A Case Report: Building communities with training and resources for Open Science trainers

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A Case Report: Building Communities with Training and Resources for Open Science Trainers

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Abstract

To foster responsible research and innovation, research communities, institutions, and funders are shifting their practices and requirements towards Open Science. Open Science skills are becoming increasingly essential for researchers. Indeed general awareness of Open Science has grown among EU researchers, but the practical adoption can be further improved. Recognizing a gap between the needed and the provided training offer, the FOSTER project offers practical guidance and training to help researchers learn how to open up their research within a particular domain or research environment.

Aiming for a sustainable approach, FOSTER focused on strengthening the Open Science training capacity by establishing and supporting a community of trainers. The creation of an Open Science training handbook was a

first step towards bringing together trainers to share their experiences and to create an open and living knowledge resource. A subsequent series of train-the-trainer bootcamps helped trainers to find inspiration, improve their skills and to intensify exchange within a peer group. Four trainers, who attended one of the bootcamps, contributed a case study on their experiences and how they rolled out Open Science training within their own institutions.

On its platform the project provides a range of online courses and resources to learn about key Open Science topics. FOSTER awards users gamification badges when completing courses in order to provide incentives and rewards, and to spur them on to even greater achievements in learning.
The paper at hand describes FOSTER Plus' training strategies, shares the lessons learnt and provides guidance on how to re-use the project's materials and training approaches.

Keywords: open science; training; bootcamp; handbook; book sprint; online-courses

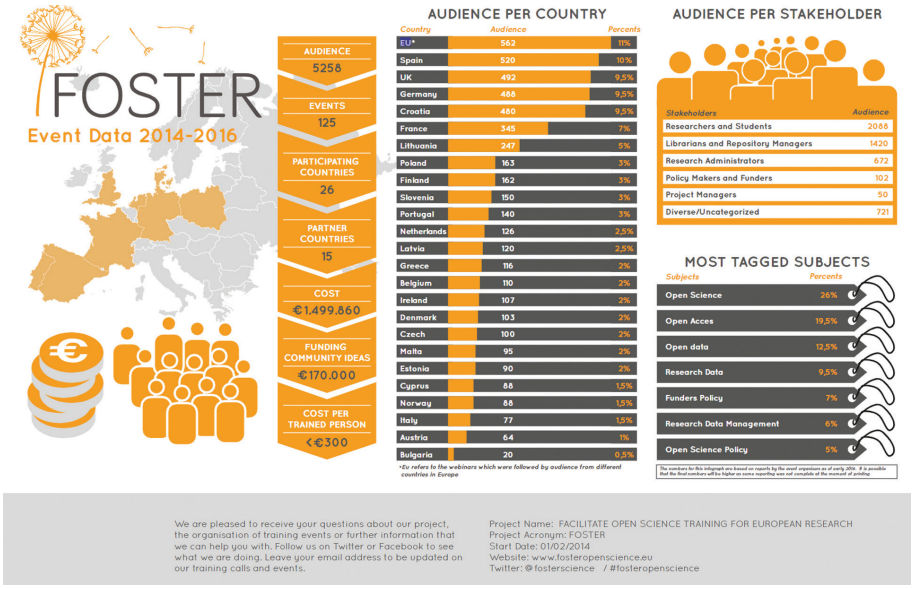
1. Introduction

The shift towards Open Science has gained significant momentum through support from funders and policy makers in the European Research Area. The European Commission, has introduced several Open Science policies and mandates in its framework programmes already since 2008 including the Open Access pilot (FP7, 2007–2013) and an Open Access mandate combined with a voluntary Open Data Pilot[1] (Horizon 2020 (2014–2020)).

In particular, the launch of "Plan S" in September 2018, declaring Open Access to be the standard for scholarly publishing by 2021, shows a clear intention to accelerate the practical implementation of Open Science.[2]

The Working Group on Education and Skills under Open Science at the European Commission noted, "[f]or Open Science to become a reality, researchers need appropriate discipline-dependent skills training and professional development at all stages of their research careers" (O'Carroll et al., 2017). Academia needs to be aware and trained to implement policies such as Plan S in research workflows. As "training standards are highly variable

Fig. 1: FOSTER infographic (FOSTER Partners, 2016).



between institutions and research groups" more adequate training is necessary to improve knowledge about "the responsible conduct of research and critical thinking skills" (McDowell et al., 2014, p. 8).

