An open science strategy for EUNICE universities

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LIST OF ACRONYMS

- *PUT: Poznan University of Technology*
- *BTU C-S: Brandenburg University of Technology Cottbus-Senftenberg*
- *UC: University of Cantabria*
- *UMONS: University of Mons*
- *UNICT: University of Catania*
- *UPHF: Université Polytechnique Hauts-de-France*
- *UVA: University of Vaasa*
- *OS*: Open Science
- *OA*: Open Access
- *OER*: Open Educational Resources
- *OEP*: Open Educational Practices
- *EUNICE*: EUROPEAN UNIVERSITY FOR CUSTOMISED EDUCATION
- *REUNICE*: Research with and for Society in EUNICE
- *UNESCO*: United Nations Educational, Scientific and Cultural Organization
- *FAIR*: Findability, Accessibility, Interoperability, and Reusability
- *APC*: Article Processing Charge
- *DOI*: Digital Object Identifier
- *UBICO*: University Bibliography - Cottbus
- *EOSC*: European Open Science Cloud
- *CARE*: Collective Benefit, Authority to Control, Responsibility and Ethics
- *ANR*: Agence Nationale de la Recherche
- *RDM*: Research Data Management
- *ASI*: Information Systems Area
- *OJS*: Open Journal Systems
- *UNICT-DFA*: Dipartimento di Fisica e Astronomia
- *INFN*: Istituto Nazionale di Fisica Nucleare
- *OpenAIRE*: Open Access Infrastructure for Research in Europe
- *COLab*: Creative OpenLab
- *ORCID*: Open Researcher and Contributor ID
- *HAL*: Hyper Articles en Ligne
- MOOC: Massive Open Online Courses
- *NFDI*: National Research Data Infrastructure

- *GDPR*: General Data Protection Regulation

- *AI*: Artificial Intelligence

- *HEI*: Higher Education institution

- *VEBIC*: Vaasa Energy Business Innovation Centre

- *Archivia*: Archivio Istituzionale ad Accesso Aperto

- *OAI-PMH*: Open Archives Initiative Protocol for Metadata Harvesting

Executive summary

In order to create an open science strategy for the EUNICE European university alliance, in this report, we conducted a survey to collect information about the current situation of open science in EUNICE universities from seven representatives in the alliance (one representative from each university). Based on the collected data, we have created an open science framework that contains five main parts, namely: open science principles, open science practices, constraints, open science strategies in the alliance, and stakeholders. Specifically, in the open science practices, which are the core of open science, we have followed the UNESCO categorization of practices (open science knowledge, open science infrastructures, open engagement of societal actors, and open dialogue with other knowledge systems) (UNESCO, 2021) to see which practices were being used at each university. We also shed light on the open science practices mentioned by UNESCO but still not implemented at the EUNICE universities, calling for joint efforts to also implement these practices.

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1. Introduction

Open science is a movement that aims to make scientific research and data accessible to everyone, regardless of their background or affiliation. It involves the sharing of research data, software, and methods, as well as the promotion of transparency and collaboration in scientific research (UNESCO, 2021). Open science has gained momentum in recent years as a way to increase the quality, efficiency, and impact of scientific research. Consequently, several universities around the world have integrated open science in their strategies to improve the quality and impact of their scientific research (Armeni et al., 2021).

In the context of the REUNICE (Research with and for Society in EUNICE) project, this report presents a study of the current situation of open science in the European universities alliance. Specifically, the report focuses on deliverable 3.1, "An open science strategy for EUNICE universities," of work package 3 within the REUNICE project, which aims to implement an open science strategy for the European universities alliance based on the current situation of open science in these universities. Therefore, a survey was conducted to collect the necessary data. Based on the collected data from the survey, we proposed an institutional framework for the development of open science within the European University alliance, which comprises five main parts: open science principles, open science activities/practices, constraints, open science strategies in the alliance, and stakeholders. The proposed framework aims to support the integration of open science principles and practices across the European University alliance, ultimately promoting transparency, collaboration, and innovation in scientific research.

Regarding the open science practices, which is the main part of open science, this report referred to the four categories of open science proposed by UNESCO (UNESCO, 2021), namely: (1) open science knowledge which refers to open access to scientific publications, open research data, open educational resources, open source software and source code, and hardware that are available in the public domain or under copyright and licensed under an open license; (2) open science infrastructures which refers to virtual and physical infrastructures used for sharing data, collaboration and digital research services; (3) open engagement of societal actors refers to extended collaboration between scientists and members of the public outside of the scientific community by applying citizen and participatory science, crowdsourcing, crowdfunding, and scientific volunteering; and, (4) open dialogue with other knowledge systems which refers to the dialogue between different knowledge holders, such as indigenous peoples, marginalised scholars, local communities. Each of these categories focuses on a different aspect of open science, with the goal of promoting the values of openness, transparency, and collaboration in scientific research.

In order to enhance open science practices, several studies in the literature highlighted the potential of AI in making science more open and accessible (Wang, 2019). For instance, AI can be used to analyse large datasets, predict outcomes, identify patterns, and automate repetitive tasks. Furthermore, AI can facilitate interdisciplinary collaborations between

scientists from different fields, leading to novel insights and discoveries that would otherwise have been difficult to achieve.

This report explores these four categories, by examining the challenges and opportunities associated with each category in each university of the alliance, as well as the potential impact of open science on scientific research and society at large. The report will also highlight examples of organizations and initiatives that are implementing open science practices and discuss the implications of these practices for the future of scientific research.

