D2.3 Content & learning objectives for all Open Science target groups

WP2 Content

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Detailed table with Learning Objectives is openly available at:

https://docs.google.com/spreadsheets/d/1UwsYf8fEFZzK8IPfK-7rFE3BO_VbjvOjQm3CigqBqyk/edit?usp=sharing

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EXECUTIVE SUMMARY

This brief outlines simplified Learning Objectives for the main stakeholders in the Research Value Chain. Learning Objectives are structured by Open Science Topics, which accompany the main responsibilities of the research stakeholders along the Research Lifecycle.

The ultimate objective is to support the integration of Open Science best practices into the daily routine of performing and supporting research, to underpin implementation of Horizon 2020 Mandate on Access to Scientific Information, and augment the "societal impact" of research, for the benefit of all stakeholders in the knowledge creation process.

Specific Learning Objectives are structured in increasing level of competence, frequently ending with successful integration of Open Science best practices in the daily research routine, facilitating self-assessment. The Learning Objectives can provide a backbone for a structured learning plan for Doctoral Schools with the ambition to train future researchers in optimizing their societal impact, alongside research excellence training. Support with relevant training content will be provided in parallel through the FOSTER Portal and accompanying e-Learning and self-learning modules.

The brief draws on FP7 FOSTER Work Packages 2 Content, WP3 Portal (Open Science Taxonomy, and learning portal infrastructure) and WP4 Training (Deliverable D4.5 Training Toolkit).

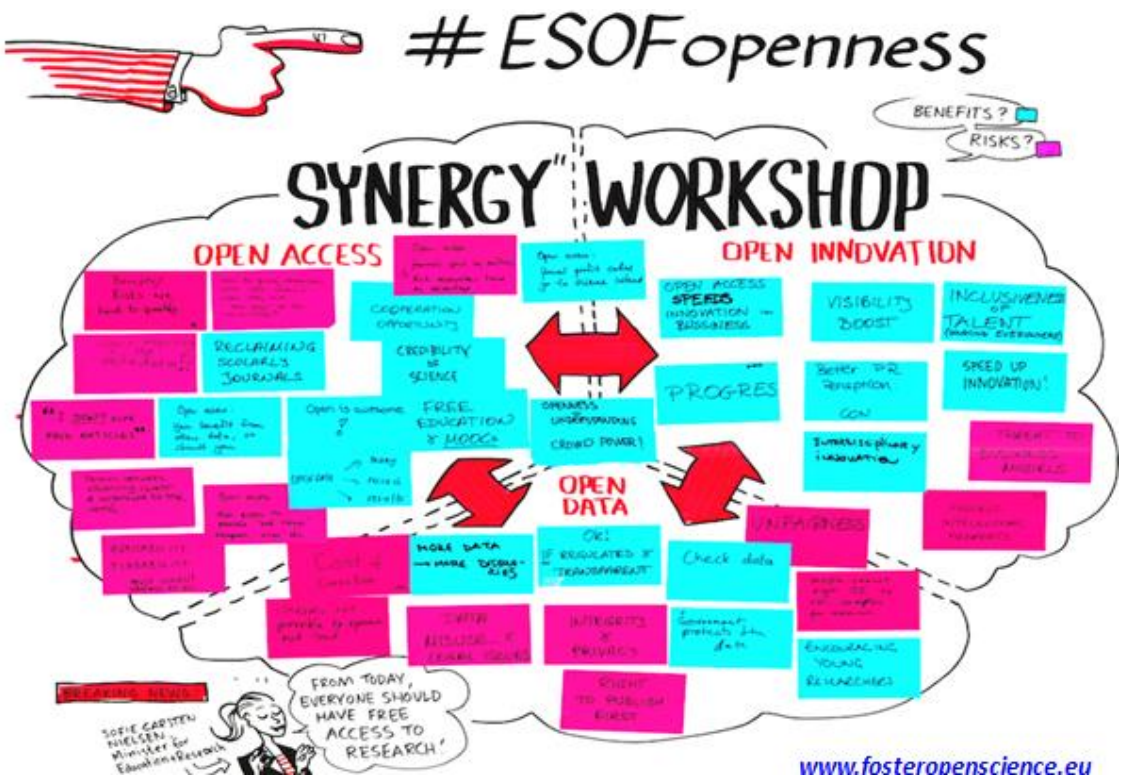
RATIONALE:

The political drive for Open Science from the funding agency (EC) point of view is mainly Return On Investment (ROI), ethics (taxpayer access to public funded research) and stimulating innovation through free-flow of ideas in order to boost economic growth through transfer of knowledge to the knowledge-based Small/Medium Enterprises (SMEs).

The Open Science community of advocates and practitioners is a diverse one, spanning the full breadth of research disciplines, as well as a range of stakeholders with various vested interests and roles in the research process.

The cumulative effect is that there is a rich diversity of strong reasons for and against making "Open Science" the default setting in the research process.

Figure 1 Why go "open"?



Consultation by FP7 FOSTER of 90 researchers from various disciplines (Fig. 1; attendees of the EuroScience Open Forum, Copenhagen 2014[1]) lists reasons in favour: ethics, return on investment, societal impact, transparency, rigour and reproducibility; and objections: national security, patient data, confidential data, patent exploitation[2].

Although most are valid, it is beyond the scope of FP7 FOSTER to provide the definitive summary of training content, or learning objectives, in order to address such a diversity of discipline-specific cases, and arguments.

[1] Thorhauge, Thomas et al., 2014. Should Science Always be OPEN?, DOI 10.5281/zenodo.10658

[2] Guidelines on Data Management in Horizon 2020 http://ec.europa.eu/research/.../**data**/ref/...**pilot**/h2020-hi-oa-**data**-mgt_en.pdf

The objective of this document is to help the organization and realization of training supporting the implementation of the Horizon 2020 Mandate, and focus on research data and knowledge at the time of generation, by:

(1) reducing the arguments in favour of adopting Open Science practices to those lowest common denominators that are most ***Target-centric*** and ***discipline-agnostic*** and offer the highest scalling capacity beyond the lifetime of FP7 FOSTER,

(2) listing the minimal competencies per Target Group required to comply with the Horizon 2020 Mandate and ***fully capitalize on Open Science potential***, in the form of modular Learning Objectives, with gradually increasing level of understanding, and

(3) supporting these Learning Objectives with ***minimum critical (not exhaustive!) content*** (WP2 Content Mapping), e-infrastructure (WP3 Portal) and actual Training ToolKit & HelpDesk support (WP4 Training).