The FOSTER project started to create learning opportunities for academia, funders and decision makers in 2014 to approach the skills gap. The team developed learning objectives, defined the term Open Science and collected training materials on the FOSTER portal from 125 supported events. From 2014 to 2016, 5,258 persons participated in the training events organised by the FOSTER project (cf. FOSTER infographic, see Figure 1).

These high numbers demonstrate a strong interest in organizing Open Science training and also a great need for training from the audience's side. Consequently, the EU-funded project FOSTER Plus (2017–2019) built on the conclusions from the first project phase, continuing and intensifying the efforts to strengthen the training capacity.

The paper at hand intends to present the FOSTER Plus' training strategies, provide guidance for re-using the project's materials and share the lessons we learnt.

2. Training the Trainers to Build Capacity

In order to improve the general Open Science training offer and to step up training capacity, FOSTER Plus set its focus on *training for trainers*. The project aimed to initiate a community of practice, in which trainers with common interests come together to exchange ideas and materials.

Striving for maximum impact, FOSTER Plus followed two practical approaches to strengthen the community: On the one hand, the project offered train-the-trainer workshops, so-called bootcamps, for participants interested in implementing Open Science training in their own institutions. On the other hand, we provided infrastructure, resources and a support network for trainers (see Section 4).

In addition, FOSTER Plus created several training resources including the Open Science toolkit, which is a set of ten online courses, and the Open Science Training Handbook (OSTH). While the toolkit is about how to practically implement Open Science (see Section 3.2.2), the OSTH is particularly intended to support trainers. The online resource introduces readers to the preparation, conduction and evaluation of Open Science workshops.

2.1. A Handbook for Open Science Training

The high numbers of events and participants in FOSTER from 2014 to 2016, showed not only the high demand for training, but also that there is already a substantial number of experts on Open Science topics that are qualified to deliver trainings (cf. FOSTER infographic,[3] see Figure 1).

In order to improve the existing training capacity, FOSTER Plus decided to create an Open Science Training Handbook in which these experienced trainers share their practical experience and theoretical knowledge with (future) trainers. The result is an informative key resource targeted at institutions,

individuals, research infrastructures and communities that would like to step up or implement trainings. Looking for a format that acknowledges the limited amount of time of professionals, FOSTER Plus organized a book sprint to realize the handbook.

2.1.1. Book Sprint

The methodology of rapidly developing a book is called "Book Sprint:" "[T]he method can be extended and applied to any context where a group of people need to work together to achieve a common goal" and allows high quality work at little cost (Zennaro, Canessa, Fonda, Belcher, & Flickenger, 2007, p. 2).

Applying the book sprint method to the context of Open Science, FOSTER Plus created an environment where selected authors managed to write a handbook about Open Science training within five days. The key for this achievement was the group composition. Based on an open call FOSTER Plus received 39 applications. After evaluating their training experience, expertise and motivation, and taking into account the group balance in terms of gender and scientific backgrounds, 14 experts were selected. In February 2018, the authors came together in Hannover, Germany, where FOSTER Plus organized the book sprint in collaboration with the German National Library for Science and Technology (TIB).

The book sprint facilitators provided an author guide and applied methods from *user centred design*,[4] which helped the authors to set the scope of the book and to focus on the "end-user," the reader of the handbook, a typical Open Science trainer. The blog post "How to Book Sprint, in Sixteen Steps," written by Heller and Brinken (2018), describes the methods used and the facilitators' experiences from the book sprint.

2.1.2. The Handbook

The result of the book sprint was a knowledge resource of 300,000-characters: The *Open Science Training Handbook*,[5] which covers key Open Science aspects, includes theoretical background knowledge on learning theories as well as

practical tips for organizing training events. In addition, the authors collected a wide range of sample exercises to be re-used or adapted to different training purposes.

The authors made the first version of the handbook available to the public immediately after the book sprint event. Around 70 persons from the Open Science community reviewed and commented on the first version. Consequently, the resource was moved to GitHub,[6] a versioning-control platform, that allows a large group of people to collaborate. With this action the book was handed over to the community to be a living handbook, which accepts contributions. Readers can send change requests, so called "pull requests," via the GitHub platform to contribute. The OSTH is not only supposed to be a living book, but also an Open Educational Resource, which is available under the Creative Commons Public Domain Dedication (CC0 1.0 Universal).[7] The authors chose this approach to make re-use and adaptation as easy as possible. No permission is necessary to create a copy of the GitHub repository, to re-use content, to copy information or to adapt it to different purposes. Noticing that GitHub might be a barrier to read the Open Science Training Handbook, we created a Gitbook,[8] that offers a more user-friendly approach. Also, a PDF and Word-document were made available via Zenodo[9] for download. The different formats can be accessed through the FOSTER portal.[10]