2. Methodology

In order to study the current situation of open science in EUNICE universities, we conducted a survey to collect data from EUNICE members. Seven participants, specifically a representative from each university in the alliance who is familiar with open science, responded to the survey to collect data regarding the current situation of open science in this university.

2.1.   Data collection

Participants responded to a survey including closed and open-ended questions aiming at identifying the level of adoption of open science and exploring the knowledge and awareness of open science components and initiatives among leaders, as well as their perceptions of the barriers influencing the practice of open science activities. After finishing the survey, it was found that the responses provided about open science practices/initiatives were not enough. Therefore, we decided to send them a complementary table to be filled out about the different types of open science initiatives launched in their universities (see Table 1).

2.2.   Data coding and analysis

We first started with a basic descriptive statistical analysis using percentage distributions to the closed-ended questions data to study the general situation of the adoption of open science in the universities of the alliance (e.g., if there are policies on open science or not). After that, open-ended questions were analysed by coding answers using themes/concepts. Through the use of questioning and the constant comparative method, we obtained an initial list of codes of open science that the universities' representatives had taken up, about open science launched initiatives/practices, principles, preventing factors, as well as their objectives from the use of open science as an alliance. Once this initial round of coding was complete, the identified codes were reviewed by a second researcher. Initial themes and concepts were then generated and refined by the two researchers through iterative cycles of discussion and review to transform them into core concepts, determine core categories, and reassemble them to propose a grounded, rigorous, useful, and comprehensive conceptual framework for the development of open science within the European University alliance.

3. Results (Open Science framework)

Regarding the general situation of the adoption of open science, results showed that the seven universities of the alliance have policies on open science, on a local, regional, national and international level, endorsed by ministries, rectors and other appropriate committees. In most of the universities, the institutional policy specifies the roles, rights and responsibilities of each member, department or other service within the institution with a role in the adoption and implementation of the policy. For instance, in UPHF, PUT and BTU, the library staff is responsible for the implementation of open science activities within the university. Additionally, UPHF shared like many universities from the alliance, such as UMONS, their open science plan in their institutional websites, so anyone can access it (https://www.uphf.fr/recherche/science-ouverte-luphf/plan-science-ouverte-luphf-linsa-hauts-france).

Detailed findings about the study of the current situation of open science in EUNICE universities are synthesised into a conceptual open science framework for EUNICE universities (see Figure 1). The proposed framework contains five main parts, namely: (1) open science principles; (2) open science practices; (3) constraints hindering the adoption of open science practices; (4) open science objectives/common strategies within the alliance; and, (5) stakeholders of open science. Each part is described below.

3.1. Open science principles

The framework distinguishes several principles that the open science practices at EUNICE universities rely on. In particular, most of the universities apply the FAIR data principles to research outputs: (1) findable—which means making research outputs discoverable by the wider academic community and the public; (2) accessible—which means using unique identifiers, metadata, and a clear use of language and access protocols; (3) interoperable—which means applying standards to encode and exchange data and metadata; and (4) reusable—which means enabling the repurposing of research outputs to maximize their research potential.

