research directions that truly have societal impact beyond pure academic publication metrics.
I participated in the EU MARINA project that developed an RRI implementation Roadmap. This tool is still very useful
I never participated in any training activity



9. Think of an Open RRI training activity you participated in. Can you list the three best things about it? Have you used any of the skills and knowledge from the training in your work?
I mostly organise / train in Open RRI training activities, it is not straightforward to me to offer the perspective of a participant.
I have not participated in any training activity on Open RRI--all was self-researched
I believe I never attended training on RRI
Ethics of Chemistry Sensors and Artificial Intelligence Chemistry applied to telemedicine
Establishing Communities of practice across organisations can be effective if all have a shared priority to establish FAIR data practices e.g. major national agriculture funder has changed research contracts and expectations now include data management plans, nomination of data repository that meet approval criteria, production of high-quality metadata interoperable to funder systems, storage of co-owned data. Etc. CoP approaches support knowledge sharing, sharing of approaches, training resources, linking up of research offices, libraries, IT infrastructure and researchers/ research groups
Discussions of literature and reproducibility crisis Exploration of different open science practices Learning how to use the open science framework
Design of experiment regularly applied din our studies
Data Management with FAIR principles
Concept of Citizen Science
Clarity of the contents Exercises/examples when applied Further resources
Application of FAIR principles (opening datasets). Standing for Research Integrity.
1. VERSION CONTROL for the entire research workflow (git) 2. Preregistration (tools and best practices) 3. Questionable Research Practices (what they are and how to identify and avoid them)

9. Think of an Open RRI training activity you participated in. Can you list the three best things about it? Have you used any of the skills and knowledge from the training in your work?
1. Small group format - facilitating open, relaxed debate 2. Specific to our projects 3. Trust in the workshop leader
1. Links to external resources 2. Expert speaker 3. In person event
1. Knowledge and experience exchange with other attendees 2. Choosing a good trainer 3. Good materials available for consultation after the course
1) professionality and empathy 2) yes I did
1) increased awareness on the theme; 2) practical indication; 3) discovered useful tools; I used some information to implement the supporting activity to researchers of my work (I am a grant officer)
1 direct questions 2 examples 3 possibility to have a picture of the other experts yes: learning using new platform to manage some specific project.
-Knowledge Exchange among humanistic and scientific expertise -Traditional knowledge and innovations - awareness
- specified scientific topic (particular programming language for example) - explanation about what is very important for researcher everyday work
- Sharing your knowledge openly. I have used this in my work. - Improving your communication skills. I have used this. - Interdisciplinary cooperation. I have used this.



10. Is there anything else about training in Open RRI that you would like to share?
This kind of training should BE mandatory at the PhD level and in some courses at the Master level, such as psychology, medicine, and other that require human participants
These training activities are very useful no matter the societal domain. We have to find the more efficient type of training activities...because the Ethical aspects involved by any social and professional, civic life become more and more A NEED.
These experiences are relatively new to our organisation and more training on these topics would be most welcome.
The concept is new to me. I may have come across some ideas but in truth, I heard about open RRI from this survey. Therefore, I am unable to properly answer this question. Moreover, the university I study at has its website and all its content including emails in Italian, so it is not possible for me to extract some information about the Open RRI training, etc. There might be something related to the topic, but I can't access it as the website is in Italian.
Process of scientific work, case studies, breakout sessions
OPEN RRI should be embedded in all programmes funded by public money
It should be mandatory for every academic, from undergrad to full prof. Thanks for promoting this work via your research project! :)
It is mentioned all the time, including in EU and Regional programmes, but it is not clear how much it is actually applied
F and A in FAIR are relatively easy but I and R take long term commitment and investment

PATTERN.

Empowering Open and Responsible Research and Innovation

OUR CONSORTIUM

APRE – Agenzia per la Promozione della Ricerca Europea
AARHUS UNIVERSITY
LOBA®
SCIENCE CONNECT – YOUR PARTNER IN SCIENCE
ZSI
OpenAIRE
Open AIRE affiliated entities
SISSA
EARMA – European Association of Research Managers and Administrators
UniSR – Università Vita-Salute San Raffaele
DANS
UNIVERSITY OF HELSINKI
Trinity College Dublin – Coláiste na Tríonóide, Baile Átha Cliath – The University of Dublin
UNIVERSITY of DEBRECEN
IZMIR INSTITUTE OF TECHNOLOGY
RB
SciLink
Universidade do Minho
HEALLINK

Funded by the European Union

pattern-openresearch.eu info@pattern-openresearch.eu