2.1.3. Lessons Learnt

Open Science is a field that changes quickly. FOSTER Plus intended to create a handbook to be kept alive even after the project's lifetime. The first step to ensure this was choosing the book sprint method, in which according to Zennaro et al. (2007) "[t]he initial close physical proximity of the authors allows for much more intense interaction than can be achieved in a purely online environment, and helps to build a team that can persist after the event," meaning that the community of authors developed a sort of ownership and can be in charge of accepting and managing future contributions. The second step was to attach a Creative Commons Public Domain license to the handbook, handing over the book to the community and to the public. The third step towards sustaining longevity and increasing outreach, was to widen the audience by translating the OSTH into different languages.

FOSTER Plus has been approached by several national initiatives, organizations and communities, e.g. the CEPAL library in Chile and the Italian OSSG (Open Science Support Group), which expressed their interest in translating the handbook into different languages. In addition, some FOSTER Plus project partners initiated translations in their national communities. These efforts resulted in the release of a Spanish and a Portuguese translation of the handbook. Further, the translations into Greek, French, Italian and German are in progress and FOSTER encourages translations into more languages.

The Open Science Training Handbook GitHub repository[11] is the hub for all translations. Each language has its own sub-repository, from which a separate Gitbook[12] is created. In the following, three coordinators of the translations share their insights into the procedure, provide tips for coordination, explain the tools that were used, etc.

2.1.3.1. Spanish Translation

Even before the handbook itself was written, the CEPAL library, Chile, expressed their interest to translate the OSTH into Spanish and make it accessible for the Latin-American community as well. The Spanish translation of the handbook[13] was carried out by a group of eight volunteers belonging to different Latin American institutions, coordinated by the library of CEPAL.[14] Also using GitHub, a time-line was established for the translation, the book chapters were assigned, and guidelines were created on how to approach the translation. CSIC, a FOSTER Plus project partner, edited and finalized the translation. The team faced minor difficulties related to style and some terms used in the translation, due to the geographical linguistic diversity of the translators. In general, the process flowed without complications and in a good collaborative environment.

2.1.3.2. Portuguese Translation

University of Minho, coordinator of FOSTER Plus, initiated and managed the translation into Portuguese. Portuguese Open Science experts and activists were personally invited to contribute, and as a result, a group of 22 people[15] translated the OSTH. In addition to the translators, three coordinators and reviewers contributed to the translation project. The book content

was divided into sections with similar dimensions, which allowed people to choose topics that they related to the most. Afterwards an online meeting was organized to explain the practical aspects of the translation, tasks distribution, deadlines, tools, etc. The group chose to use a markdown editor (Caret[16]) for the translation. A shared document was established to indicate the most common terms and the preferred translation for each. The appointed coordinator revised the content of the translated sections before uploading it to GitHub. Two other rounds of reviews focused on the format, links, bibliographies, etc. The translators were very enthusiastic about being part of this process and this allowed a swift release of the book, within two months from the start.

2.1.3.3. Greek Translation

The Spanish and the Portuguese versions were released during the project's lifetime. In addition, several translations have been initiated and are in progress, such as the Greek translation. Foreseeing the need at national level to translate the OSTH, the FOSTER Plus partner LIBER approached colleagues in Greece. Four moderators coordinate the Greek translation and in total fourteen collaborators, including two participants of the Open Science Training Bootcamp in Barcelona, work on the translation. This translation is an ongoing activity and its procedure and progress has been presented at the Greek Open Science Symposium[17] on 29–30 November 2018 in Athens.

2.1.4. Conclusion and Impact

Whilst the national Open Science communities managed to translate the handbook without any difficulties and the successful releases can be interpreted as a strong indication of the need for support in different languages, the project experienced difficulties in fully monitoring how many people used the handbook. The reason for this was a change in the user conditions of one of the services we chose to host the OSTH. However, the FOSTER Plus team moved the OSTH to its own servers and managed to enable proper tracking. The English original version and each of the released translations receive around 2,000 views every two months. These numbers show that there is a great interest from the community in improving Open Science training skills.