Additionally, transparency, participation, collaboration, and inclusiveness were considered to ensure equal opportunities for all scientists, regardless of their individual differences, and promote collaboration between disciplines. With respect to the transparency of research outputs, it depends on the shared output. For example, if someone claims that his/her algorithm is accurate in performing a given task, he/she needs to be transparent about the procedure for measuring the accuracy level. This can increase the level of trust toward the shared outcome. It can also catalyse collaboration towards this outcome, for instance, by making more researchers and practitioners working together on further adopting and enhancing this shared algorithm. These principles underlie the observed open sharing practices that the EUNICE universities developed or were engaged in. The next subsequent section presents the main identified open science practices implemented in the universities of the alliance.
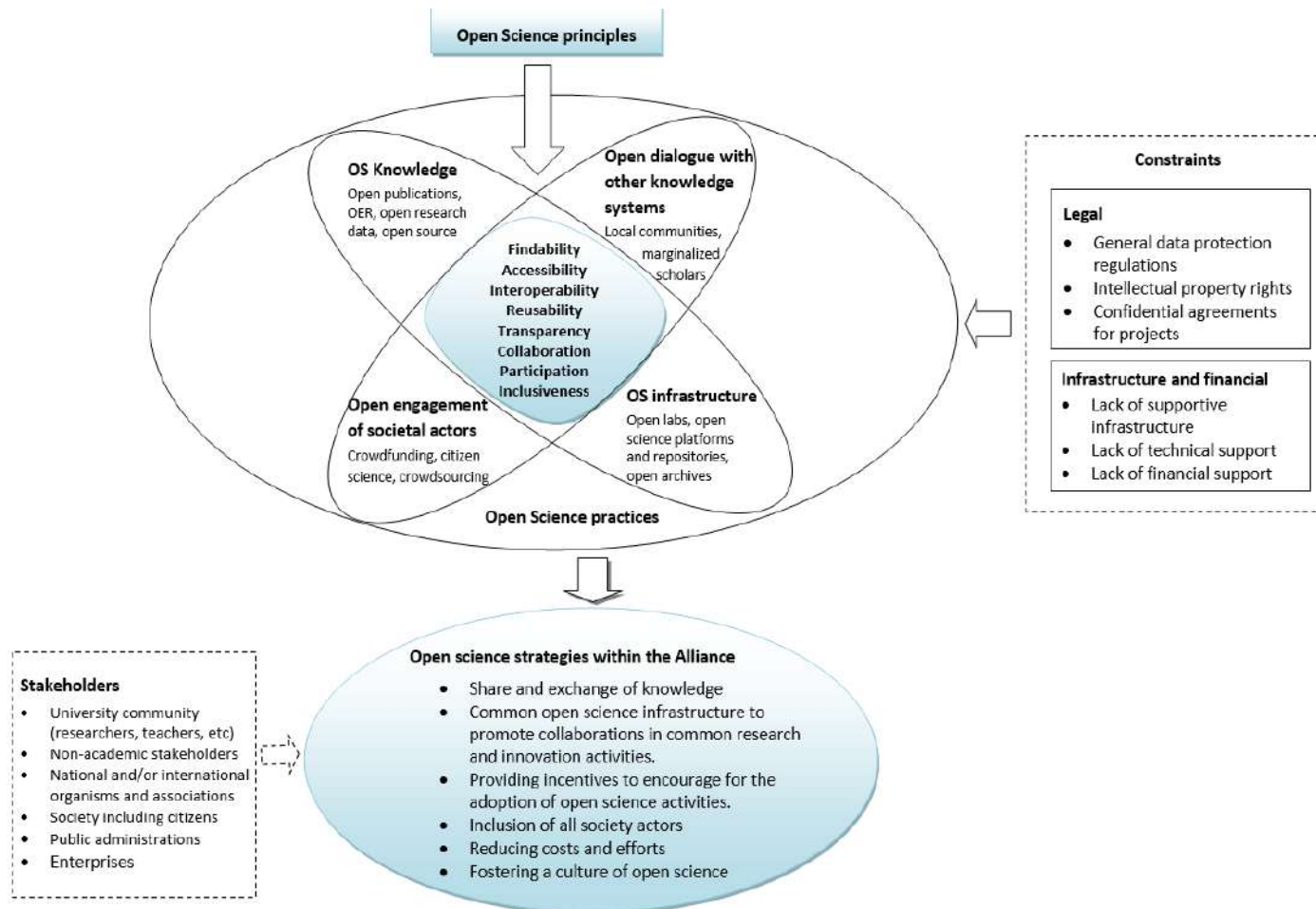
Figure 1. Open science framework for the EUNICE European university alliance
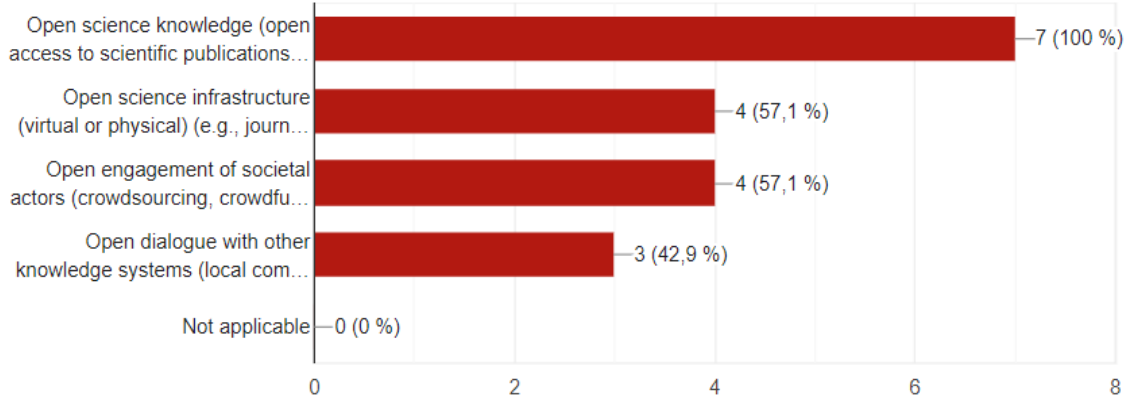
Figure 2. Type of open science practices in EUNICE universities

3.2. Open science practices

Several open science practices/initiatives were implemented at the EUNICE universities. Figure 2 presents an overview of universities' involvement in different open science practices. Specifically, results showed that among the four identified open science categories by UNESCO, open science knowledge-related activities, such as the sharing of publications and research data, are the most implemented. This may be explained by Horizon Europe's requirement for the immediate dissemination of knowledge and new skills across European societies (Gabriel, 2021). The next subsequent sections describe the results of the identified open science practices and initiatives in the EUNICE universities based on the four categories, namely open science knowledge, open science infrastructures, open engagement of societal actors, and open dialogue with other knowledge systems.

3.2.1. Open science knowledge

The results showed that sharing scientific publications and open research data were the most applied practices in EUNICE universities. Specifically, almost all the universities in the alliance have encouraged open access publications by providing financial support to cover article processing charge (APC) fees. In addition, they have encouraged the storage of PhD dissertations, projects' publications, and research data and tools in their institutional open publication archives at the end of the projects.

In order to foster a culture of open science knowledge among researchers, almost all universities launched open science trainings. For example, UPHF launched trainings for: (1) PhD students regarding the dissemination of their thesis and open science publications; and (2) for university staff, including teachers, as part of their continuous training regarding publications in the institutional open repository, how to improve the visibility of their scientific publications, how to manage their digital identity, and how to manage research data. PUT also proposes a training for researchers about "Financing of open access in practice".