The document is based on significant feedback from attendees and organizers of FP7 FOSTER training events throughout 2014, that informs the formulation of the learning objectives below [3].

ANDRAGOGY

The learning approach of FOSTER initiative is based on Andragogy assumptions that identify a set of characteristics of adult learners that differs from child learners (pedagogy)[4]. Adults usually define their self-motivation depending on their personality and use the existing experience as a resource to complement and construct their knowledge. Intrinsic motivation and readiness to learn is based on the immediate tasks and responsibilities at hand, and problem-focused application.

Form these assumptions, the adult learner must be involved in the planning and evaluation of their instruction, the objectives must be problem-focused (rather than topic oriented), and the learning activities and learning process must be relevant and have impact on the learner's daily responsibilities.

THE RESEARCH LIFECYCLE

Of all the arguments for adopting Open Science best practices, the most durable, discipline-agnostic and scalable in terms of potential to mobilize the desired en-masse culture change for adopting Open Science, are those that overlap well with the core principles of research across all disciplines: ***transparency & reproducibility, rigour of method*** and ***impartial peer-review.*** The latter can be summarized together as ***integrity of research*** in order to be more inclusive of practices in the humanities, where the equivalent of "reproducibility" might be seen as access to the same obscure archival sources and artefacts used by earlier researchers (Barnet & Heath, 2013: 21), something closer to "verifiability", but to which Open Science tools have clear capacity to contribute positively.

[3] FOSTER Events https://www.fosteropenscience.eu/events

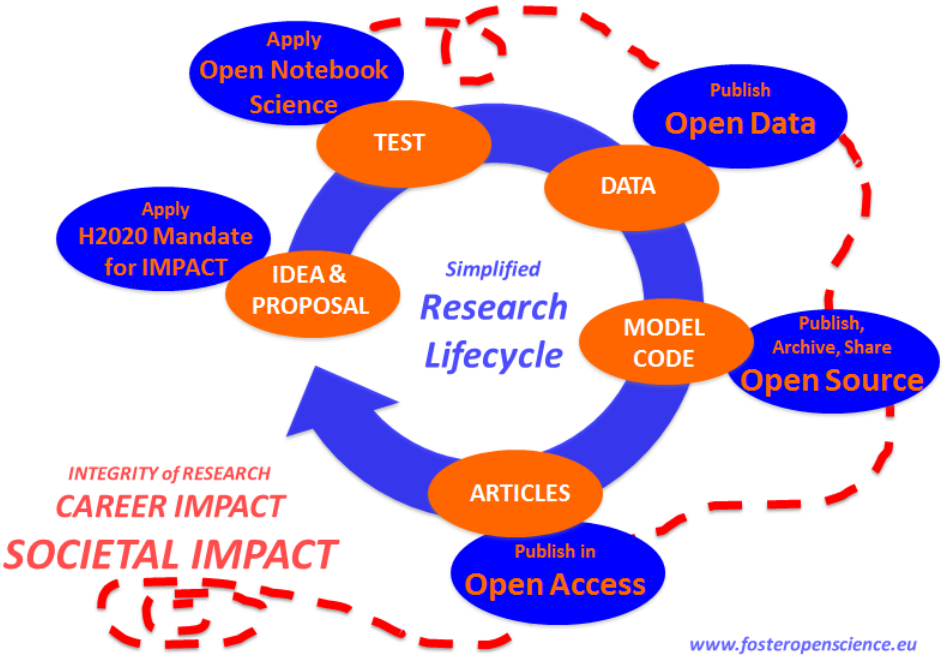
[4] Kearsley, G. (2010). Andragogy (M. Knowles). The theory into practice database. Retrieved form http://tip.psychology.org

Any desired large scale culture change in the research process (as required by the adoption of Open Science best practices) would have greater chances of uptake and implementation if strictly relevant to those core principles.

Relevance to core principles would provide personal motivation and justify the effort to go through a culture change. It also adds scalability to the desired en-masse adoption of new research practices, as the agents of change become the researchers themselves (bottom up), rather than mandates, funder policies (top-down) or any other external incentives.

As a result, the Learning Objectives listed per Target Group below, all gravitate around the process of generating and testing hypothesis, and producing new data and knowledge through a range of research output objects (Figure 1) while underpinning ***the integrity of research*** and placing Open Science at the center of ***intrinsic motivations*** of the Target Groups.

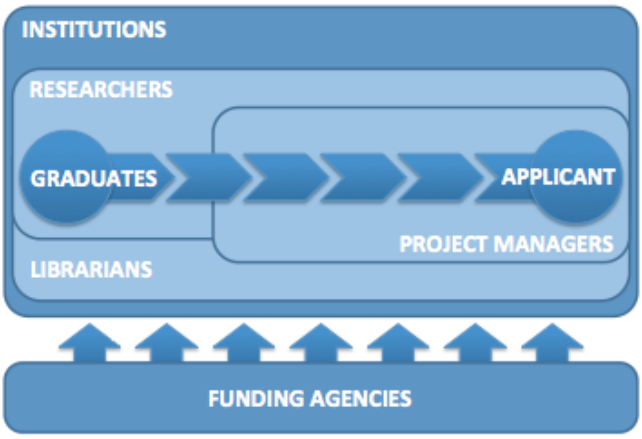
Figure 2 Simplified Research Lifecycle (adapted from Tenopir et al 2011) and Open Science contribution to reproducibility.



TARGET GROUPS FOR OPEN SCIENCE IMPLEMENTATION:

FP7 FOSTER prioritizes the key Target Groups for the implementation of the Horizon 2020 Mandate as shown in Figure 3. The choice of Target Groups is based on the key actors supporting and implementing practicing the Research Lifecycle (Fig.2) on a daily basis. Longevity of concept is ensured by focusing on the future Horizon 2020 applicants, represented by Graduate Students currently in training.

