Requirements to Updated Courses with New Subjects on Open Science

OPTIMA

Open Practices, Transparency and Integrity for Modern Academia

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[This report summarizes findings from two workshops on gathering requirements for introducing Open Science (OS) training to Ukrainian higher education institutions (HEIs) and presents a roadmap for implementation. It develops recommendations for Open Science training implementation based on the findings of the two requirements gathering workshops as well as a roadmap for OS course development for Ukrainian Higher Education Institutions.]

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Executive Summary

Aims: This report summarizes findings from two workshops on gathering requirements for introducing Open Science (OS) training to Ukrainian higher education institutions (HEIs) and presents a roadmap for implementation. It develops recommendations for Open Science training implementation based on the findings of the two requirements gathering workshops.

In particular, the report develops a roadmap for OS course development for Ukrainian Higher Education Institutions, taking into account background research on the Ukrainian academic context. Based on OS course requirements, the report also sketches requirements for the development of training handbooks on Open Science and how these could be integrated with university courses.

Findings: In addition to updating existing courses starting at the graduate (Master) level, the workshop revealed a need to provide introductory Open Science training already at the undergraduate level to familiarize students with basic concepts and aims of Open Science.

Recommendations: The main recommendations to the consortium can therefore be summarized as: Identification of institutional gatekeepers (individuals and institutions within universities) as soon as possible; building a knowledge base of participant institutions regarding accreditation & course development; develop course content for a baseline introductory Open Science course (plus a collection of training materials); develop discipline-specific modules for each of the OPTIMA use cases; form working groups to co-create an OS Handbook into Ukrainian partly reusing content from existing handbooks and to develop discipline-specific modules (in close connection to the development of course content).

1. The OPTIMA Context: Open Science and Ukrainian Academia

1.1. Academic Integrity and Open Science

Academic integrity is the foundation of any educational or scientific institution. However, open science principles aren't widely known in Ukraine yet, even though they are essential in the academic integrity culture. Creation of such culture through updating the existing educational courses with innovative subjects, interactive content and learning ICT tools with simultaneous improvement of competencies and skills of students are the points for long-term popularization of the open principles. Modernization and updating of existing courses, instead of the creation of new ones, will allow the introduction of the necessary study subjects quickly and efficiently. Open Science skills are increasingly essential for students, PhD students, early career and already established researchers etc. Embedding Open Science in Master and PhD programmes will positively influence the development of their research careers. Basic Open Science principles integrated in new academic subjects will help to create a more equitable academia and incentivise ethical behaviour on the part of researchers. In addition, it will advance the professional qualification of academic and laboratory staff. In brief, OPTIMA aims to improve the quality of higher education in Ukraine by increasing the level of academic integrity through bringing open practices and transparency to relevant content and services, as well as through modernisation and internationalization of Ukrainian HEIs. OPTIMA will introduce open practices as a quality assurance (QA) process and IT solutions and an international virtual community of reviewers as a quality assurance mechanism.

1.2. Background: Displaced Universities and Academic Misconduct

The system of higher education (HE) in Ukraine is characterized by serious deficiencies, such as inefficient quality assurance and low levels of internationalization. Both affect educational attainment and reduce the country's general potential. A second acute problem currently facing the country's HE system is caused by the military conflict in eastern Ukraine. In 2014 the concept of "displaced higher education institutions" emerged as since the beginning of hostilities in the Donbass region, 18 higher education institutions (HEIs) have been moved from the non-governmental controlled areas. The displaced HEIs managed to resume the educational process and now continue to educate over 40,000 students and employ about 3,500 academic staff (HE Portal, 2016). However, despite numerous achievements, problems of quality and integrity remain in the Ukrainian education system, harming society and economy (OECD, 2017). The Ministry of Education and Science understands the situation all too well, referring to academic integrity promotion as the "main bottom line" of QA mechanisms for Ukrainian HE (Hrynevych, 2019; CMU, 2019). Unfortunately, full implementation of these vital reforms is a highly demanding process due to a lack of recognition for values of academic integrity, as well as widespread disbelief in the need for change at the local level.

"[W]idespread practices of academic misconduct and plagiarism, their high support within the academic community" are among the four key academic challenges facing Ukrainian HE (KAS 2017). OECD (2017) reports that misconduct in HE, when students do not properly represent their acquired knowledge because of cheating, plagiarism and ghost-writing, is one of the main problems of the Ukrainian education system. Manifestations of dishonesty are promoted, in particular, by the absence of generally accepted ethical standards for academic integrity and the limited ability of HEIs to detect and assess existing integrity violations. A survey by EUFSR (2015) shows that 78% of students do not take exams independently as they prepare cheat sheets, write off from others during exams etc. An absolute majority of students (90%) commit plagiarism in some form. It is significant that while 57% of freshmen say that writing off is "unacceptable", only 15% of sophomores retain the same belief (SAIUP, 2017). This provides clear evidence of a systemic problem limiting the capacity for tangible progress in education quality with the existing means and tools in Ukraine. There is a need for development and implementation of innovative QA mechanisms built on academic integrity culture. Integrity is based on the principle of transparency (Smith & Hamilton, 2016). Transparency is celebrated as the most important principle alongside integrity in the guidance documents of contemporary scientific (ALLEA, 2017) and educational (ENAI, 2018) communities. In the OPTIMA context, transparency refers to the disclosure of information, rules, plans, processes and actions (Velliaris, 2019). As a principle, all actors have a duty to act visibly, predictably and understandably to promote participation and accountability. Transparency and openness are the key ingredients to building and spreading integrity culture based on trust. Such a process of change requires time, especially given the inertia of academia in general.

1.3. Background: Open Science in Ukraine

Although Open Science is very new to Ukrainian researchers, Ukraine is not starting from scratch in implementing open principles in academia. However, the working group for shaping the National Plan for Open Science has just been formed and hasn't produced any documents yet as of July 2021 (the deadline for releasing the plan is January 2022).

Despite that, Ukraine has some successes regarding Open Access. There are 385 Ukrainian research journals indexed on the DOAJ website and 105 Open Access repositories in Ukrainian universities and research institutions. Also, 17 institutional Open Access policies were adopted in Ukraine and the Open Access to Knowledge statement was endorsed by over 150 Ukrainian university librarians in 2009. At the National level, Open Access and Open Science have been integrated into several laws, e.g., the Law of Ukraine on the Principles of Developing Information Society in Ukraine in 2007-2015. In 2018 the National Repository was launched, a nationwide distributed electronic database in which academic texts are accumulated, stored, and systematized. On top of that, the National Initiative of the European Open Science Cloud Initiative was launched in November 2020.

Still, the awareness level of and attitudes towards Open Science among members of the Ukrainian academic community have a vast space for improvement. According to the all-Ukrainian survey conducted in spring 2020, almost 67% of young scientists (under 35 years of age for Ph.D. holders and 40 years of age for ScD holders) and almost 51% of senior scientists were unaware of Open Science, and only 6% (PhDs) resp. 9% (Senior Scientists) practice Open Science. The survey also highlighted awareness and involvement levels in Open Peer Review: more than 67% of young scientists and more than 53% of experienced scientists were unaware of it. Only about 2% and about 6% accordingly peer-reviewed research outputs openly. The above-mentioned numbers suggest that Ukrainian young scientists (Ph.D. candidates, early-career researchers, and youth in science under 35) need even more support in adopting open academic practices.