Despite the potential benefits of open educational resources (OER), open source software and source code, and open hardware, there have been limited initiatives launched by the seven universities to implement these tools. These resources can greatly reduce costs and effort for teachers and researchers. In terms of OER, only two universities (UPHF and UC) have presented some initiatives regarding the creation of open MOOCs and training for educators on how to create them. However, it seems that for the other universities most initiatives are conducted on an individual level, and there is no overarching strategy followed by the universities. In this context, a recent study on the adoption of OER found that the most commonly cited barrier to adoption is sustainability, which refers to the lack of institutional support (Luo et al., 2020). Therefore, it is crucial to support the OER initiative and provide institutional support, such as infrastructure, to ensure the sustainability of OER.

Furthermore, OER is part of open educational practices (OEP) in addition to open teaching, open collaboration, and open assessment (Huang et al., 2020), and several studies in the literature showed that OEP can contribute to open science by raising the awareness of students of future open science goals and teaching them the skills needed to become a researcher that successfully conducts open science in the future (Czerwonogora & Rodés Paragarino, 2019; Heck et al., 2020). Therefore, given its importance, more focus should be given to OEP in universities, not just OER as part of open science.

3.2.2. Open science infrastructures

For open science infrastructure for knowledge and data sharing, all universities in the alliance have implemented physical infrastructure, specifically open repositories and archives. We can find Osuva[1] archive for UVA, HAL[2] for UPHF, Opus[3] for BTU, OAR[4] for UNICT, SIN[5] for PUT, ORBI[6] for UMONS, and UCREA[7] for UC.

In addition to open repositories and archives, some universities, such as BTU and UVA, have also created virtual research environments, specifically open labs, to enhance collaboration between internal and external stakeholders in some research topics. Other open science infrastructure initiatives were also launched by BTU, such as the open journal system to encourage open publications and university bibliography (UBICO). However, limited activities/initiatives were reported by university representatives regarding digital research services, in particular those that allow to identify unambiguously scientific objects by persistent unique identifiers, such as the Digital Object Identifier (DOI), and which are considered key components of open science infrastructures.

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[1] https://osuva.uwasa.fi/

[2] https://uphf.hal.science/

[3] https://opus4.kobv.de/opus4-btu/home

[4] https://www.openaccessrepository.it/

[5] https://sin.put.poznan.pl/

[6] https://orbi.umons.ac.be/

[7] https://repositorio.unican.es/xmlui/

3.2.3. Open engagement of societal actors

Regarding open engagement with societal actors, only a few initiatives were launched by universities. For instance, no activity/initiative was launched in PUT to engage researchers in open collaboration with external actors from the university. However, UMONS and UC encourage the application of citizen science, which is the engagement of citizens in scientific research. BTU; UNICT and UVA also applied citizen science by including the public in their events and open labs and opening collaborations with them. Citizen science has the potential to generate large quantities of data and engage citizens to better address and respond to complex environmental and societal issues.

However, no university from the alliance mentioned their application of new forms of collaboration with societal actors, such as crowdsourcing, which is so beneficial to collect big data from different people with different backgrounds and skills and can lead to new and innovative ideas that may not have been possible with a limited group of collaborations, crowdfunding, which can be used to provide funds for research projects, and scientific volunteering to support research experiments.

3.2.4. Open dialogue with other knowledge systems

Finally, with respect to open dialogue with other knowledge systems, almost all universities are members of various public associations that may include local communities. For instance, UC and UMONS are members of the European Open Science Cloud (EOSC) association and are involved in their projects and activities. Specifically, EOSC supports communication, outreach, and engagement with its members and observers, external service providers, research communities, stakeholder organizations, and society as a whole to promote open science for the benefit of all. This result may be explained by international policies for inclusive education (Armstrong, Armstrong, & Spandagou, 2009).

However, only one university of the alliance (PUT) has referred to the inclusion of indigenous knowledge in its open archive. Specifically, incorporating indigenous individuals is consistent with both the 2007 United Nations Declaration on the Rights of Indigenous Peoples and the principles for managing indigenous data known as the CARE (Collective Benefit, Authority to Control, Responsibility and Ethics) data principles. In light of this, it is very important to provide more open science activities that establish links with multiple knowledge holders.

3.2.5. Summary and recommendations

Table 1 presents a summary of the identified open science practices/initiatives in the EUNICE universities based on the four categories of UNESCO open science practices. Specifically, the table was filled out by university representatives as part of the survey.

Table 1. Summary of open science initiatives/activities

Initiative category	University	Initiative
Open science knowledge	PUT	- Open access publication: The Ministry of Education and Science ensures financial support in open access publications (by covering APC fees to some extent with selected publishers). - Supporting open research data: PUT is working on bringing together research data available on the external Zenodo repository into one university collection. - Organizing training about the area of publishing, the basics of licensing, grant accounting (precisely in the context of OA publications, research data) or administering financial support programmes for open access publications. - PUT also proposes training on open science issues: "Financing of open access in practice".
	UVA	- The University of Vaasa encourages its researchers to publish openly their research articles, materials and methods, including the used algorithms and source code in accordance with the FAIR principles (Findable, Accessible, Interoperable, Reusable). Therefore, the university sets aside funds to cover the costs relating to publication and openness. - Researchers' scientific publications are made open access by parallel storage in the publication archive Osuva and by publishing them in open access publication channels. - After the completion of a study or research project, national services, such as the FAIR data service and the information archive, are utilised in the publication and long-term storage of materials.
	UPHF	- UPHF adopted and applied the ANR national open access policy to encourage the deposit of funded publications in open archives systems and in particular HAL. - UPHF voted its Plan Science Ouverte (Open Science Roadmap) in Spring 2021, making the referencing of all its publications in its open archive HAL-UPHF mandatory and encouraging depositing the associated