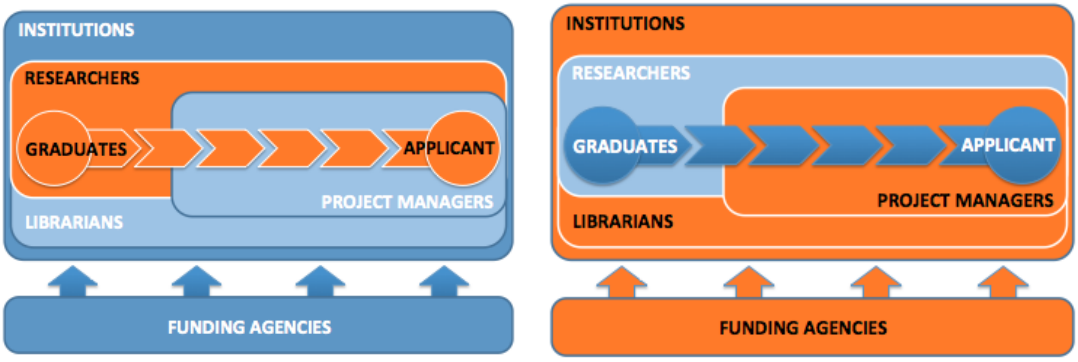
Figure 3 KEY Target Groups of critical importance to Horizon 2020 Mandate implementation



Training the future generation of researchers (and Horizon 2020 applicants) in Open Science principles and best practice, as well as the staff and institutions that support Doctoral Students in career development, carries the greatest potential for long-term culture change, especially if such training is performed in the interest of maintaining core principles of research, while also offering career development benefits.

The target groups of ***Graduate Students***, ***Researchers***, ***Research Project Managers***, ***Knowledge Managers*** and ***Institutional Administrators*** can then be divided into those that actively apply the Research Lifecycle, and those that ensure critical support, resources and governance for it (Figure 4).

Figure 4 Target Groups (in orange) that actively apply the Research Lifecycle, and those ensure its optimal functioning.



INTRINSIC MOTIVATION FOR EACH TARGET GROUP:

Even though the potential of Open Science to contribute to personal, institutional and strategic impact may be more widely recognized even among the most skeptical stakeholders, ***institutional inertia*** can still be a significant barrier despite the cumulative benefits (Gagliardi et al., 2014). To defend against this, the Learning Objectives for Open Science would be more effective if clearly related to the ***target-***

specific intrinsic motivation for applying, or supporting, the Research Lifecycle (as opposed to the broader ethical arguments for "openness").

If Open Science and the Learning Objectives are presented as direct service to daily responsibilities, likelihood of sustained uptake, while resisting unfavorable institutional inertia, is greater.

The following paragraphs list simplified intrinsic motivations and generic professional challenges for each target group. These are used to define potential area where Open Science tools and best practices can be make a clear and concrete positive contribution to the target group's daily workflow and responsibilities.

Doctoral Students & Senior Researchers perform research driven by strong discovery-driven subject curiosity, but their ability to do so is a direct factor in securing a career path and employment. The latter depends on the integrity of their work, and its impact and relevance as measured by the Research Assessment criteria of institutions and funders. Following this logic, Open Science practices are more likely to be considered essential to daily workflows if they concretely show potential to contribute integrity of research, but also multiply collaborations and the output of quality research, to ensure ***research profile impact & career path*** (represented by ●).

Institutional Stakeholders providing support for optimum functioning of the Research Lifecycle are, as a group, more driven by the reputation and integrity of the research institutions, dependent on high output and research integrity. Institutions are also subject to cyclical Research Assessment exercises that can dictate their financial viability and existence. Although institutional motivations can be summarised as Research Assessment impact alone, it is the clear definition and metrics of ***societal impact*** of research in the Research Assessment frameworks of the next decade, that may be the upcoming challenge for institutions to live up to (hereon represented by ●).

Funding Agencies overarching motivations aside from maintaining the Research Lifecycle as a basic responsibility (knowledge is a public good to be shared across all members of society), are a mix of ethical and politico-economic. Recent challenge for Funders is to drive innovation by investing in research, and to do so with better return-on-investment (ROI), transparency and justification of public spending. Especially during economic crisis, such high-level objectives can directly dictate conditions for funding at individual funding call level and impact individual researchers career path. The funders` current challenge and motivation is here summarized as to ***"drive innovation"***, which is dependent on research integrity, but also ROI and measurable impact on economic growth (hereon represented by ●).

The suggested learning objectives below are matched to these target-specific motivators, where relevant in order to drive uptake of new workflows and culture change.

Table 1 Open Science contribution & relevance to Target-specific intrinsic motivation or challenges.

OS Tool / Target	Doctoral Students	Researchers	Project Managers	Knowledge Managers	Institutions	Funders
OS Definitions	●	●●	●●	●●	●●●	●●●
Open Reproducible Research	●●	●●●	●●	●●	●●●	●●●

Open Research Data	●●	●●●	●●	●●	●●●	●●●
Research Data Management	●	●	●●	●●	●●●	●●●
Open Access	●●	●●●	●●	●●	●●●	●●●
OS Tools	●	●●●	●●	●●	●●●	●●●
OS Evaluation	●	●●●	●●	●●	●●	●●
OS Policies		●●●	●●	●●	●●	●●
…						

LEARNING OBJECTIVES GRANULARITY

Effective Learning Objectives need to be ***action driven***, broken down into ***manageable tasks*** of progressively increasing competence, as well as easy to verify and ***measure progress*** on. To optimize uptake, the learning objectives should also be as close as possible to the daily routine tasks of the target groups (Figures 2 & 4).

Ideally, the Learning Objectives, training content and methods for assessing progress would be revisited in a reiterative process throughout the learning/training period to adapt and optimize. It is beyond the project`s resources and scope to support that process fully. One way to simplify the process is to ensure that tasks lend themselves to "self-learning" and the penultimate task in each set of specific Learning Objectives per Open Science topic, can be "self-assessed" by the Target Group itself as direct contribution to daily research responsibilities.

The granularity of specific learning objectives is kept to a minimum, and to a few critical tasks than can lead to "self-assessment" in order to provide a simple lasting framework that allows for adaptability in future, while the overarching goal to perform ***high integrity research*** remains.