2.2. Recommendations on Training Trainers on Open Science

In order to multiply Open Science training forces, FOSTER Plus followed a train-the-trainer approach. Early career researchers, research support staff and librarians delivering or planning to deliver Open Science training to researchers and students and looking for ways to make their training more effective, were invited to join FOSTER Open Science Trainer Bootcamps. Ten bootcamps, ranging from three-day to one-day train-the-trainer events, contributed to confidence building and equipped 254 Open Science trainers with the skills they need to conduct training events in their own institutions and communities.

2.2.1. Three-Day Open Science Trainer Bootcamp

Overall, thirty participants attended the first FOSTER Plus bootcamp, that took place on 18–20 April 2018 at the Centre for Genomic Regulation in Barcelona.

The intense three-day training programme included a sufficient amount of time to address content – the main aspects of Open Science such as open access to publications and data, open peer review, licences, open innovation, open source software and workflows, text and data mining and citizen science – and skills focusing on how to spread the word about Open Science principles most effectively.

The selection criteria for choosing the participants took into account the applicants' training experience, statements of intent to support Open Science training from institutions, and demonstrable commitments to Open Science.

The programme and logistics of the bootcamp were a collaborative team effort that, among others, included combining good ideas and best practices into a workable programme with interesting learning objectives, outcomes and a format that was useful for the future Open Science trainers. The participants gained confidence, shared knowledge and resources to use and build on in their Open Science training. Both the content and the mix of formats and learning paths reflected the diverse background of the bootcamp participants.

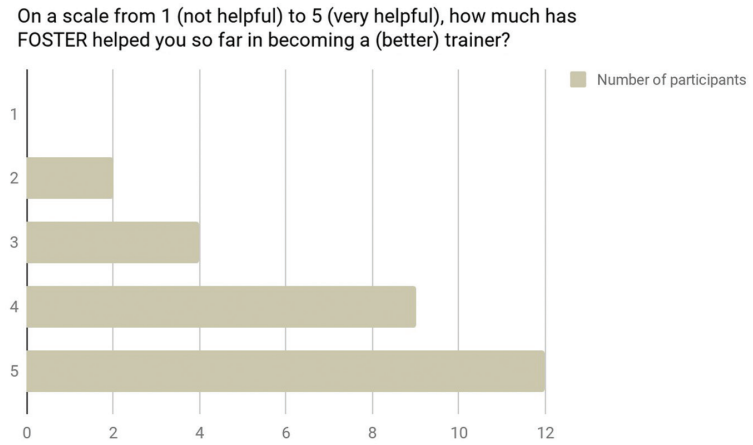
It was also important to let participants practise what they have learnt – they were asked to develop and conduct mini training workshops (15 minutes each) and outline a roadmap about their training plans for the upcoming months.

In the end the main goal has been achieved: the bootcamp team and structure provided the participants with the skills and knowledge not only to give training to researchers themselves, but also to be able to advise their peers on the academic and societal impact of Open Science.

This bootcamp was also the kick-off activity for the FOSTER trainer network, a cohort of Open Science trainers, who not only use the FOSTER resources, but also contribute their training material and provide Open Science training in several institutions, regions and across disciplines, working as multipliers of Open Science. The bootcamp participants have been encouraged to fill in their profiles on the Trainers Directory[18] on the FOSTER portal.

In a survey run for bootcamp participants, a vast majority stated that FOSTER helped them become a better trainer (see Figure 2), hundreds of trainings were provided after the bootcamp, while more have been scheduled to be delivered in the coming period.

Fig. 2: Responses to bootcamp feedback survey.



Below is an outline of the three-day train-the-trainer bootcamp for those who would like to replicate it in their setting:

Day 1 – revolves around the different aspects of Open Science, and the materials that can support training events. Make sure to start with an icebreaker exercise and draft your code of conduct. You could end the day with a case study on putting open science into context.

Day 2 – Start the second day with a warming-up exercise and train your participants on how to deliver training. In the afternoon, let them work on their own open science mini-training in small groups. Don't forget a group picture.

Day 3 – On the third day, participants provide mini-trainings they have prepared on the day before to other bootcamp participants. You might want to split people into two groups and allocate sufficient amount of time for individual feedback and evaluation. In the afternoon, let them work on their own open science training roadmaps: plans of trainings they will give and how to get there. End your event with a wrap up, evaluation and certification.

2.2.2. One-day Open Science Trainer Bootcamps

With the launch of the *FOSTER Open Science Toolkit*[19] the content discussion of Open Science topics could be shortened. FOSTER Plus hosted various one-day train-the-trainer bootcamps asking participants in advance to go through the ten courses, in order to focus on training related discussions during the shorter bootcamps.