		file. A vast project of retrospective referencing was launched in 2020 and is still ongoing.
		- The university library offers training sessions about open science, open data, open access and HAL.
		- The implementation of the UPHF Open Science Barometer (local adaptation of the French national Open Science Barometer) is planned for the first semester of 2022-2023: https://www.uphf.fr/recherche/barometre-science-ouverte-luniversite-polytechnique-hauts-france
		- UPHF launched a global survey on research data management and open data in 2022 to analyse the practices and needs of its researchers. Relevant services will be implemented accordingly in 2023.
		- UPHF produced 2 open MOOCs:
		1. **Num.e-Sport**[8], on the use of digital technology in the sports context (sports club, etc.)
		2. **Comparative contract law: Germany - France**[9] - 2 sessions
	BTU	- Encouraging the open code and open access initiative (e.g. via GitHub or Open Source Coding); financial (publication fund) and administrative support of open access publications; transformative agreements with publishers; courses offered by the library concerning open access and RDM; record of research data; research data policy; Open Science Strategy (for the whole university in preparation); administrative support of research data management
	UNICT	- UNICT is committed to open access. - Encouraging the collection of the PhD dissertations in an institutional open access archive (ArchivIA) since 2009. - UNICT provides a team in ASI (Information Systems Area) in charge of the publication of scientific journals edited at UNICT by means of the open source OJS (Open Journal Systems) software, ensuring high visibility of the publications through search engines and

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[8] https://www.fun-mooc.fr/fr/cours/num-e-sport-le-numerique-sportif/

[9] https://www.fun-mooc.fr/fr/cours/droit-compare-des-contrats-allemagne-france/

		service providers. Journals are indexed, enriched with metadata and openly accessible. - In the context of the National Plan for open science and with recommendation from the Italian Ministry, UNICT has recently launched an internal survey to map all the datasets, software and research output available in each department with the goal of scoping the requirements of an institutional repository compliant with the FAIR principles and able to connect the scientific publications and research outputs to the data sets and software that have been used to produce them.
	UMONS	Encouraging open access through the institutional repository, open access is mandatory in Belgium, designation of research data manager (for open data), transversal training of open science for students/researchers, open source used by researchers and analysis of code through Fossology[10] by research administration, designation of data ambassadors at UMONS and for all French-speaking universities of Belgium.
	UC	- Open Course ware initiative (includes educational resources from different modules from UC): https://ocw.unican.es/ - On a regular basis UC promotes the creation of Open Access courses by launching a call to support the creation of new open courses. - UC recommends the members of the scientific community to publish the results of their teaching and research activity in open Access scientific journals or allow authors to deposit a copy in open repositories, taking into account the Recommendations for the implementation of article 37 Dissemination in Open Access of the Law of Science, Technology and Innovation (this is a national level law): https://www.recolecta.fecyt.es/sites/default/files/contenido/documentos/Implantacion_Art37_AccesoAbierto.pdf - Last year UC provided funds to support open access publication among their researchers.

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[10] https://www.fossology.org/

		-Courses about open science are offered to lecturers, researchers and PhD students on a regular basis. - Courses about how to apply open statistical software (for instance, R) are offered to researchers. - UC offers training for lecturers on how to create MOOCs.
Open science infrastructure	PUT	-Participation in the developing of a database of Polish technical journals, BazTech, which mostly includes open access journals (under construction), -The university has an open archive/repository for their publications (sin.put.poznan.pl) - PUT share for the university researchers and other stakeholders the professional infrastructure (unique in Poland), i.a.: airport infrastructure (Kakolewo Campus); Skylab (a professional astronomical observatory); flight simulator, European Centre for Bioinformatics and Genomics (https://ecbig.pl/).
	UVA	- Osuva (open publication archive) and open access publication channels. - Joint laboratorios with other HEI's in the area, Technobothnia and VEBIC.
	UPHF	- HAL open archive created in 2019 https://hal-uphf.archives-ouvertes.fr/
	BTU	- Opus (digital repository), open journal systems (under construction); UBICO (university bibliography); transfer database (e.g. information on sharing methods, material, devices, and infrastructure) - COLab (CreativeOpenLab) – open laboratories and garage (e.g. 3D printers or laser cutter) for university members and external stakeholders (https://www.b-tu.de/colab)
	UNICT	Since 2019, UNICT-DFA and INFN operate the FAIR-principles and Plan S compliant, Open Archives Initiative, Open DOAR and OpenAIRE certified Open Access Repository (OAR, www.openaccessrepository.it).
	UMONS	- Institutional repository, dataverse, institutional Gitlab