A basic and simplified level of competence is also applied based on Bloom's Taxonomy (Bloom 1956; and more recent updates by Krathwohl 2002). Without explicitly labelling the expertise levels, specific learning objectives tend to follow Bloom's (1956) matrix of increasing knowledge from factual to procedural and analytical, as follows:

AWARE = Retrieve relevant knowledge, and basic definitions;

UNDERSTAND = Determining the meaning of instructional messages, able to interpret, classify;

APPLY = Implement, modify and adapt to special cases, able to recommend & justify.

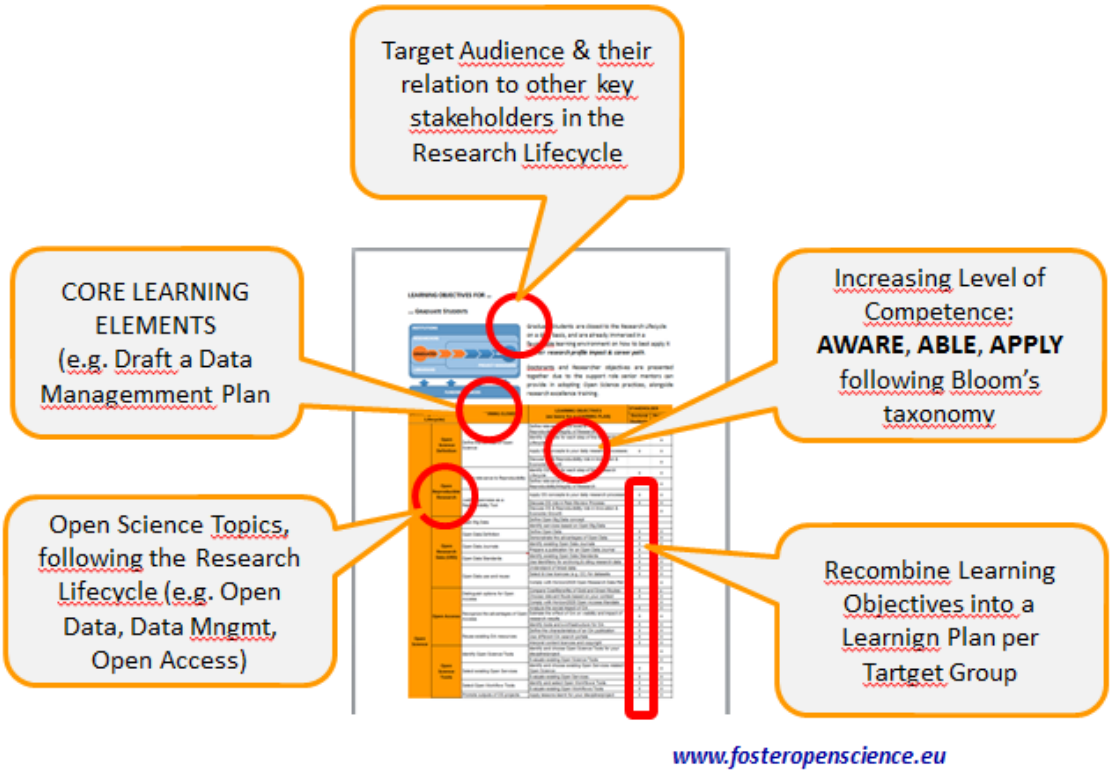
FROM THE TOPICS TO THE COURSE

To maintain the coherence between an Open Science taxonomy that accompanies the target audience workflow, and to be able to match it with relevant training content (via the FOSTER Portal), the following logic is applied in structuring the Learning Objectives:

For each main topic and subtopic of the Portal taxonomy, we define one general objective that can be structured in specific learning objectives. These specific learning objectives will be the basis for the course creation in through a variety of possible approaches (face-to-face, blended or e-Learning) and allow the course creator to choose which specific objective are relevant to which target audience.

This method allows us to map the learning objectives with the training content (via the FOSTER Portal) and the learning activities. It also allows the course creator to adapt the course to specific local context, depending of the level of competence, and the ultimate objectives for performing the training.

Figure 5 Structure and Approach to Open Science Learning Objectives

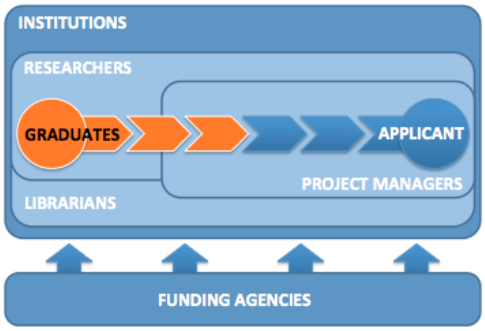


The list of specific Learning Objectives, and accompanying resources on the FOSTER Portal, can be recompiled to address audience–specific needs, and potentially can be used as a basis for a short Self-Learning courses for FOSTER WorkPackage 4 Training, according to agreed e-Learning Course templates.

The Learning Objectives per Target Group can be adapted to increase granularity, and are packaged into a < 2 page document to be easily included in target-specific ToolKit (Deliverable 4.5 ToolKit) and for ease of dissemination.

LEARNING OBJECTIVES FOR …

… GRADUATE STUDENTS

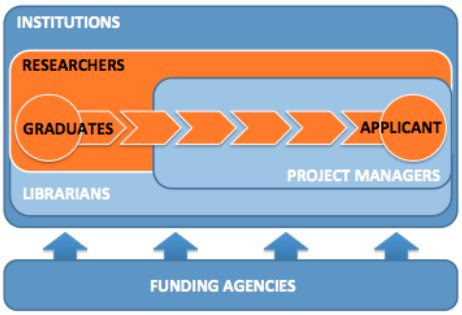


Graduate Students are closest to the Research Lifecycle on a daily basis, and are already immersed in a favorable learning environment on how to best apply it to their ***research profile impact & career path***.

Doctorates and Researcher objectives are presented together due to the support role senior mentors can provide in adopting Open Science practices, alongside research excellence training.