1.4. Aims of Open Science

Transparency is at the core of Open Science (OS), a global movement which is rapidly developing and has gained increasing EU-level recognition and popularity in recent years. OS is not an end but a means to support better quality science, increased international collaboration and integrity (wider evaluation, promotion of honesty and self-correction etc.) (OECD, 2015; RISE, 2017). These goals are highly relevant to Ukrainian HEIs and can be effectively applied in the wider academic context through fostering research integrity culture and practices among academic staff, students and administrators in order to improve education quality. Emerging first in the early 2000s as "Science 2.0" (Mirowski 2018; Franzen 2018), OS is an umbrella term for a multitude of assumptions about the future of knowledge production (Fecher and Friesike 2014), encompassing a variety of meanings that range from publicizing research outputs (Open Access in its various forms) to making accessible all aspects of the research process (Fell 2019), including data (e.g. Giffels 2010), notebooks, analysis plans, and code (Ibanez, Avila, and Aylward 2006; Ram 2013) as well as research evaluation and peer review (Ross-Hellauer 2017; Shanahan and Olsen 2014). OS denotes a bundle of practices and associated key ideas such as reproducibility, accessibility, sharing, and collaboration (Vicente-Saez and Martinez-Fuentes 2018). Free access to research outputs has been associated with better and more efficient science (Leonelli, Spichtinger, and Prainsack 2015), economic growth (Tennant, Jacques, and Collister 2016), and increased transparency of knowledge production (Gilmore et al. 2017).

OS promotes accessibility of scientific outputs to facilitate uptake, enhance the exchange of ideas and contribute to a more equitable scientific system. OS emphasizes the importance of collaboration and exchange within academia, but also with extramural societal actors, taking its point of departure in a critical analysis of what stands in the way of wide reuse of scientific knowledge as produced by conventional scientific practices. Among the benefits of OS practices for researchers have been cited increased citation rates (Piwowar, Day, and Fridsma 2007; Piwowar and Vision 2013), increased media coverage (McKiernan et al. 2016), more transparent research evaluation (Pöschl 2012; Beck et al. 2018), increased reproducibility (Toelch and Ostwald 2018), increased control over research outputs through retaining copyright and publishing under Creative Commons (CC) licenses (McKiernan et al. 2016), and establishment of priority via preprints (Vale and Hyman 2016).

1.5. Open Science Implementation

The turn towards OS involves profound cultural change of the scientific system. However, neither changes on an organizational level (within scientific institutions) nor an individual level will suffice. Rather, profound change is needed in the wider social context in which scientific practices operate. Consideration of these wider preconditions foregrounds the decisive role of infrastructures, science policy, and economic framework conditions. OS will only be able to realize its full potential if the desired cultural change of the scientific system is firmly backed up by respective policies to regulate copyright, data protection and licensing (Carroll 2015; Carrozza and Brieva 2015; Caso and Ducato 2014; Pisani et al. 2010) and is supported with training actions. Compared to the EU, Ukraine is still in its infancy with respect to OS implementation. In a national-level online survey carried out by Lviv Polytechnic National University (Ukraine, Jun-Dec 2018; participants: 1,094 academic staff and students), only 33.5% of respondents had heard of OS while only 8% have applied OS practices. The OS roadmap is diverse. Open Peer Review (OPR), it is assumed, has the biggest potential in Ukraine as it brings transparency to the already familiar practice of academic evaluation and provides hands-on learning opportunities for early career researchers (ECRs), helping to build new skills under collective mentorship of international experts.

1.6. OPTIMA's Target Audiences

The OPTIMA project addresses representatives of the Ukrainian academic community in diverse roles to advance the academic integrity culture via introducing more open and transparent practices. In particular, students and Early Career Researchers will learn how OS can be of direct benefit to their career development and help strengthen their international research profiles. Project outputs will empower them to embed OS principles in their research workflows on early career stages. Supporting researchers in good publication and research data management practices will help HEIs gather research outputs and measure their overall impact. By providing institutional support staff with a suite of easy to use training materials, the project will be helping HEIs to realise such gains without the need to invest heavily in developing soft infrastructure within each institution. Research administrators, e.g. research office staff, research ethics advisors, legal/contracts staff and innovation related staff need support with Intellectual Property management and advise on the right balance between OS and commercialization of research. Research results exploitation and other related issues will be addressed in our OS training activities. The General Public will also be made aware of the benefits of OS. One of the training outputs for researchers will concern how to engage the general public as well as citizen scientists. Teaching staff will get acquainted with theory and best practices of OS and participate in the modernisation of existing courses with new subjects on OS. Master students and PhD candidates will familiarize themselves with new subjects on OS. A professional open online course on OS will help in self-education.

2. Task Description and Aims

The following section details the task at hand - development of course requirements for Open Science courses in Ukrainian Higher Education institutions. In particular, the task aims at identifying requirements on updating of PhD and Master level academic courses with the following new subjects on OS:

- Open Science Practices (PhD level) *
- Open Science in Ecology (Master level) *
- Open Science in Information Management (Master level)
- Open Science in Biology (Master level)
- Open Science in Chemical Technology (Master level)

* These subjects will be enriched by examples on climate change and its mitigation. This will help raise awareness on this painful topic in Ukraine. Expertise on climate change issues will be provided by NASC.

EU experts from TU GRAZ, UCA and EIFL contributed to this activity during online workshops hosted by TU Graz and EIFL (March 2021) and UCA (June 2021) as well as during online communication sessions. The major outcome is this report, detailing

1) Institutional constraints and workflows for introducing OS in Ukraine and possible strategies
2) Requirements for the development of OS courses for selected subjects
3) Requirements to OS training handbooks for the stated subjects and how these relate to university courses

The report further contextualizes all of these results within the general (European) Open Science training landscape as well as preliminary findings on attitudes towards Open Science practices in Ukraine, to be discussed in the following two sections.

3. Elements of Open Science

The UNESCO draft Open Science Recommendation provisionally adopted on May 11, 2021, defines Open Science "as an inclusive construct that combines various movements and practices aiming to make multilingual scientific knowledge openly available, accessible and reusable for everyone, to increase scientific collaborations and sharing of information for the benefits of science and society, and to open the processes of scientific knowledge creation, evaluation and communication to societal actors beyond the traditional scientific community. It includes all scientific disciplines and aspects of scholarly practices, including basic and applied sciences, natural and social sciences and the humanities, and it builds on the following key pillars: open scientific knowledge, open science infrastructures, science communication, open engagement of societal actors and open dialogue with other knowledge systems.

- **Open scientific knowledge** refers to open access to scientific publications, research data, metadata, open educational resources, software, and source code and hardware that are available in the public domain or under copyright and licensed under an open licence that allows access, re-use, repurpose, adaptation and distribution under specific conditions, provided to all actors immediately or as quickly as possible regardless of location, nationality, race, age, gender, income, socio-economic circumstances, career stage, discipline, language, religion, disability, ethnicity or migratory status or any other ground; and free of charge. It also refers to the possibility of opening research methodologies and evaluation processes. Users therefore gain free access to:
- **Scientific publications** that include among others peer-reviewed journal articles and books, research reports, conference papers. Scientific publications may be disseminated by publishers on open access online publishing platforms and/or deposited and made immediately accessible in an open online repository upon publication, that are supported and maintained by an academic institution, scholarly society, government agency or other well-established not for-profit organization devoted to common good that enables open access, unrestricted distribution, interoperability, and long-term digital preservation and archiving. Scientific outputs related to publications (e.g. original scientific research results, research data, software, source code, source materials, workflows and protocols, digital representations of pictorial and graphical materials and scholarly multimedia material), that are openly licensed or dedicated to the public domain should be deposited in a suitable open repository, following appropriate technical standards that allow them to be properly linked to publications.
- **Open research data** that include among others digital and analogue data, both raw and processed, and the accompanying metadata, as well as numerical scores, textual records, images, and sounds, protocols, analysis code and workflows that can be openly used, reused, retained and redistributed by anyone subject to acknowledgement. Open research data are available in a timely and user friendly, human- and machine-readable and actionable format, in accordance with principles of good data governance and stewardship, notably the FAIR (Findable, Accessible, Interoperable, and Reusable) principles, supported by regular curation and maintenance.
- **Open Educational Resources** that include teaching, learning and research materials in any medium – digital or otherwise – that reside in the public domain or have been released under an open license that permits no-cost access, use, adaptation and redistribution by others with no or limited restrictions.
- **Open source software and source code** that generally include software whose source code is made publicly available, in a timely and user-friendly manner, in human- and machine-readable and modifiable format, under an open license that grants others the right to use, access, modify, expand, study, create derivative works, and share the software and its source code, design, or blueprint. The source code must be included in the software release and made accessible on openly accessible repositories and the chosen license must allow modifications, derivative works, and sharing under

equal or compatible open terms and conditions. In the context of Open Science, when open source code is a component of a research process, enabling reuse and replication generally requires that it be accompanied with open data and open specifications of the environment required to compile and run it.