	UC	- Open repository (includes academic and research works from students and researchers from UC): https://repositorio.unican.es/xmlui/ - Researcher Portal (information about publications and projects developed by UC researchers and research groups): https://web.unican.es/portal-investigador/
Open engagement of societal actors	PUT	-The Researchers' Night event: The purpose of the Researchers' Night is to bring science closer to the society. During this event there are plenty of lectures, workshops and simple scientific experiments. It makes the event attractive and helps to promote science in the society.
	UVA	- According to the University of Vaasa's strategy, they work actively in international and national top research and education networks and partnerships. In addition to digital interaction and personal contacts, the ongoing campus renewal brings together academics, organisations and other partners.
	UPHF	- Commitment in European work groups (Science with and for Society)
	BTU	- Open lab (COLab) for university members and external stakeholders, Open University, Children's University (in German 'Kinderuni'), Night of Creative Minds (in German 'Nacht der kreativen Köpfe') – invitation of societal actors to foster engagement; Entrepreneurship initiatives (COLab; Innovation Hub 13 with Science Gallery (https://innohub13.de/showrooms/sciencegallery/) in particular to promote science-business cooperation
	UNICT	- Open Days - Student Salon of the University of Catania (Salone dello Studente dell'Università di Catania) is the university orientation event dedicated to 4th and 5th graders of 2nd grade high schools, high school graduates and, in general, to all those who are interested in enrolling or transferring to the University of Catania, in order to encourage an informed choice of university studies. - Sharper Night - The SHARPER project was created in response to the need to enhance the figure of male and female researchers and their role in society. To achieve this goal, the central idea of the promoters of Sharper

		has been, since 2013, to interpret the Night as a festive opportunity to share with the general public the passions that animate researchers in their work by discovering that these passions are common to everyone. In recent years, the project has expanded to both central and southern Italy, and alongside the three cities that had been part of the first SHARPER project and for 2022, the cities of Ancona, Cagliari, Camerino, Catania, Genoa, L'Aquila, Macerata, Nuoro, Pavia, Palermo, Perugia, Sassari, Terni, and Trieste have been involved.
	UMONS	- Citizen science done by research projects
	UC	- There's a Spanish national call to promote scientific culture and it includes specific reference to citizen science that is launched every year: https://www.convocatoria.fecyt.es/Publico/Bases/Bases.aspx - Researchers from UC that want to apply to this call can get support from the Scientific Culture and Innovation Unit.
Open dialogue with other knowledge systems	PUT	- The PUT repository archive system has an open application interface for Polish nationwide knowledge database.
	UVA	- In addition to digital interaction and personal contacts, the ongoing campus renewal brings together academics, organisations and other partners.
	UPHF	- Participation in national networks: couperin consortium, ORCID consortium, CasuHAL association
	BTU	- BTU is a member of various public associations; participation in public fairs – dialogue, (science) communication and technology and knowledge transfer with external stakeholders; Participant in NFDI4earth; Membership NFDI.ev; Forschungsdatenstrategie Brandenburg (in preparation)
	UNICT	-
	UMONS	- UMONS is member of OAI-PMH, OpenAIRE, Working Group of EOSC
	UC	- UC is member of EOSC Association: https://eosc-portal.eu/

Table 3 presents a summary of the identified open science practices/initiatives in the EUNICE universities based on the four categories of UNESCO open science practices. Specifically, the table was filled out by university representatives as part of the survey. In order to compare the results of open science practices in EUNICE universities with the open science practices identified by UNESCO, Figure 2 presents a framework that further sheds light on the open science practices mentioned by UNESCO but still not implemented at the EUNICE universities, calling for joint efforts to also implement these practices. Specifically, this framework presents the state of universities' involvement in different open science practices based on the four categories identified by UNESCO. Specifically, the green color means that many initiatives were launched regarding this practice; the orange color means that limited initiatives were launched; and the red color means that very few or no initiatives were launched.
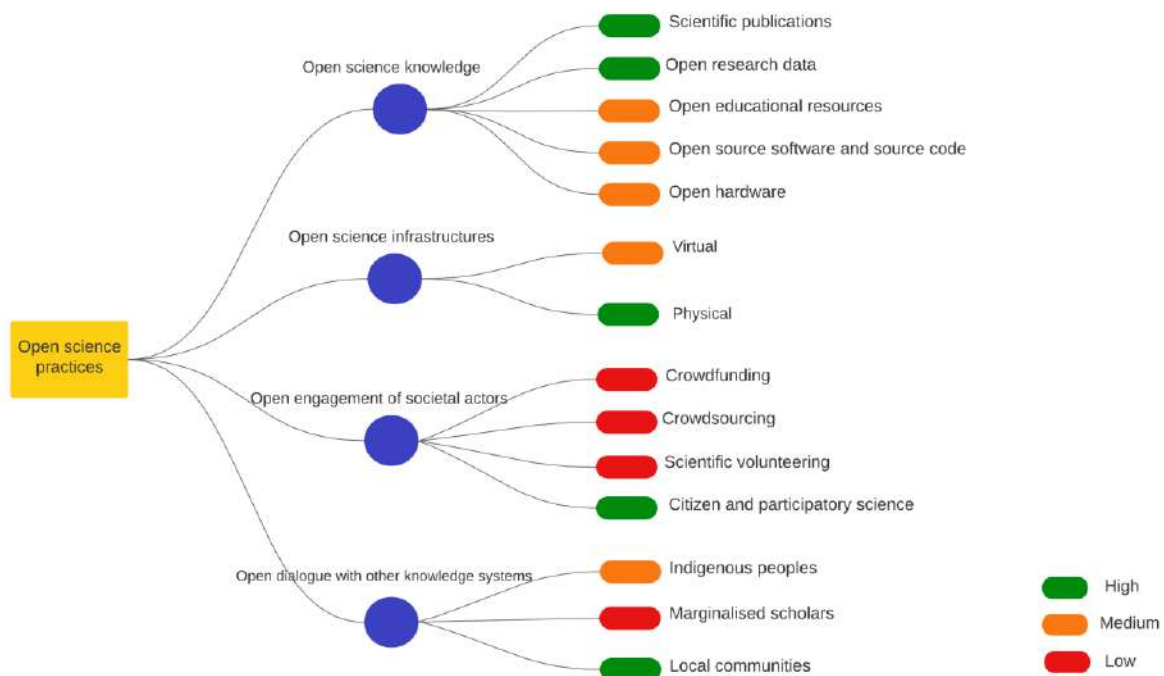