TOPICS (following the Research Lifecycle)		CORE LEARNING ELEMENTS	LEARNING OBJECTIVES (as basis for a LEARNING PLAN)	STAKEHOLDER	
				Doctoral Students	Resear-chers
Open Science	Open Science Definition	Define the concept of Open Science	Define relevance of OS tools to Reproducibility/Integrity of Research	o	o
			Identify OS tools for each step of the Research Lifecycle	o	o
			Apply OS concepts to your daily research processes	o	o
			Discuss OS & Reproducibility role in Innovation & Economic Growth		o
	Open Reproducible Research	Define relevance to Reproducibility	Identify OS tools for each step of the Research Lifecycle	o	o
			Define relevance of OS tools to Reproducibility/Integrity of Research	o	o
		Justify Openness as a Reproducibility Tool	Apply OS concepts to your daily research processes	o	o
			Discuss OS role in Peer-Review Process	o	o
			Discuss OS & Reproducibility role in Innovation & Economic Growth		o
	Open Research Data (ORD)	Open Big Data	Define Open Big Data concept		
			Identify services based on Open Big Data		
		Open Data Definition	Define Open Data	o	o
			Demonstrate the advantages of Open Data	o	o
		Open Data Journals	Identify existing Open Data Journals	o	o
			Prepare a publication for an Open Data Journal	o	o
		Open Data Standards	Identify existing Open Data Standards	o	o
			Use Identifiers for archiving & citing research data	o	o
		Open Data use and reuse	Understand of linked data	o	o
			Select & Use licences (e.g. CC) for datasets	o	o
			Comply with Horizon2020 Open Research Data Pilot		o
	Open Access	Distinguish options for Open Access	Compare Cost/Benefits of Gold and Green Routes	o	o
			Choose relevant Route based on your context	o	o
			Comply with Horizon2020 Open Access Mandate		o
		Recognize the advantages of Open Access	Analyze the social impact of OA	o	o
			Estimate the effect of OA on visibility and impact of research results	o	o
			Identify tools and e-infrastructure for OA	o	o
		Reuse existing OA resources	Define the characteristics of an OA publication	o	o
			Use different OA search portals	o	o
			Interpret content licences and copyright	o	o
	Open Science Tools	Identify Open Science Tools	Identify and choose Open Science Tools for your discipline/project		o
			Evaluate existing Open Science Tools		o
		Select existing Open Services	Identify and choose existing Open Services related to Open Science	o	o
			Evaluate existing Open Services	o	o
		Select Open Workflow Tools	Identify and select Open Workflows Tools	o	o
			Evaluate existing Open Workflows Tools	o	o
		Promote outputs of OS projects	Apply lessons learnt for your discipline/project	o	o

... FOR RESEARCHERS



"Researchers" target group includes academics that support Graduate Students, and still actively apply the Research Lifecycle, but are also engaged in additional support tasks.

In addtion to the Learning Objectives relevant to Graduate Student above, the following may also be relevant to "researchers" building a research group:

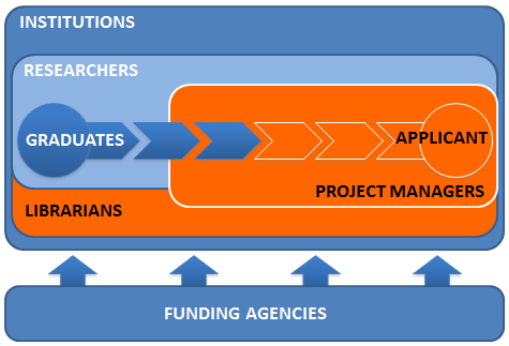
"***Role of Open Science in Peer-Review***" refers to optimizing "***reproducibility***" at peer-review process by seeking full transparency, discoverability, access and re-usability of research object (protocols, data, images, software code etc.) underpinning a manuscript`s conclusions (Aleksic et al 2014).

"***Open Science Evaluation***" refers to making essential contribution to funding agencies objectives on ***Responsible Research & Innovation***, ***Economic Growth & Innovation*** and ***Societal Engagement***, in order to optimize both proposal evaluations (e.g. FP7 FOSTER`s "Winning Horizon 2020 with Open Science"), as well as prepare doctoral students for evolving Research Evaluation criteria towards "societal impact" (e.g. REF 2020 in the UK).

Table 3 Learning Objectives for Researchers supporting Doctoral

TOPICS (following the Research Lifecycle)		CORE LEARNING ELEMENTS	LEARNING OBJECTIVES (as basis for a LEARNING PLAN)	STAKEHOLDER	
				Doctoral Students	Resear-chers
	Open Science Evaluation	Identify Altmetrics & Impact	Identify the suit of Altmetrics for future Research Evaluation	o	o
			State Pro`s and Con`s of various Altmetrics measures	o	o
			Interpret OS contribution to Research Evaluation Assessments (e.g. REF 2020)		o
		Understand Altmetrics & Impact	Use of academic networks scores	o	o
			Discuss OS contribution to Research Evaluation Assessments (e.g. REF 2020)		o
		Recognize Open Peer-Review Characteristics	Indicate the pros and cons of the Open Peer Review process	o	o
			Critically compare Open vs Closed Peer-Review in your discipline	o	o
Research Data Mngmt	RDM Plans	Define RDM Plans	Indicate characteristics of the RDM Plans	o	o
			Appraise the characteristics of a RDM plan to your discipline/project	o	o
		Prepare a RDM Plan	Create a RDM Plan	o	o
			Apply the RDM Plan to your discipline/project	o	o
	RDM Policies	Understand RDM Policies	Identify RDM Policies		o
			Comply with RDM Policies		o
	RDM Services	Identify RDM services	Identify relevant RDM Services		o
			Categorize RDM Services		o
		Use RDM services	Integrate RDM services in your discipline/project/workflow		o
			Evaluate & Compare RDM services		o
	RDM Standards	Describe existing RDM Standards	Identify existing RDM Standards	o	o
			Analyse RDM standards requisites	o	o
		Implement existing RDM Standards	Promote RDM Standards in your discipline/project	o	o
			Apply existing RDM Standards	o	o
	RDM Tools	Identify existing RDM Tools	Identify existing RDM Tools	o	o
			Compare RDM Tools	o	o
		Use RDM Tools	Select relevant RDM Tools	o	o
			Evaluate the use of RDM Tools	o	o

... FOR RESEARCH PROJECT MANAGERS & KNOWLEDGE MANAGERS



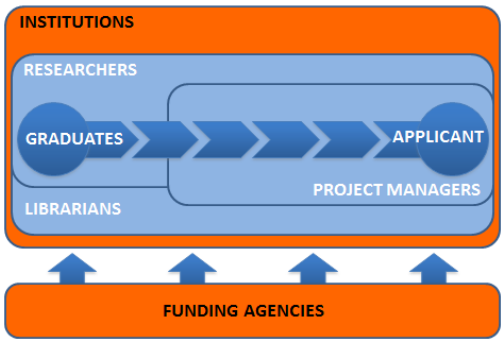
Research Project Managers and Knowledge Managers (Librarians) need to have the capacity to support all of the Target Groups competence in Open Science, but in the context of the Target Groups daily responsibilities e.g. ***research integrity*** for Doctoral Students, ***societal impact*** and Knowledge Transfer of research for Horizon 2020 applicants based on Open Science, and the potential of Open Science to directly contribute to ***Research Institutions strategies*** for administrators (Open Innovation, Economic Growth, Citizen Science, Co-creation with society).