- **Open hardware** that generally include the design specifications of a physical object which are licensed in such a way that said object can be studied, modified, created, and distributed by anyone providing as many people as possible the ability to construct, remix, and share their knowledge of hardware design and function. In the case of both open source software and open hardware, a community-driven process for contribution, attribution and governance is required to enable reuse, improve sustainability and reduce unnecessary duplication of effort."
- **Open Peer Review** is an important aspect of Open Science. Opening up what has traditionally been a closed process increases opportunities to spot errors, validate findings and to increase our overall trust in published outputs.

Open Science requires investment in capacity building and human capital via targeted education and training. UNESCO recommends that "a core set of data science and data stewardship skills, skills related to intellectual property law, as well as skills needed to ensure open access and engagement with society as appropriate should be regarded as part of the foundational expertise of all researchers and incorporated into higher education research skills curriculum."

Major European University and research funders associations - CESAER, European University Association (EUA) and Science Europe representing more than 880 universities and research-performing and research-funding organisations - are strong supporters of Open Science and Open Access. It is fundamental that researchers, universities, and other research-performing organisations disseminate and reuse their research findings without restrictions or embargoes.

In the FAIR in European Higher Education report (Stoy et al., 2020) more than three quarters of respondents indicated that they provide training for researchers (80%). These findings indicate a positive trend compared to the sample of the 2017-2018 EUA Open Access Survey, in which only around 50% of universities were providing training. Most universities provide research data management training at the doctoral level, e.g. through research training and methods courses, as well as at master and bachelor levels.

4. Needs Assessment: How Open Science could benefit Ukrainian HEIs

4.1. Preliminary Findings: Results of a survey among OPTIMA project partners

In the planning phase, TUG conducted a survey among Ukrainian partner institutions in order to aid in resource planning for the TU Graz workshop. A questionnaire comprising 43 questions was developed to quantify familiarity with Open Science practices, experience with academic publishing, and adherence to Open Science practices. Respondents were asked to gauge their specific interest in areas usually considered canonical to Open Science (e.g. Open Access, FAIR Data, Reproducibility, Open Licenses, Citizen Science, Open Evaluation, etc.) using a 5-point Likert scale and to assess their familiarity with OS practices, also based on a 5-point Likert scale (from "novice" to "expert"). Last, participants were asked to express agreement/disagreement with a total of 17 Open science-related statements on a 5-point Likert scale (from "Completely agree" to "Completely disagree"). The survey questions were developed in a local instance of LimeSurvey hosted by TU Graz. The access link was mailed to participants using project-internal mailing lists. The survey was kept open for two days, after which the dataset was downloaded in an Excel-format (.csv) and then imported into SPSS 25. The data were cleaned and analysed (mostly) descriptively. Data analysis is based on frequencies and mean values of key variables.

In total, 23 responses were received. All respondents are employed by universities or other higher education institutions, in various roles ranging from research-related roles (48%) to administrative (8%) and support staff (4%). Respondents in management/leadership roles comprise 40%. All respondents have an academic background. 60% of respondents hold a doctorate, 24% hold a master's degree or equivalent, and 16% hold a habilitation (academic teaching qualification or second doctorate). Familiarity with Open Science practices is average (mean: 2.79). 41.7% consider themselves novices or only somewhat familiar. Respondents express great interest in learning more about various aspects of Open Science. Interest in learning more is high across all subfields of Open Science (mean between 3.92 and 4.74 on a 5-point Likert scale). Overall, interest is highest for Open Peer Review (mean=4.74), Open Access Publishing (mean=4.52), and the FAIR principles (mean=4.46). In total, 15 respondents identified themselves as researchers; all of them answered (most of) the questions concerning OS in their research practice. Respondents report average levels of ascent to Open Science principles (e.g. data sharing, reuse of available data) in their work. Making data accessible (mean=3.60, 5-point-Likert scale) and making research outputs reusable (mean=3.60) is a priority for only half of the respondents. The same holds for data sharing and data reuse (mean=3.07). 34.7% submit a DMP. 66.7% publish in OA journals wherever possible (mean=4.00). Only a small number of respondents attend or give OS training (mean=2.57 and 2.07, resp.). Only one fifth of researchers in the sample publish preprints (mean=2.07).

4.2. Methods: Requirements Gathering Workshop

EU experts from TU GRAZ, UCA and EIFL conducted two Open Science online training workshops hosted by TU Graz and EIFL (March 2021) and UCA (June 2021) which were used to gather requirements for Open Science Training. This report summarizes the findings of these requirements gathering exercises. Requirements were collected using field notes and recordings of the sessions. For all sections of the workshop, discussion prompts prepared in advance were used. The following section describes the workshop on OS training requirements led by I. Kuchma. The workshop started with introductory lectures about Open Science to ensure a common knowledge base among participants to enable later discussion as well as a short introduction to the OPTIMA training plan and training needs. In particular, the instructor reminded participants of the OPTIMA objectives to:

- Update existing Master and PhD level academic courses by adding new courses on OS such as:
    - Open Science Practices (PhD level)
    - Open Science in Ecology (Master level)
    - Open Science in Information Management (Master level)
    - Open Science in Biology (Master level)
    - Open Science in Chemical Technology (Master level)

During the workshop, participants were able to interact with presenters (and each other) and contribute to the workshop either via microphone or via chat. Both recordings and field notes were used to document the workshop proceedings. After the introductory lecture, participants were divided into two breakout groups tasked with sharing their best and worst experience with (online) courses.
Following additional input on Open Science training objectives and rationales by the instructor, participants were invited to join “pair and share”-breakout sessions (in Ukrainian and English) to brainstorm on learning objectives and outcomes as well as (potential) training programme structures. Specifically, participants were asked what types of training and support they would need in order to be able to meaningfully participate in Open Peer Review as well as other Open Science practices. In particular, participants were asked to jointly reflect on the following questions:

1) Standalone courses or parts of existing courses?
2) Audience for Master level courses – students of ecology/information management/biology/chemical technology or any student in your university interested?
3) Optional or mandatory courses?
4) Same course structure for all courses (with disciplinary differences of courses) or different structure for different disciplines?
5) Online or face to face?
6) Duration of courses
7) Format: interactive lectures, seminars, practical assignments
8) Who will teach them?

The exercise was followed by a more extensive plenary discussion to illuminate next steps for Open Science training in OPTIMA. The workshop ended by closing remarks and a wrap-up of the requirements gathering exercises. Following the workshop, both breakout sessions as well as plenary discussion recordings were used to edit and amend the field notes that were taken throughout the entire workshop. The revised field notes of the plenary discussions and breakout sessions were then organized into categories to ensure a systematic overview for later analysis. The following section describes the outcomes of the requirements gathering workshops in detail, developing recommendations based on the conclusions we were able to draw from the material.

5. Elements of Open Science Training: Results of the Requirements Gathering Workshop

5.1. Institutional Constraints and Conditions in Ukraine

5.1.1. What is specific about Ukrainian academia?

The workshops taught us two main lessons with respect to Ukrainian academia:

1) Universities in Ukraine have a lot of autonomy and are therefore at liberty to act individually and
2) decisions are made or influenced by several institutional actors or (political) stakeholders.