A key element of the workshops was to focus on conducting training and not to learn more about Open Science itself. At the registration stage potential participants were asked to write about their experience and skills in Open Science, the kind of training they attended and organized. In addition, they highlighted their training plans for the coming year and explained their motivation to attend the Open Science trainer bootcamp.

At the bootcamp they were guided through a range of training techniques, including how to identify training needs, how to provide training focusing on learning objectives and learning outcomes and how to make training as

open and inclusive as possible. In addition, they reflected on their own roles as trainers and on the audience they aim to reach. They had the opportunity to discuss and share training examples as well as to test different gamification approaches. The FOSTER trainers provided practical guidelines on finding training materials and re-using them.

Interactivity was the most important part of the FOSTER bootcamps. Already during the morning session, participants shared their thoughts on training that they had attended or organized in the past: what went well, what didn't work at all, what would they do differently? They also talked about the most effective types of training in their own organizations, topics and formats and what kind of training would have the biggest impact in the long term. In order to facilitate the discussion, Mentimeter[20] (an online polling system used during live events) was used so that participants could give their opinions freely and anonymously.

The largest part of the training was dedicated to a session where participants designed their own Open Science training, on a topic of their choice. The participants usually based their choice on the needs in their own institution. For example, some would like to create a general Open Science course, while others have more specific training needs such as intellectual property and open licensing; research data management planning; preprints sharing or open source software for research. Although every bootcamp had a diverse group of participants, this approach guaranteed that everyone was able to take home a training design tailored to his or her training plans.

But – and here's the twist – even though the participants were free to choose the topics they wanted to work on, they couldn't choose the format and circumstances. Using a card game,[21] each group selected the specific conditions for their training. Before they started designing their training, they randomly picked cards in four different categories: 'audience size,' 'audience type,' 'knowledge level,' 'training type.' The idea was that, by having to create their training proposal with these four categories in mind, the trainers would be forced to step outside of their comfort zones.

To make it a bit easier though, the trainers-to-be were asked to complete a persona exercise, in which they described members of their intended audience, before they started with the training design. This ensured that they would keep their audience in mind. After participants designed their training

sessions, they briefly presented them and selected two additional cards in the categories 'audience mood' and 'trouble.' These were unexpected and unpredictable circumstances. After providing their solution there was a general discussion on how others would deal with the situation (or have already dealt with it in the past), e.g. What do you do when the room is very noisy? If the internet is not working? If people do not stop checking their emails or browse their mobile phones? When the audience is really not keen to participate or even hostile? Or just very shy? As it turns out, the combined insights and experiences of the audience were an excellent way to find solutions for almost all worst-case-scenarios.

Training materials and formats are available for re-use, e.g. from FOSTER train-the-trainer bootcamps in Riga,[22] Latvia, in November 2018, in Debrecen,[23] Hungary, in January 2019 as well as in Kaunas,[24] Lithuania, The Hague,[25] the Netherlands, and Belgrade,[26] Serbia, in April 2019. Spanish and Portuguese materials are available from the bootcamp in Lisbon,[27] Portugal, in October 2018 and Salamanca,[28] Spain, in March 2019.

2.2.3. Lessons Learnt

FOSTER Plus organized ten train-the-trainer bootcamps with a total of 254 participants. This resulted in a successful multiplier effect as the new FOSTER trainers organized 107 follow-up events.

Regular feedback by bootcamp participants helped us to learn and improve the training approach continuously. In the following we would like to share insights in what we have learnt in the meantime and what our participants considered as important:

First, a nice atmosphere, an open, friendly and comfortable environment — "easy and happy learning environment," as one of the participants wrote, was as important and valuable as the training programme itself. Also, the pre-event communication and communication during the event have been highlighted as positive aspects of the FOSTER training events.

Moreover, having a diverse audience – different backgrounds and career paths – was a challenge and an opportunity and helped to broaden discussions. It

was a challenge in terms of the level of content that would be appropriate for all. On the other hand, it provided an opportunity to engage with people with different backgrounds and to share experiences.

Furthermore, fun and hands-on were two key aspects we wanted to highlight in our trainings. The tapas workshop organized as a social event at the first bootcamp allowed the participants to get to know each other and get comfortable, without being centered around drinks and small talk, like most social events at conferences and workshops.

The hands-on mini-training sessions were considered very helpful because they allowed to brainstorm and prepare training material with other people rather than alone, and to get practical knowledge and learn from other trainings.

As mentioned before, diversity of trainers in terms of level of understanding of their audience can be challenging, which led to a few trainers mentioning that they would need further resources geared to more advanced audiences or richer from a disciplinary view.