Figure 3. Open science practices implementation according to UNESCO framework

Based on the identified limitations of open science practices in EUNICE universities in each category, we proposed a list of recommendations that universities should consider while implementing open science strategies with partners in the alliance, in order to enhance future research. Specifically, these recommendations are categorized based on the four categories of UNESCO as follows:

- *Open science knowledge*
  - Supporting the OER initiatives by providing support, such as infrastructure, for sustainable OER.
  - Promoting the culture of OEP within educators since it is widely linked to open science practices.

- Providing training regarding OEP, including open collaboration, open assessment, and open teaching.
- Encouraging more initiatives regarding the use of open source software and source code and open hardware to share knowledge.

- *Open science infrastructures*:
  - Providing more physical and virtual open science infrastructures to support the sharing of knowledge between researchers and non-academic stakeholders.
  - Providing support to researchers on digital research services, particularly persistent unique identifiers, such as ORCID and DOI.
- *Open engagement of societal actors*:
  - Applying new forms of collaboration between universities' researchers and societal actors, such as crowdsourcing, crowdfunding and scientific volunteering.
  - Focusing on practices that promote the satisfaction of belongingness and uniqueness needs.
- *Open dialogue with other knowledge systems*
  - Implementing practices that facilitate the inclusion of different knowledge holders, such as indigenous peoples and marginalized scholars, in work groups. For instance, by providing them access to information and including them in decision-making (Nishii, 2010).

Our study further exposes constraints preventing the adoption of open science activities in EUNICE universities. The next subsequent section presents the main identified constraints.

3.3. Constraints

Several constraints were found to hinder the adoption of open science practices. In particular, within the EUNICE universities, we found that legal constraints, such as the General Data Protection Regulations (GDPR) and intellectual property rights, and infrastructure constraints are the most dominant constraints that hinder the adoption of open science. For instance, several universities claimed that when conducting collaborations with industrial partners (e.g., companies), the culture of openness and sharing is hard to adopt because most companies want to keep their results and data for commercial purposes. Therefore, more policies and regulations should be established to encourage sharing outputs, especially in the industrial field. Particularly within our alliance, it is crucial to follow a data management plan that clearly defines intellectual property rights. The next subsequent section presents some common open science strategies/objectives to enhance the research in Europe and in particular at EUNICE university.

3.4. Open science strategies in the alliance

Based on the identified practices, principles, and constraints, it has been identified that the open science objectives at EUNICE universities aim to achieve various common purposes. Therefore, it is very important to join the efforts of all the universities in the alliance for a common benefit by aligning the universities' strategies and implementing a common open

science strategy for EUNICE University based on the identified open science principles. The common strategy will consider the proposed recommendations regarding different open science practice categories in order to enhance the open science situation and provide solutions for some universities regarding open science activities hindered by constraints. The central pillars of this strategy encompass the following proposals: (1) Fostering a culture of open science between European universities, for instance, by promoting collaboration between universities in common research and innovation activities; (2) Developing a common open science infrastructure, to share and exchange knowledge and promote collaboration between EUNICE researchers and non-academic stakeholders. The platform will be connected to the different national repositories and archives of EUNICE partners to broaden the knowledge of the different works done in their laboratories; (3) Using AI in the open science platform to enhance the cooperation between EUNICE partners in common research on the common open science platform, for example, by automatically analysing publications' content by intelligent agents to identify their research themes and notifying researchers working in the same field about new publications. Additionally, using machine learning functionalities, such as ranking functions, to create a dashboard that presents the most important and cited articles in each field; (4) Disseminating the results of training and educational activities on open science skills to enhance mutual learning and the exchange of good practices among the alliance members regarding science and society and public engagement in science; (5) Encouraging researchers from the alliance to publish in the common open platform by providing rewards and incentives and including the adoption of open science as a formal criteria in research assessment, and evaluation procedures; (6) Deposit of author's accepted version of the article for publication and/or final PDF (if accessible) in the open platform in order to ensure the accessibility of publications; (7) Ensure the sustainability of files' storage and the link to access them; (8) Reusability of shared data and resources within the alliance in order to reduce the cost and time needed and to determine conditions and legal protection for reusability. To accomplish this, we propose the use of an open source tool, such as Dataverse, which can collect data and metadata from a variety of open archives, such as Zenodo; and, (9) Including societal actors in EUNICE open science activities through the use of new forms of collaboration such as crowdfunding, crowdsourcing, and scientific volunteering.

3.5. Stakeholders

Several stakeholders were identified that could contribute to and benefit from the open science practices within the alliance, namely: the university community, including researchers, educators, HEI's executive staff, library staff, non-academic stakeholders, society, including citizens, public administrations, national and/or international organisms and associations, and enterprises. For example, the university community, such as educators and researchers, will be involved in the sharing and exchange of their research outputs with other researchers from the alliance via the common open science platform. Library staff, who are generally responsible for open repositories and achieve within universities, may be involved in the management of open publications and training sessions. Additionally, cooperation between the university community and the non-academic sector can also be reinforced through the

involvement of citizens, civil society, and public authorities in research and innovation. Specifically, communication between all the stakeholders will be assured by the common open science infrastructure for EUNICE University.