Institutional constraints and conditions in Ukraine enact enormous influence on the implementation of OS training. Ukrainian HEIs enjoy autonomy, which can be expected to have an impact on implementation. However, since the OPTIMA project is supported by the top-level university management at LPNU and other Ukrainian HEI partners, course adoption can be expected to run smoothly. Therefore, several specific pathways for implementation need to be considered as well as different institutional actors and (political) stakeholders to obtain an adequate roadmap for OS training implementation in Ukraine. Processes of OS implementation are generally implicated in a number of interconnected pillars, as workflows, rules, success metrics and recognition of (online) courses differ between institutions. As has been stated in the introduction to this report, the situation in Ukraine is further exacerbated by the phenomenon of soc.- "displaced universities". These institutions experience additional resourcing issues which entails that adding courses to their curricula can be even more challenging (e.g. in terms of getting accreditation etc.). Moreover, universities impose different regulations, have strict systems and curricula and depend on politics and local circumstances. As one workshop participant pointed out, the consortium does not focus on universities exclusively. University autonomy and institutional differences have a tremendous effect on the degree of implementation of OS courses, because curriculum development is controlled by universities which entails that implementation of OS courses depends, among other factors, on the political will of each institution. Some institutions might not be supportive in terms of introducing OS courses. Moreover, even if some universities are willing to offer OS courses, differences between faculties might complicate homogenous and comprehensive implementation of OS training. Some departments might choose to offer discipline-specific OS training modules, some might choose not to offer any OS training. In some instances, courses will not be specific to departments.

5.1.2. Implementation pathways

Because universities are in a position to shape curricula independently, this autonomy will have to be taken into account in the proposed pathways. As a consequence of university autonomy, internal goals matter a lot for implementation procedures. Strategies for implementing OS courses might serve to overcome or reduce barriers. A viable strategy would have universities decide autonomously but report decisions in coordinating meetings where universities could also outline accomplishments, readiness, degree and needs for OS training implementation. Therefore, this report will describe potential scenarios/models for implementing OS courses to universities. Workshop participants identified four models for Open science implementation that can be described as

1) top-down-implementation
2) bottom-up-implementation
3) bypassing (external)-implementation and
4) implementation/facilitation via gatekeepers.

Each implementation pathway depends on multiple factors (internal and external) that are explained in what follows. Which of these four implementation strategies to choose strongly depends on the access/avenue. Implementation pathways are presented below.

The first model involves top-down implementation, which is only tangentially related to university autonomy. There, university management (the rectorates) adopt OS training and mandate its implementation, e.g. through the ratification of respective policies. This approach has been practiced very successfully for aspects of Open Science, such as Research Data Management, by institutions such as TU Delft and TU Graz.

Bottom-up implementation is the default mechanism practiced when there is not much institutional support for the aims of Open Science. Starting with people in the field, occupying lower ranks in the university hierarchy is crucial to bottom-up implementation of OS training as they could offer training as well. Difficulties could come along with deep integration of OS and might be overwhelmed by commitment from individual professors. Deep integration might only be feasible for one individual subject within (at least) one university within the consortium. However, some workshop participants pointed out that the additional workload allocated to the new OS subjects would draw from resources possibly required elsewhere; this might cause resentment due to possible additional workload required on the part of instructors.

Another, slightly different, solution would bypass universities, departments, institutions and instructors altogether via the libraries. This constitutes an external strategy for OS implementation; however, it entails several issues and might be better suited as an additional implementation strategy. As a general strategy, however, participants felt that this pathway would be difficult to implement as most Ukrainian universities do not offer library training at all. If doctoral schools were to allow libraries to offer courses, special arrangements would be needed first. In general, a potential role in implementation depends on the level of support already provided, such as support services for academic staff and training in e.g. Open Access publishing. In general, then, involving the libraries will significantly improve the overall strategy, even though it must be stressed that libraries are not ready to deliver by themselves and that librarians are regarded as purely technical positions in many cases (Nice workshop day 4, field notes).

A fourth, and more promising, route would employ gatekeepers to coordinate OS training implementation. Gatekeepers, contact persons and coordinators could be relevant as this would not involve the creation of new curricula. Additionally, gatekeepers could be integrated from the very beginning.

5.2. Levels of integration: Modular approaches to Open Science training

5.2.1. Gatekeepers, contact persons, and coordinators

Participants agreed that finding or nominating gatekeepers as OS champions will be essential for OS training implementation. One viable suggestion in this direction was to include (external) guest lectures into research methods courses in each subject, thereby linking OS explicitly to research methods. This would be an elegant strategy as it would bypass creating new curricula from scratch, as this would build upon existing courses. Baseline integration of OS (within at least one university of the consortium and at least one general OS course within each university) could be implemented via such guest lectures. Implementation of general, introductory OS training constitutes a minimal requirement within the project. Another advantage consists in the possibility of multiple actors at the university acting as gatekeepers. These individuals will have to be identified by the consortium members in due course, i.e. each institution is required to decide who will be leading that activity. For this, a list of email addresses of each person who will be leading this accreditation/implementation at each university is needed. Gatekeepers could also act as informants for the consortium to report on the state of play at each institution. Ideally, the consortium will identify more than one person per institution. The consortium feels that as a baseline, at least three people who are already involved in conversations and who are attending OPTIMA project meetings would be necessary per institution to build a meaningful number of gatekeepers.

Gatekeepers will usually be department members by default. This can be exploited in the sense that these individuals will also be responsible for communicating the OPTIMA aims and approach to the universities/university management. Teaching and learning departments might act as a relevant additional gatekeeper as it is implemented in the university's culture and structure, as they are also responsible for coordinating the process of, and changes to, curricula. Therefore, participants agreed that involving the teaching and learning department would be helpful. A link between institution and teaching and learning for implementing OS in graduate programmes and so on could be an option.

In terms of doctoral studies, departments and faculties differ in some cases. In some cases, doctoral programs are organised around doctoral schools, but this is not always the case. At any rate, given the importance of OS training at the doctoral level (see below), doctoral schools and the respective departments/faculties need to be on board as well. In terms of process, Ukrainian partners should already identify contact persons who will be involved in teaching courses and who should be included in the requirement and deliverable for review and in the courses. Even where universities, departments and faculties are ready to offer OS training, the issue of how to integrate five courses in five study programmes remains. A potential solution involves development of a single general introductory course with additional, discipline-specific modules on top. Introduction of new courses also involves creating new standards for programmes. Here, participants pointed out that as the Ukraine has recently introduced new PhD programmes, this might facilitate adding courses on Open Science.

5.2.2. Open Science training: Optional or mandatory?

Participants agreed that Open Science training should be part of the general higher education system in Ukraine. To begin with, target groups and circumstances need to be clarified. Access to OS courses for students and early career researchers and conditions for implementation of OS training were broadly discussed by participants. Students having full access to any general (basic) OS course throughout the university is desirable, but not always possible (see below). Furthermore, general online courses on OS should be open to anybody with an interest in the subject. In particular, where OS training is offered in the form of online courses, these should be open to 1) undergraduate students 2) graduate students, and 3) to anyone who graduated from university and is just interested in Open Science (e.g. PhD students, postdocs, and other professionals, e.g. industry researchers). (Introductory) OS courses should be integrated with training in good scientific practise. Careful consideration needs to be placed on the level of integration with existing curricula,

i.e. whether to make OS training mandatory or optional for instance, for whom, and at what level of granularity. These considerations will impact the content and level of implementation, e.g. whether departments will be asked to offer discipline-specific training. Some universities are flexible with respect to introducing courses that are optional for students while also being creditable in transcripts and records.
Making OS training optional was regarded as advantageous, as this would allow for early contact with Open Science practices, e.g. already at the undergraduate level. There are a number of downsides as well, such as the problem of allocating credits to OS training within existing curricula. Participants have sympathies for working with “baseline” mandatory courses offering general Open Science training (e.g. introduction to aims, concepts, practices) that can then be amended by additional discipline-specific modules that departments can deploy as they see fit. According to some participants, incorporating OS training into general courses (as an add-on to existing courses) would be easier than in specific courses and hence a general course with modules would work well. In this model, each university would offer general-level courses on OS and allow departments to tailor them to specific disciplinary needs, e.g. by offering additional, specific modules. This approach was deemed feasible in terms of resources and political will. Additionally, at least one general introduction to OS practices and principles would need to be made obligatory and offered as a baseline. This part of the modular approach might be associated with specific problems, e.g. finding an institutional host for such a baseline course and finding dedicated instructors. This way, each university would introduce OS training at a very general level at a minimum. Defining minimum requirements might reveal that there might not be much content left to make optional, aside from observing disciplinary differences in the adoption of open practices.