Such competencies are specific to the two target groups above, and can be a significant catalyst for making Open Science a central tool in all the Target Groups discrete professional objectives.

Table 4 Learning Objectives for Research Project Managers & Knowledge Managers

TOPICS (following the Research Lifecycle)		CORE LEARNING ELEMENTS	LEARNING OBJECTIVES (as basis for a LEARNING PLAN)	STAKEHOLDER	
				Research Project	Knowledge Managers &
	Open Science Evaluation	Identify Altmetrics & Impact	Identify the suit of Altmetrics for future Research Evaluation	o	o
			State Pro`s and Con`s of various Altmetrics measures	o	o
			Interpret OS contribution to Research Evaluation Assessments (e.g. REF 2020)	o	o
		Understand Altmetrics & Impact	Use of academic networks scores		o
			Discuss OS contribution to Research Evaluation Assessments (e.g. REF 2020)	o	o
		Recognize Open Peer-Review Characteristics	Indicate the pros and cons of the Open Peer Review process		o
			Critically compare Open vs Closed Peer-Review in your discipline		o
	Open Science Guidelines	Identify Open Science Guidelines	Analyse existing OS Guidelines	o	o
			Compare existing OS Guidelines		o
		Apply Open Science Guidelines	Choose a OS Guideline that applies to your discipline/project		o
			Identify the Guidelines requisites		o
			Comply with Horizon2020 Open Access Mandate	o	o
			Comply with Horizon2020 Open Research Data Pilot	o	o
	Open Science Policies	Identify Open Science policies	Identify the different types of OS policies	o	o
		Draft Open Science policies	Formulate an OS policy to your discipline/project	o	o
		Comply with Horizon2020	Identify the requirements of Horizon2020 Open Access Mandate	o	o
			Comply with Horizon2020 Open Access Mandate	o	o
			Comply with Horizon2020 Open Research Data Pilot	o	o
		Monitor Horizon2020 compliance	Define metrics and tools to monitor compliance	o	o
			Report level of compliance	o	o
Research Data Mngmt	RDM Plans	Define RDM Plans	Indicate characteristics of the RDM Plans	o	o
			Appraise the characteristics of a RDM plan to your discipline/project	o	o
		Prepare a RDM Plan	Create a RDM Plan	o	o
			Apply the RDM Plan to your discipline/project		
	RDM Policies	Understand RDM Policies	Identify RDM Policies	o	o
			Comply with RDM Policies	o	o
	RDM Services	Identify RDM services	Identify relevant RDM Services	o	o
			Categorize RDM Services	o	o
		Use RDM services	Integrate RDM services in your discipline/project/workflow	o	
			Evaluate & Compare RDM services	o	o
	RDM Standards	Describe existing RDM Standards	Identify existing RDM Standards	o	o
			Analyse RDM standards requisites	o	o
		Implement existing RDM Standards	Promote RDM Standards in your discipline/project	o	o
			Apply existing RDM Standards		
	RDM Tools	Identify existing RDM Tools	Identify existing RDM Tools	o	o
			Compare RDM Tools	o	o
		Use RDM Tools	Select relevant RDM Tools	o	o
			Evaluate the use of RDM Tools	o	o

... FOR INSTITUTIONAL ADMINISTRATORS & FUNDERS



In the case of Research Institutions and Funding Agencies, "topics" of discussion and mutual awareness, may be a more appropriate term than "learning objectives".

The priority topics for these target groups, with which the FP7 FOSTER community can assist, focus on ***Research Evaluation criteria*** focused on "***societal impact***" and "***societal engagement***", as well as return on investment for funding agencies and compliance with ***Responsible Research and Innovation***[5].

Table 6 Topics Relevant to funding agencies staff CAPACITY TO INTEGRATE Open Science

TOPICS (following the Research Lifecycle)		CORE LEARNING ELEMENTS	LEARNING OBJECTIVES (as basis for a LEARNING PLAN)	STAKEHOLDER		
				Research Project	Knowledge Managers &	Funding Agencies
	Open Science Evaluation	Identify Altmetrics & Impact	Identify the suit of Altmetrics for future Research Evaluation	o	o	o
			State Pro`s and Con`s of various Altmetrics measures	o	o	
			Interpret OS contribution to Research Evaluation Assessments (e.g. REF 2020)	o	o	o
		Understand Altmetrics & Impact	Use of academic networks scores		o	
			Discuss OS contribution to Research Evaluation Assessments (e.g. REF 2020)	o	o	o
		Recognize Open Peer-Review Characteristics	Indicate the pros and cons of the Open Peer Review process		o	
			Critically compare Open vs Closed Peer-Review in your discipline		o	
	Open Science Guidelines	Identify Open Science Guidelines	Analyse existing OS Guidelines	o	o	o
			Compare existing OS Guidelines		o	o
		Apply Open Science Guidelines	Choose a OS Guideline that applies to your discipline/project		o	
			Identify the Guidelines requisites		o	
			Comply with Horizon2020 Open Access Mandate	o	o	
			Comply with Horizon2020 Open Research Data Pilot	o	o	
	Open Science Policies	Identify Open Science policies	Identify the different types of OS policies	o	o	o
		Draft Open Science policies	Formulate an OS policy to your discipline/project	o	o	o
		Comply with Horizon2020	Identify the requirements of Horizon2020 Open Access Mandate	o	o	o
			Comply with Horizon2020 Open Access Mandate	o	o	
			Comply with Horizon2020 Open Research Data Pilot	o	o	
		Monitor Horizon2020 compliance	Define metrics and tools to monitor compliance	o	o	o
			Report level of compliance	o	o	o
Legal Issues	Intellectual Property Rights	Definition of copyright	Define copyright in Open Data, Open Access, Open Science content	o	o	
			Define IPR-OS complementarities & conflicts	o	o	o
		Authors & Publisher rights	Define copyright agreement limits	o	o	o
			Amend a copyright agreement	o	o	o
			Retain Copyright to a publication		o	
			Apply Green OA to your discipline/project/workflow	o	o	
	Law	Identify local copyright laws	Understand copyright laws relevant to your discipline	o	o	o
	Licences	Choose appropriate Licences	Differentiate level of access rights	o	o	
			State types of licences	o	o	o
		Apply your licence	Apply licence and apply to your content		o	
Ethics	Ethics	Define ethical limits	Define Open Data limitations to clinical data, patient privacy, national security, IPR	o	o	o
		Operate within ethical limits	Relate to Responsible Research and Innovation (RRI)	o	o	o
			Comply with Horizon2020 Open Access Mandate	o	o	
			Comply with Horizon2020 Open Research Data Pilot	o	o	