4. Conclusion

In order to create an open science strategy for the alliance, this report investigates the state of open science at EUNICE universities. Based on the collected results, it outlines a comprehensive conceptual framework for the development of open science within the EUNICE European university alliance, which is divided into five main parts. As a first finding, the study found that FAIR principles are the most commonly applied open science principles. Second, open science knowledge-related activities were identified as the most implemented practices among the four open science categories identified by UNESCO. Furthermore, the report proposes a framework to address open science practices mentioned by UNESCO but not implemented at EUNICE universities, encouraging joint efforts to adopt these practices. Third, the study highlights legal constraints as the primary obstacles hindering the adoption of open science. Fourth, the report presents common open science strategies among universities and proposes new ones to promote open science culture based on the limitations identified in the open science practices. Lastly, the study identifies individuals involved in different open science practices both within and outside universities.

5. References

Armeni, K., Brinkman, L., Carlsson, R., Eerland, A., Fijten, R., Fondberg, R., ... & Zurita-Milla, R. (2021). Towards wide-scale adoption of open science practices: The role of open science communities. Science and Public Policy, 48(5), 605-611.

Armstrong, A. C., Armstrong, D., & Spandagou, I. (2009). *Inclusive education: International policy & practice*. Sage.

Birks, M., & Mills, J., (2015). Grounded theory: a practical guide, 2nd edition. SAGE.

Czerwonogora, A., & Rodés Paragarino, V. (2019). PRAXIS: Open educational practices and open science to face the challenges of critical educational action research. Open Praxis.

Gabriel, M. (2021). OPEN SCIENCE EARLY KNOWLEDGE AND DATA SHARING, AND OPEN COLLABORATION. Accessed on February, 23, 2023. from: https://www.horizon-europe.gouv.fr/sites/default/files/2021-12/open-science-5161.pdf

Heck, T., Peters, I., Mazarakis, A., Scherp, A., & Blümel, I. (2020). Open science practices in higher education: Discussion of survey results from research and teaching staff in Germany. *Education for Information*, *36*(3), 301-323.

Huang, R., Tlili, A., Chang, T. W., Zhang, X., Nascimbeni, F., & Burgos, D. (2020). Disrupted classes, undisrupted learning during COVID-19 outbreak in China: application of open educational practices and resources. *Smart Learning Environments*, *7*, 1-15.

Luo, T., Hostetler, K., Freeman, C., & Stefaniak, J. (2020). The power of open: Benefits, barriers, and strategies for integration of open educational resources. *Open Learning: The Journal of Open, Distance and e-Learning*, *35*(2), 140-158.

Nishii, L. H. 2010. The benefits of climate for inclusion for diverse groups. Unpublished paper, Cornell University, Ithaca, NY.

UNESCO (2021). UNESCO Recommendation on Open Science. [online] Available at: https://unesdoc.unesco.org/ark:/48223/pf0000379949.locale=en [Accessed 23April. 2022].

Wang, K. (2019). Opportunities in open science with AI. Frontiers in big Data, 2, 26.

6. APPENDIX

INFORMATION GATHERING FOR REUNICE PROJECT: Task 3.1. Study of the current situation of Open science

We have created this form to collect information about the open science situation in EUNICE universities in order to create an open science strategy for the European university alliance, which is the goal of our first task in the WP 3.

*Obligatoire

Demographic information

1. First and Last name *

2. University *

3. Occupation *

Open science situation in your university

4. Did your University launch or participate in an open science initiative? *

( ) Yes

( ) No

5. What was the type of the initiative? *

    ☐ Open science knowledge (open access to scientific publications, open research data,open education resources (OER), open source software and source code, open hardware,etc.)

    ☐ Open science infrastructure (virtual or physical) (e.g., journals and open access publication platforms, repositories, open labs, digital research services, etc.)

    ☐ Open engagement of societal actors (crowdsourcing, crowdfunding, scientific volunteering, citizen or participatory science)

    ☐ Open dialogue with other knowledge systems (local communities, marginalized scholars or indigenous people)

    ☐ Not applicable

6. What is the level of the launched policies? *

    ☐ Internal within your University

    ☐ National

    ☐ International

    ☐ Not applicable

7. Who are the involved partners in the initiative? (e.g., universities, non-profit
    *
    organizations, etc.)

    _____

8. What was the objective of the open science initiative? (e.g., to create OER
    to
    *make education accessible for everyone and reusable for teachers to facilitate their
    tasks.)

    _____

    _____

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9· What was the impact of this initiative on your university? *

_____

10· Regarding the REUNICE project, how do you think that this open science
*

initiative can impact your university and the alliance?

_____
_____
_____
_____
_____

To what extent do you think that participants will contribute to the REUNICE open science platform? *

( ) Frequently

( ) Rarely

( ) I don't know

11· Do you think that we should provide some mechanics to motivate participants to contribute to the platform (e.g., rewards)? *

( ) Yes

( ) No

Are there any legal constraints that can hinder the sharing of data in your university?
*

Yes ◯

◯ No

12· If YES, please cite them.

_____

_____

_____

_____

_____

13· Please elaborate if you have additional remarks.

_____

_____

_____

_____

_____