As a start, universities could offer a broader range of general courses to choose from. At this stage, there is also a pressing need to consider potential difficulties of implementation at the institutional level. Regarding accreditation, surveying each university about prospects of accreditation is necessary to gather information about potential difficulties associated with accreditation at each institution. A different but related strategy would involve developing a set of modules where each department would then be able to mandate certain modules (with mandatory introductory modules). As has been suggested in the Nice workshop, the system of electives at all levels could be a viable gateway for introducing Open Science training (Nice workshop day 4, field notes).

5.2.3. Modular Open Science: Introductory and discipline-specific courses

In the view of the authors of this report, there is indeed a baseline knowledge in Open Science and research integrity that will be similar for all OPTIMA case disciplines. This should form the basis of a general introduction to Open Science and its aims, principles, and concepts and be integrated with the use of the Open Science Handbooks (see the respective section below). The lecture format might itself be problematic, however, as this poses the question of which departments[1] would host such a lecture (or whether this needs to rotate, say). This was not discussed during the workshop where it was only pointed out that a possible workaround involves hosting such a course at the library and offering specialized, discipline-specific courses to cover (open) research practices. This kind of training would (presumably) come in later in the curriculum as it presupposes a certain familiarity with the research process already. The ability to present openness and transparency as the default mode of doing research might be a definitive advantage of this approach. Once

[1] Research methods, in particular open methods and digital research are no longer coextensive with disciplinary boundaries. This needs to be taken into account when designing introductory Open Science courses.

students reach the postgraduate level to pursue a doctorate (or alternatively, work in industry research and are interested to learn about Open Science), applying Open Science principles and practices should be a matter of course. Hence, any *Open Science training offered at the PhD level needs to be mandatory*. A workshop participant pointed out (Nice workshop day 4, field notes) that training in good scientific practice seems in many ways to resemble training in workplace safety or cybersecurity in the important sense that all three seem to have low retention levels on the part of students. The knowledge about research practices (especially with respect to literature search and databases) at the more advanced levels (e.g. at the graduate level) can be an indicator here. This seems to be a considerable downside of mandatory training in good scientific practice and use of knowledge infrastructures. In both cases, there appears to be a rather large resistance on the part of students to absorb this knowledge. A possible solution would be to incorporate elements of training into other courses (Nice workshop day 4, field notes).

It is important to point out (Nice workshop day 4, field notes) that the general (introductory)/discipline-specific distinction is not the same as the distinction between open science training at the undergraduate/graduate/postgraduate levels as we can expect different levels of urgency/interest in Open Science training from, say, PhD candidates versus undergraduate students. There is then a sense in which Open Science training needs to be introductory resp. general even when delivered at the postgraduate level (Nice workshop day 4, field notes). Since OPTIMA needs to deliver *subject-specific courses*, using these for *digging deeper into specific disciplines and to consider discipline-specific tools was deemed a viable strategy* (Nice workshop day 4, field notes). As an example, *discipline-specific topics would cover study pre-registration, discipline-specific data types, and discipline-specific repositories*. Such a concept would focus on additional values for the students hidden behind the course.

There is a class of baseline skills that need to be mandatory, such as computer use competencies, correspondence in English (in terms of the ability to ask an author for a copy of the article). Whether typologies of search engines fall into this category as well is an open question. The same is true for types of scientific papers, online tools and repositories which can count as basic knowledge in a way but will have to be discipline-specific.

General introduction to Open Science would best be placed in an early semester, but not right at the start (Nice workshop day 4, field notes) to give students time to develop a general picture of how research works. Otherwise, concepts like FAIR data might be difficult to grasp. This will need to be squared with the requirement to implement Open Science in a way that echoes the sentiment “Open Science is just science done right”, however, as the proper way to conduct research. Over time, establishing continuity in teaching open practices will be key. This will enable a progressively more hands-on engagement with open practices from the very start, e.g. when students produce FAIR data and subsequent are then asked to locate and reuse these data.

At any rate, the new subjects on Open Science need to reflect the general approach to teaching science by doing science (Nice workshop day 4, field notes). At present there is a gap in teaching students how to use resources for data. The aim of OPTIMA is to teach students a new approach of doing just that. Before labelling this as “Open Science”, universities need to make sure that students understand the baseline before switching to the new model.

5.2.4. Integration into existing courses

A more holistic solution was discussed that involves integrating OS training in specialized courses in Ukrainian. In addition, adding OS training elements to existing curricula might be more lenient on resources while preserving the perception of Open Science as an important part of good scientific practice. This will help the perception of open practices as "just science done right" way, OS training could be incorporated into each subject and not be perceived as something on top of existing curricula, in addition to saving universities the trouble of creating new courses from scratch. Making OS training optional and open to all students was discussed but dismissed. This could be interesting to students with a more general interest in, say, scientific practices from fields other than their own, but participants also acknowledged that some disciplines might oppose this strategy, not least because instructors themselves have a stake in curricula development. Indeed, teaching open science practices can be demanding on instructors' skills. This needs to be taken into account when deciding on who will offer Open Science training (which faculties, departments, individuals). Most have their specialties that they would like to see represented within curricula. This could be problematic as Open Science skills are of a more general nature (in the sense that good scientific practice is no-one's specialty in particular). On the other hand, this could provide degrees of freedom in terms of implementation, as it suggests gradual integration of OS training courses as another viable option.

As a start, participants suggested that Open Science courses could be offered separately and for a general audience (instead of developing discipline-specific OS training right away), with evaluations each year, to add discipline specific courses/modules. Participants were in favour of teaching different levels of familiarity with Open Science at the graduate and postgraduate level. Since many graduate programmes are not intended solely for people wishing to pursue a PhD, the expectations in terms of Open Science practices can be lower compared to postgraduate students pursuing a PhD, although this does not mean that graduate students should leave without a baseline understanding of Open Science. This falls in line with the suggestion, made above, to regard Open Science training simply as training in good scientific practice. Therefore, we recommend *general-level Open Science training combined with discipline-specific modules* as a viable strategy.

As was pointed out during the Nice workshop, the adoption of Open Science practices is intimately linked to PhD research within a specific research group ("learning by doing"). Hence, promoting open practices will to a large extent be the responsibility of PIs. While this has certainly been recognized by universities in their attempts to regulate research data management, this is not within the scope of OPTIMA. At any rate, this strategy would only reach PhD candidates who are employed at a particular institution. (Nice workshop day 4, field notes) In this context OPTIMA might envision a qualification programme for PhD supervisors how to supervise within an Open Science landscape. This might prove elementary in that supervisors have a fundamental role in teaching open practices by their own example (Nice workshop day 4, field notes).