[5] EC Responsible Research & Innovation http://ec.europa.eu/research/science-society/document_library/pdf_06/responsible-research-and-innovation-leaflet_en.pdf

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APPENDIX: USER FEEDBACK ON DRAFT V1

Input from: Elise Pinta, PhD, University of Turku Graduate School

I find the Learning Objectives good and useful to our Graduate School, as we planning training to our Doctoral Candidates, in co-operation with our University Library.

Elise Pinta, PhD
Coordinator
University of Turku Graduate School
FI-20014 University of Turku
FINLAND

Input from: Gretchen Repasky,

FIMM-EMBL International PhD Training Program
FIMMPOD Postdoctoral Training Program
Institute for Molecular Medicine Finland FIMM
Nordic EMBL Partnership for Molecular Medicine
https://www.fimm.fi/en/training
and
Doctoral Programme in Biomedicine (DPBM)
Doctoral Programme in Oral Sciences (FINDOS)
University of Helsinki Doctoral School in Health Science
http://www.helsinki.fi/health/

1. A minor, but semantics-type of comment: By "graduate students", do you mean doctoral students? There are many terms to define students of different degrees, and I often feel that there is confusion over these terms. For example, in Finland we used to always use “postgraduate” to refer to PhD students, but to someone from North America, a postgraduate is something different. Now, we are switching our language to “doctoral students” to distinguish them from MSc students and postdocs. Here MSc students are often called undergraduates, which is terribly confusing terminology to some foreigners. Thus, perhaps you could specify “doctoral students” rather than “graduate students”?

2. Then, I wonder the learning objectives are different for “graduate students' than for “researchers". Should they actually be different? Would it make sense to adopt the terminology of MSCA for these target groups? early stage researchers and experienced researcher?

3. The objective that begins on p. 6 with "The objective of this document is to support t…” could be made more prominent in the document so that the focus is not lost by the figure above. For example, it could start as its own section at the top of the next page.

4. I agree fully with the main objectives on p. 7 and think they both doable and most beneficial. They also seem to flow in a somewhat sequential order.

5. It would be helpful to specify what is the H2020 open science mandate early on - p. 6 or 7.

6. For Fig. 2, the red text on blue background is tough on the eyes.

7. I fully agree with this statement: Training the future generation of researchers (and Horizon 2020 applicants) in Open Science principles and best practice, as well as the staff and institutions that support Graduates in career development, carries the greatest potential for long-term culture change, especially

if such training is performed in the interest of maintaining core principles of research, while also offering career development benefits.
But, also wonder if the best pool of candidates for this training would be doctoral students and postdocs. Postdocs are applying for their own funding more often than doctoral students and they are facing these questions both on a daily basis in their research projects as well as with their funding applications. I think open science can be brought into postdoctoral training programs.

8. How about addressing head-on the current events issue of scientific reproducibility or the lack of it? This is something that badly harms science in the public eyes and the lay public is generally not savvy enough in science to understand the reasons for the irreproducibility. So, couldn't this be of interest to institutional stakeholders?

9. In order to be attractive to be implemented, this has to seem easy and naturally part of an existing graduate curriculum. We are fighting an uphill battle for people's time, and so a ToolKit must ideally mesh with existing training. For example, aspects of open science can be brought into existing courses. Thus, some customization of the Toolkit on a case by case, school by school, program by program basis will be needed in order to be attractive.

10. What do you think about running a pilot implementation with a select set of research institutes or doctoral programs? For example, I wonder if EU-LIFE institutes would be interested in a such a collaboration. I am co-chairing the training working group there and could put it on our agenda. It would be nice to see some success stories.

11. Who is the intended audience of the learning objectives document? It is quite dense, so I suggest that when the time comes, any educational coordinators or researchers see a user-friendly sliver of this document.

---------- end of user feedback appendix ----------

APPENDIX: TABLE OF LEARNING OBJECTIVES

Access: https://docs.google.com/spreadsheets/d/1UwsYf8fEFZzK8IPfK-7rFE3BO_VbjvOjQm3CigqBqyk/edit?usp=sharing

TOPICS (following the Research Lifecycle)		CORE LEARNING ELEMENTS	LEARNING OBJECTIVES (as basis for a LEARNING PLAN)	STAKEHOLDER				
				Doctoral Students	Researchers	Research Project Managers	Knowledge Managers & Librarians	Funding Agencies
Open Science	Open Science Definition	Define the concept of Open Science	Define relevance of OS tools to Reproducibility/Integrity of Research	o	o	o	o	o
			Identify OS tools for each step of the Research Lifecycle	o	o	o	o	
			Apply OS concepts to your daily research processes	o	o			
			Discuss OS & Reproducibility role in Innovation & Economic Growth		o	o	o	o
	Open Reproducible Research	Define relevance to Reproducibility	Identify OS tools for each step of the Research Lifecycle	o	o	o	o	
			Define relevance of OS tools to Reproducibility/Integrity of Research	o	o	o	o	o
		Justify Openness as a Reproducibility Tool	Apply OS concepts to your daily research processes	o	o			
			Discuss OS role in Peer-Review Process	o	o			
			Discuss OS & Reproducibility role in Innovation & Economic Growth		o	o	o	o
	Open Research Data (ORD)	Open Big Data	Define Open Big Data concept			o	o	o
			Identify services based on Open Big Data			o	o	o
		Open Data Definition	Define Open Data	o	o	o	o	o
			Demonstrate the advantages of Open Data	o	o	o	o	o

		Open Data Journals	Identify existing Open Data Journals	o	o		o	
			Prepare a publication for an Open Data Journal	o	o			
		Open Data Standards	Identify existing Open Data Standards	o	o	o	o	o
			Use Identifiers for archiving & citing research data	o	o	o	o	
		Open Data use and reuse	Understand of linked data	o	o	o	o	o
			Select & Use licences (e.g. CC) for datasets	o	o	o	o	
			Comply with Horizon2020 Open Research Data Pilot		o	o	o	
	Open Access	Distinguish options for Open Access	Compare Cost/Benefits of Gold and Green Routes	o	o	o	o	o
			Choose relevant Route based on your context	o	o	o		
			Comply with Horizon2020 Open Access Mandate		o	o	o	
		Recognize the advantages of Open Access	Analyze the social impact of OA	o	o	o	o	o
			Estimate the effect of OA on visibility and impact of research results	o	o		o	
			Identify tools and e-infrastructure for OA	o	o	o	o	
		Reuse existing OA resources	Define the characteristics of an OA publication	o	o	o	o	
			Use different OA search portals	o	o	o		
			Interpret content licences and copyright	o	o	o	o	
	Open Science Tools	Identify Open Science Tools	Identify and choose Open Science Tools for your discipline/project		o	o	o	
			Evaluate existing Open Science Tools		o	o	o	
		Select existing Open Services	Identify and choose existing Open Services related to Open Science	o	o	o	o	o
			Evaluate existing Open Services	o	o	o	o	o
		Select Open Workflow Tools	Identify and select Open Workflows Tools	o	o			
			Evaluate existing Open Workflows Tools	o	o			
		Promote outputs of OS projects	Apply lessons learnt for your discipline/project	o	o	o	o	o
	Open Science Evaluation	Identify Altmetrics & Impact	Identify the suit of Altmetrics for future Research Evaluation	o	o	o	o	o

			State Pro`s and Con`s of various Altmetrics measures	o	o	o	o	
			Interpret OS contribution to Research Evaluation Assessments (e.g. REF 2020)		o	o	o	o
		Understand Altmetrics & Impact	Use of academic networks scores	o	o		o	
			Discuss OS contribution to Research Evaluation Assessments (e.g. REF 2020)		o	o	o	o
		Recognize Open Peer-Review Characteristics	Indicate the pros and cons of the Open Peer Review process	o	o		o	
			Critically compare Open vs Closed Peer-Review in your discipline	o	o		o	
	Open Science Guidelines	Identify Open Science Guidelines	Analyse existing OS Guidelines		o	o	o	o
			Compare existing OS Guidelines				o	o
		Apply Open Science Guidelines	Choose a OS Guideline that applies to your discipline/project		o		o	
			Identify the Guidelines requisites		o		o	
			Comply with Horizon2020 Open Access Mandate	o	o	o	o	
			Comply with Horizon2020 Open Research Data Pilot	o	o	o	o	
	Open Science Policies	Identify Open Science policies	Identify the different types of OS policies		o	o	o	o
		Draft Open Science policies	Formulate an OS policy to your discipline/project			o	o	o
		Comply with Horizon2020	Identify the requirements of Horizon2020 Open Access Mandate		o	o	o	o
			Comply with Horizon2020 Open Access Mandate	o	o	o	o	
			Comply with Horizon2020 Open Research Data Pilot	o	o	o	o	
		Monitor Horizon2020 compliance	Define metrics and tools to monitor compliance			o	o	o
			Report level of compliance			o	o	o
Data	**RDM Plans**	Define RDM Plans	Indicate characteristics of the RDM Plans	o	o	o	o	o
			Appraise the characteristics of a RDM plan to your discipline/project	o	o	o	o	
		Prepare a RDM	Create a RDM Plan	o	o	o	o	

		Plan	Apply the RDM Plan to your discipline/project	o	o			
	RDM Policies	Understand RDM Policies	Identify RDM Policies		o	o	o	o
			Comply with RDM Policies		o	o	o	
	RDM Services	Identify RDM services	Identify relevant RDM Services		o	o	o	
			Categorize RDM Services		o	o	o	
		Use RDM services	Integrate RDM services in your discipline/project/workflow		o	o		
			Evaluate & Compare RDM services		o	o	o	
	RDM Standards	Describe existing RDM Standards	Identify existing RDM Standards	o	o	o	o	
			Analyse RDM standards requisites	o	o	o	o	
		Implement existing RDM Standards	Promote RDM Standards in your discipline/project	o	o	o	o	
			Apply existing RDM Standards	o	o			
	RDM Tools	Identify existing RDM Tools	Identify existing RDM Tools	o	o	o	o	
			Compare RDM Tools	o	o	o	o	
		Use RDM Tools	Select relevant RDM Tools	o	o	o	o	
			Evaluate the use of RDM Tools	o	o	o	o	
Legal Issues	**Intellectual Property Rights**	Definition of copyright	Define copyright in Open Data, Open Access, Open Science content		o	o	o	
			Define IPR-OS complementarities & conflicts		o	o	o	o
		Authors & Publisher rights	Define copyright agreement limits	o	o	o	o	o
			Amend a copyright agreement	o	o	o	o	o
			Retain Copyright to a publication	o	o		o	
			Apply Green OA to your discipline/project/workflow	o	o	o	o	
	Law	Identify local copyright laws	Understand copyright laws relevant to your discipline		o	o	o	o
	Licences	Choose appropriate Licences	Differentiate level of access rights	o	o	o	o	
			State types of licences	o	o	o	o	o
		Apply your licence	Apply licence and apply to your content	o	o		o	
Ethics	**Ethics**	Define ethical limits	Define Open Data limitations to clinical data, patient privacy, national	o	o	o	o	o

			security, IPR					
		Operate within ethical limits	Relate to Responsible Research and Innovation (RRI)	o	o	o	o	o
			Comply with Horizon2020 Open Access Mandate	o	o	o	o	
			Comply with Horizon2020 Open Research Data Pilot	o	o	o	o	