5.2.5. Summary: Standalone courses or parts of existing courses?

To summarize briefly: After careful consideration of advantages and disadvantages of various implementation strategies, participants suggested the following pathway for integrating Open Science into existing curricula. As has been said, participants agreed that Open Science can either be integrated in the form of general (introductory) courses - to be supplemented with discipline-specific modules where needed - or several, discipline-specific courses (or a combination of both). Participants agreed that for students taking Open science as part of their major it would be best to make the course mandatory, while making it optional for everybody else. A general Open Science course would provide an excellent starting point that could then be adapted by different faculties, institutes or disciplines according to their specific needs. Beyond that, considering difficulties and workload is essential in terms of introducing new subjects. As a KPI, the recommendation is to implement at least one specialized (discipline-specific) course in every University, in addition to a general introductory course. In terms of project aims, a higher degree of integration in existing curricula is desirable. Another but related issue pertains to the institutional thrust of some courses which may belong to some field of expertise within a particular institute that may already have a stronger stake in providing OS courses.

5.3. Open Science trainees: Students, postdocs, professionals

5.3.1. Open Science beyond academia

Besides students from the undergraduate to the postgraduate level, Open Science training may be of interest to a group loosely connected to academia, i.e. industry researchers. In general, the need for OS courses for professionals e.g. in industry and medical fields could be seen as a problem, a participant highlighted. This follows from the fact that universities are expected to train future scientists as well as professionals (see e.g. Stichweh 1993) whereas Open Science, strictly speaking, is geared towards the needs of science more narrowly conceived[2]. However, when providing training this means that many course participants won't end up pursuing academic careers, as when students e.g. plan to become veterinarians. As OS practices are about research, participants pointed out that OPTIMA needs a strategy for those students as well (or at the very least, give recommendations on the extent to which they should receive OS training as well) This is certainly more of an issue in some fields than others. Additionally, the "leaky pipeline" phenomenon means that most of those people who are studying, say, chemistry as a Postdoc will nevertheless end up in industry. However, possibilities and demands with which these groups are faced are completely different (industry versus research). On the other hand, industry researchers are researchers just as well. The important question thus concerns the extent to which students can be expected to engage with science later in their careers, which seems to depend heavily on the field. Participants agreed that this is very likely for graduates working in industry research. The extent of the phenomenon is large. The question of how to deal with these students seems even more pressing when moving from general-education institutions (universities) to applied universities. However, the OPTIMA consortium partners feature general and technical institutions exclusively[3], so at least within the project, this should not pose a problem.

[2] R. Merton (1973) claimed that science as an institution is guided by a certain set of norms. Important to our purposes, one of these norms is disinterestedness, which in essence refers to the fact that unlike professions (lawyers, doctors, engineers, etc.) scientists do not serve (external) customers, i.e., the outputs of science (in the form of publications) are only interesting to other scientists. Of course, this view has come under criticism seeing how science is increasingly expected to provide actionable expertise (critically: Nowotny et al. 2003).

[3] LPNU is a technical university but offers a wide range of programmes, SUMY State Uni is a comprehensive university, Lutsk NTU is a technical university, and Donetsk University is also a comprehensive university.

5.3.2. Undergraduate publications

Offering OS courses for PhD students exclusively was roundly rejected, because OS practices are certainly relevant at earlier stages as well. In Ukraine, publishing papers already at the bachelor and master level is mandatory for students in order to get their degree. This creates a demand for Open Science training (and training in research integrity more generally) already at the undergraduate level. Some participants pointed out that Open Science training should start as early as possible which is warranted given that Open Science is not about doing science differently, but properly, and so is simply part of good scientific practice; therefore, presenting Open Science practices as something over and above more traditional, closed practices might threaten to plant the idea that Open Science is indeed an optional add-on. In terms of integration, universities could start with optional Open Science training at the undergraduate level and mandatory Open Science training starting from the graduate level.

Building upon the suggestion, discussed above, to make OS training optional for undergraduate students, it was suggested that OS courses could be linked to the preparation of Master theses (for which there already are dedicated courses). This could be credited along with the credits received for preparing the thesis. A separate track for doctoral schools was suggested. Participants pointed out a potential trade-off especially at the PhD level between additional courses and the demands on producing original research. This entails that participants were somewhat split on the question whether to introduce more courses at the PhD level.

5.4. Course Content, Format, Structure, and Duration

5.4.1. Online versus face-to-face courses

Overall, participants agreed that both online and face-to-face formats have their merits, and that given the current situation, there is a certain urgency attached to developing online formats (at least as an addition to face-to-face formats). For example, master-level courses could be offered face-to-face by default and converted to online formats if required by circumstances. This is especially poignant given the current situation (as of July 2021) regarding the Covid-19 pandemic. Given the aims of Open Science, some participants made the case that courses should be online by default, to which others replied that the aim is to plan for face-to-face teaching or at least hybrid formats. This is indeed crucial as many participants felt that the project needs to prepare for situations such as the pandemic. In conclusion, participants were in favor of offering both (which is something OPTIMA is anyway expected to deliver). Going both routes might prove problematic in the sense that there might (need to) be overlaps in content between online and offline formats, a problem that will need to be taken into account when developing the Open Science handbooks (due M18) (see the recommendations for the course contents below) as well.

5.4.2. Course Duration and ECTS credits

Universities need guidelines for how to recognize Open Science training. Participants agreed that students need to be able to receive ECTS credits for Open Science training. This decision lies with the departments, however, which enjoy autonomy in deciding how many credits to award for courses. For instance, participants pointed out that in those courses viable for OS training implementation, the standard is around 12 ECTS credits. Participants pointed out that with the Bologna reform, students are expected to spend more time in courses which means they are given less time to pursue research (in the form of writing theses). This means that OPTIMA should recommend a strategy that does not add ECTS credits to already high course workloads while of course recommending adding open science training. This might prove problematic as it could involve a trade-off between Open Science and other course content (which might produce resistance from instructors/departments, see above). The procedure would have to be different for the online course. For instance, an online course on introductory Open Science would need to be evaluated by every university allowing students to take the course, relative to the university's requirements to determine how many of these credits would be counted. Differences in crediting systems between universities, especially between graduate and PhD courses could be an issue. In terms of duration, the aim is that the course accreditation recognizes between three and five ECTS. In some places, preparation is already under way and could serve as a role model. E.g., one participant pointed out that their institution already prepared a draft programme for PhD candidates worth 3 ECTS credits. Workshop participants agreed on a *joint effort for three credits which universities could then customize* according to their workflows and needs (where 5 ECTS credits is the minimum for Master theses nowadays).

5.4.3. Format

Course format is another salient issue. Participants' suggestions were diverse, ranging from interactive lectures, seminars to the inclusion of practical assignments. In terms of offering a more practical, hands-on training in FAIR data management, participants suggested lectures and practical or laboratory lessons taught by PhD students. Open Science tools and services could be one of the topics for lectures and practical assignments. Whether or not the structure of all these courses should be the same across disciplines was left open; there will need to be greater variation at the more advanced levels, i.e. introductory courses can be similar across disciplines. A viable strategy could be to develop a course to build upon by introducing discipline-specific aspects (e.g. specific data formats, databases, and research practices). This could entail a customizable course with basic content for all disciplines and discipline-specific examples and hands-on exercises. To wit, an introduction to the FAIR Guiding principles can happen in a similar way across disciplines, but examples to illustrate FAIR data management would probably have to be discipline-specific to accommodate students' different backgrounds and experience. Participants suggested a proportion of ⅓ specific examples on top of general instructions that should be customizable, i.e. an OS core module amended by examples from the discipline along with practical exercises with different tools from that discipline.

6. Beyond Academia: Development of Training Handbooks for Open Science

6.1. Aim

An important aspect of developing OS training concerns developing appropriate training materials and resources. As the Open Science landscape already has a variety of OS training resources on offer, the authors of this report expressly recommend not to reinvent the wheel. Rather, we wish to give directions on how to make the best use of the available resources. The recommended strategy will be to use existing materials as a starting point to producing an Open Science Training Handbook in Ukrainian which will contain an overview of aims, concepts, practices, and tools for Open Science in an accessible format to be used as a resource by instructors and students alike. Ideally, this handbook would comprise a comprehensive resource. Given the thematic focus of OPTIMA, the handbook will then feature specialized sections on discipline-specific open science practices and tools as needed, to be featured in the form of addendums. This mirrors the modular approach to Open Science training recommended above, as these modules/addenda can be easily combined for different disciplinary training needs. As a minimum, the handbooks should feature structured advice for students, researchers and other employees and hands-on guidelines for all participants of scientific and educational processes (Nice workshop day 4, field notes).

6.2. Preliminary Work: The Open Science Training Handbook (Heller et al.)

There are a number of resources available to guide Open Science training, such as the vast materials developed and popularized by FosterOpenScience or Eurodoc. While all these materials will be relevant, The Open Science Handbook[4], written in 2018 by a consortium of 14 authors provides an excellent starting point in our opinion. The text is organized around Open Science Basics, Training, Organizational Aspects, with a chapter collecting examples and practical guidance, and is written as an Open Educational Resource with an open license (CC0 1.0 Universal). The OS Training Handbook provides an excellent starting point here as it is already geared towards teaching and instruction in matters related to Open Science, following a train-the-trainers approach. It provides ample materials to those seeking to instruct others in Open Science practices. Since the field of Open Science is moving fast, providing the contents in a format that is easily updatable is preferred[5]. The Open Science Training Handbook

> "offers guidance and resources for Open Science instructors and trainers, as well as anyone interested in improving levels of transparency and participation in research practices. Supporting and connecting an emerging Open Science community that wishes to pass on its knowledge, the handbook suggests training activities that can be adapted to various settings and target audiences. The book equips trainers with methods, instructions, exemplary training outlines and inspiration for their own Open Science training. It provides Open Science advocates across the globe with practical know-how to deliver Open Science principles to researchers and support staff. What works, what doesn't? How can you make the most of limited resources? Here you will find a wealth of resources to help you build your own training events." (https://www.fosteropenscience.eu/content/open-science-training-handbook)

[4] https://www.fosteropenscience.eu/content/open-science-training-handbook The text is citable via the following DOI: https://doi.org/10.5281/zenodo.1212496.

[5] At present, the handbook is maintained in the form of a GitHub repository: https://github.com/Open-Science-Training-Handbook. This or a similar strategy is highly recommended here as well.

Practically for present purposes, the book is already designed in a modular way which will facilitate discipline-specific content to be developed by the consortium. The chapter on "Open Science Basics" presents the content of the training and is equally structured into smaller modules that can be combined according to interest or prior knowledge. Chapter 3 gives an overview of learning and training in general which may be of special interest to those not vested in training methods in general, as it contains (among other things) practical tips for designing training. This is amended by chapter 4 which provides useful tips and information about organizational aspects of (Open Science) training. The Open Science Training Handbook contains a very helpful glossary of all relevant Open Science terminology. Discipline-specific addenda (already in Ukrainian) can then be used to add flesh to the rather more abstract discussions of Open Science principles and terminology and to provide resources to trainers and students alike, e.g. in terms of (meta)data formats, repositories, data citation standards, etc., anything that might be relevant to Open Science practice.

The Passport For Open Science[6], coordinated by the University of Lille will also be reused to produce the text of the Ukrainian Handbook. This guide was designed to accompany PhD students at every step of their research career and at all disciplinary fields and provides a set of tools and good practices that can be directly implemented. The visually appealing guide includes the following chapters: Planning an open approach to scientific work: Using freely accessible resources; Research Data Management planning, Working in a reproducible way: For yourself, for others; Disseminating research: Disseminating your publications in open access, Making your thesis openly available, Making research data open; Preparing for after your thesis, join the movement: Deeply rooted public policies, Evaluating research differently; Act now; Going further; Glossary and Sources.

In addition, we will consult the Open Science Guide of Guides[7] - a compendium of Open Science guides outlining their specific features and fields of application. The book was made as part of a student seminar at the Hannover University of Applied Sciences and Arts in close cooperation with the TIB Open Science Lab as part of TIB Book Sprints R&D.

OPTIMA will follow the writing sprints approach to create the Handbook.

6.3. Strategy: Update and translate the Handbook

We believe that the Open Science Training Handbook in its current form provides an excellent starting point. The text was written in 2018 and would likely have to be updated. As part of the strategy proposed here, we recommend that *the consortium put together a working group tasked with producing an (authoritative) Ukrainian-language OS Handbook reusing content from the existing handbooks* listed above. In addition, we will need *five disciplinary working groups to develop the addenda* about disciplinary open science practices. Translating the glossary into Ukrainian provides an indispensable starting point for further work, as most of the concepts in use do not have non-English equivalents. From there, we recommend building/translating the relevant sections on Open Science basics into Ukrainian, as these will form the basis of introductory Open Science courses.

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[6] https://www.ouvrirlascience.fr/passport-for-open-science-a-practical-guide-for-phd-students/

[7] See https://zenodo.org/record/4740163 and https://github.com/TIBHannover/open-science-guide-of-guides, respectively.

As has been pointed out in Nice (Nice workshop day 4, field notes), the consortium will rely on a host of Open materials in developing the five Open Science handbooks. The aim will be to create five Ukrainian-language Open Science handbooks, building upon existing materials. Importantly, discipline-specific aspects should come from discipline-specific examples throughout the text. I.e., the basic handbook contents should be the same across all OPTIMA target disciplines, but the examples given should be discipline specific.

7. Roadmap: Recommendations for OS Training Implementation at Ukrainian Universities

7.1. Development and Integration of OS Courses

7.1.1. Identification of Open Science Champions

We recommend that Ukrainian partner institutions already identify contact persons at departments who would act as gatekeepers to support us in communicating with the institution and to push OPTIMA's agenda, in addition to championing Open Science practices more generally. Gatekeepers can be those who will eventually be responsible in implementing Open Science training (most likely as instructors). During the initial implementation phase, the consortium will also need their support in gathering requirements and constraints (e.g. regarding accreditation processes). As a start, we recommend partners identify individuals whom they see fit for this task and provide their contact details in a dedicated form (to be provided). In particular, we as a consortium should compile a list of email addresses of persons who will be leading the accreditation/implementation process at each university. These individuals will also be contacted to find out where each institution stands and be responsible for overseeing implementation (on the part of OPTIMA) at each institution. Given OPTIMA's schedule, we recommend that these individuals be involved in our conversations as soon as possible. In addition to Open Science champions and gatekeepers, the teaching and learning departments at each institution need to be brought on board as well as they are responsible for coordinating curricula and study programme changes and can therefore be consulted regarding course development and accreditation procedures. In addition, the consortium needs to be in touch with those responsible for teaching at the faculty level as well (via the gatekeepers) but also at the institutional level. Finally, the consortium needs to involve the doctoral schools (where they exist) into this conversation regarding Open Science training.

7.1.2. Integration of OS courses

In terms of integrating Open Science into curricula, we as a consortium must be mindful of the following issues. It has been suggested multiple times that there is a need for general, introductory Open Science courses. While the authors of this report support this idea, it does raise some additional questions regarding feasibility, such as the issue of institutional links. There might be institutions where it would be possible to offer such a fundamental training at the faculty level, but in some instances, this might not be feasible and so, the departments would have to offer introductory Open Science lectures. There may be (dis)advantages to both strategies. In general, where possible we recommend offering introductory open science courses for the entire institution (and think about where they should be located/who should be in charge) where possible. Where necessary, these courses can be offered at the departmental level (e.g. "Good Scientific Practice for social Scientists", "Good Scientific Practice for Computer Scientists", "Good Scientific Practice for Engineers" etc.) with additional modules for discipline-specific practices (at the Master and PhD level). Given the need to change existing curricula, our recommendation is to go via already existing content/courses on good scientific practice where we expect there to be similarities and across faculties but differences between larger fields (e.g. research ethics will turn out differently in the social sciences versus the natural sciences). Here, the introduction of a university-wide module on "Good Scientific Practice" could be a good strategy - there would probably need to be dedicated instructors from each faculty or possibly department.

7.1.3. Incentives

At any rate, all of the following recommendations suggest mandatory introductory courses early in the curriculum and mandatory discipline-specific courses later in the curriculum. Of course, this does not preclude additional (optional) training on top. In terms of resources, integration into existing curricula would be best (e.g. by including OS practices into modules on good scientific practice for instance), as both students and instructors have incentives (although different ones) to oppose additional courses. For students, additional courses would mean additional workloads on top of already high workloads in terms of course participation and writing their theses; departments and faculties would have to find resources (time and, ultimately, money) to devote to offering Open science training if this means additional credits for students.

7.1.4. Content: Introductory Courses

1 Module of, e.g., 8 ECTS Credits, i.e. 2 Lectures/1 lecture and 1 seminar

Good Scientific Practice/Research Ethics (why cite research etc.)

Open Research Practices (Open Access, Open Data, Open Software, Reproducibility, Open Licensing, Open Evaluation, Open Science Policies, Open Educational Resources, Open Innovation

All introductory courses should be in Ukrainian to the extent possible; the same is true for more advanced courses training students in disciplinary open practices, even though we are aware that graduate/postgraduate programs might be offered in English anyway. As one of the future tasks of this project involves development of an Open Science MOOC, integration of (offline) training and (online) resources will have to be discussed. To wit, the materials offered in the MOOC will also be offered in Ukrainian to reach a broad Ukrainian audience, as well as the training handbooks which will be in Ukrainian (see above).

In terms of learning outcomes, we envision the introductory courses to cover broad aspects of Open Research practices and how they relate to considerations of research ethics and integrity. Students should be familiarized with research practices and ethics more generally and understand how these considerations are embodied by open science practices. Above such considerations, students will need to be familiarized with the (what can often be quite demanding) Open Science terminology.

7.1.5. Content: Discipline-specific Modules

Open science training for advanced students should primarily be organized at the level of faculties or departments, depending on where the respective studies are (primarily) located. We recommend that the respective courses primarily involve training in Open Science practices and principles as they relate to discipline-specific research practices (data types, formats, etc.). This entails that discipline-specific training should be developed predominantly by the departments according to their needs, but in line with the aims of training in open practices. Where this will eventually be organized at each institution depends, among other things, on where study programmes are based respectively which departments are in charge of curriculum development for a given programme. We expect there to be overlaps between study programmes and fields in terms of open practices and hence, for the need for specific training. In the most general terms, discipline-specific training involves data types, file formats, metadata, data access & persistent identifiers, data licenses, repositories, data standards (community, cross-discipline), data quality, legal/ethics, data reuse, FAIR software, DMPs, publication venues, to name but a few. At this level, training will be informed by the way each discipline is organized in terms of the research, publishing, and evaluation processes. We expect that at this stage, at least two courses with a combined number of (at least) 8 ECTS credits would be needed to cover all these aspects sufficiently.

7.1.6. OS Training Handbooks

As has been described above, we recommend the Open Science Handbook as point of departure, to be translated into Ukrainian and amended by discipline-specific modules. We recommend that working groups be formed for both these tasks, one comprising members of the entire consortium to translate the handbook starting from the glossary of key terminology, and separate, discipline-specific working groups to compile and draft amendments on discipline-specific open practices. Given the fast-paced development of Open Science tools especially, using a more flexible approach to writing the handbook such as a wiki or GitHub repository is highly recommended for easy updating. This content should then be complemented with disciplinary-specific examples and modules addressing the target outlined in the OPTIMA workplan.

7.2. Priorities for the next 12 months

1) Identification of Gatekeepers (individuals and institutions within universities)
2) Survey of participant institutions regarding accreditation & course development
3) Development of course content for an introductory course (plus a collection of training materials)
4) Development of discipline-specific modules for each of the OPTIMA use cases
5) 1 Working Group to translate the OS Handbook into Ukrainian
6) 1 Working Group per use case to develop discipline-specific modules (in close connection to the development of course content)

8. References

ALLEA (2017). The European Code of Conduct for Research Intregrity. Revised Edition. ALLEA – All European Academies. Berlin. Retrieved from: https://ec.europa.eu/research/participants/data/ref/h2020/other/hi/h2020...

Cabinet of Ministers of Ukraine (2019). Program of Activities of the Cabinet of Ministers of Ukraine. CMU - Cabinet of Ministers of Ukraine. Retrieved from: https://program.kmu.gov.ua/ (in Ukrainian)

ENAI (2018). Glossary for Academic Integrity. Report. Erasmus+ project "European Network for Academic Integrity". Retrieved from: https://www.academicintegrity.eu/wp/wp-content/uploads/2018/02/GLOSSARY_...

EUFSR (2015). Conclusion of the project "Academic Culture of Ukrainian Students: Main Factors of Formation and Development". The East-Ukrainian Foundation for Social Research. Retrieved from: http://fond.sociology.kharkov.ua/index.php/ua/about-ua/21-fond/news-site... (in Ukrainian).

Higher Education Portal (2016). Displaced universities: three years in a new place. Retrieved from: http://vnz.org.ua/statti/9793-peremischenni-vnz-try-roky-na-novomu-mistsi (in Ukrainian).

Hrynevych, L. (2019). Liliya Hrynevych: we must ensure high standards of quality and be a part of the European Higher Education Area. National University of Life and Environmental Sciences of Ukraine. Retrieved from: https://nubip.edu.ua/node/55128 (in Ukrainian).

Konrad-Adenauer-Stiftung (2017). Higher Education in Ukraine: Agenda for Reforms. KAS Policy Paper. Ed. by Yevhen Nikolaiev. – Kyiv: Konrad-Adenauer-Stiftung Ukraine Office.

Merton, R. K. (1973). 'The Normative Structure of Science'. In: The Sociology of Science, 267–80. Chicago: The University of Chicago Press.

Nowotny, H., Scott, P., & Gibbons, M. 2003. 'Introduction: `Mode 2' Revisited: The New Production of Knowledge'. Minerva 41 (3): 179–94. https://doi.org/10.1023/A:1025505528250.

OECD (2017). OECD Reviews of Integrity in Education: Ukraine 2017. OECD Publishing, Paris, https://doi.org/10.1787/9789264270664-en.

SAIUP (2017). Academic Integrity: Status and Impact Factors (Study Results). Strengthening Academic Integrity in Ukraine Project. Retrieved from: https://saiup.org.ua/resursy/motyvatsiya-studentiv-navchannya-yak-vyznac... (in Ukrainian).

Smith, I. & Hamilton, T. (2016). Platform on Ethics, Transparency and Integrity in Education. Volume 2 – Ethical principles. ETINED, Council of Europe. Retrieved from: https://rm.coe.int/CoERMPublicCommonSearchServices/DisplayDCTMContent?do...

Stichweh, R. (2014). Wissenschaft, Universität, Professionen: Soziologische Analysen. Bielefeld: transcript.

Stoy, L., Saenen, B., Davidson, J., Engelhardt, C., & Gaillard, V. (2020). D7.1 FAIR in European Higher Education, https://doi.org/10.5281/zenodo.3629683

Velliaris, D.M. (2019). Prevention and Detection of Academic Misconduct in Higher Education. IGI Global, http://dx.doi.org/10.4018/978-1-5225-7531-3