2.3. Facilitating Open Science Practices: Case Studies by FOSTER Trainers

As noted above, the FOSTER Plus train-the-trainer approach resulted in a multiplier effect. In order to illustrate how the trainers implement what they have learnt in their own institutions we gathered four case studies to highlight different training and advocacy approaches currently practiced by the bootcamp participants.

2.3.1. Reproducible Research with R – a Course in Open, Transparent and Reproducible Science for Biomedical Scientists, by Ulf Toelch, QUEST Center for Transforming Biomedical Science, Berlin Institute of Health

In biomedical research, translation of preclinical findings into practice, i.e. to the patient, has proved difficult in many fields like stroke or neurodegenerative diseases (Begley & Ioannidis, 2015; Drucker, 2016; Ioannidis et al., 2014). Attrition rates are high and only few compounds make it to clinical

applications (Waring et al., 2015). Poor reproducibility of preclinical research has been identified as one potential cause for the limited success of drug or treatment development (Baker, 2015; Jarvis & Williams, 2016). To improve this situation at a large university hospital, the QUEST Center[29] for transforming biomedical research offers a course for doctoral students and clinician scientists to highlight Open Science practices across the research cycle.

Course Format

Approximately 20 participants met weekly for approximately two hours for 13 sessions. Through this long and intense format, we were able to introduce concepts in detail and devote ample time to practical exercises. A major challenge for reproducible research is the lack of researchers' formal training in a programming language suitable for data analysis like R or Python. Participants thus were assigned homework before and during the course on an online interactive course platform[30] that offers free accounts for academic courses.

Course Content

In the first three sessions, we gave an overview of the current problems of biomedical translational research to motivate the upcoming course. We then outlined potential solutions following closely Munafò et al. (2017) and the Open Science course description in Toelch and Ostwald (2018). Participants also learnt basic programming skills during the first three sessions and created their own R notebook, combining text, code, and figures in a reproducible manner (Marwick, 2017).

In the second part (ten sessions), we gave a detailed account on pre-registration and registered reports (Nosek & Lakens, 2014), open and FAIR data (Wilkinson et al., 2016)), and suitable data and code repositories. We then gave a detailed account on how to analyze data in a tidy way (Ross, Wickham, & Robinson, 2017), create meaningful figures (Weissgerber, Garovic, Winham, Milic, & Prager, 2016), compute statistics, and report findings in a reproducible manner. We concluded the course with an overview of current publishing models (including gold and green open access) and a discussion on open peer review. Material associated with both parts of the course (Introduction to and Advanced Reproducible Research with R) is freely available under an OSF profile.[31]

2.3.2. Triggering Self- and Group Reflection on the Topic of Open Science, by Katerina Zourou, iPEN Project

iPEN (Innovative Photonics Education in Nanotechnology[32]) is a "Capacity Building in Higher Education" type of project funded under the Erasmus+ programme. The project brings together higher education institutions and companies from Europe (Greece, The Netherlands, Germany, Italy) and Israel. iPEN offers mobility opportunities for staff and students as well as online & offline training in photonic sources & techniques in nanotechnology.

Context and Location
An introductory session to Open Science was organized as part of the first Intensive Course for HE students and staff in October 2018 in Tel Aviv.

The session started with a 45 minutes introductory lecture on Open Science, based on FOSTER content and materials. Next, participants were invited to express positive and negative views on Open Science by writing down their opinions on post-its (15 minutes). At the end, a 15 minutes follow-up discussion on the collection of post-its closed the session. The full collection of post-it is available online,[33] roughly categorized in positive and negative aspects of Open Science according to the participants.

Why was it good practice to engage participants in a pro and con argumentation on Open Science? The aim is twofold: firstly, to engage participants in an active process of self-reflection about their practices and aspirations. Secondly, it is an opportunity to elaborate on the pros and cons gathered and enhance the discussion through clarifications, and opportunities to deal with misconceptions.

2.3.3. Open Science – A Good Practice by Filomena Borba, ISCAL – Lisbon Accounting and Business School,[34] Instituto Politécnico de Lisboa

As a librarian, I'm strongly aware of librarians' crucial role in spreading knowledge as part of the process of creating more knowledge. That said, in my experience, we must start with the students. Forming young minds and making them curious, creates a knowledge acquisition dynamic that forces academic bodies to be more open and collaborative.

Three years ago, when I started working in the faculty library, I wanted to alert students to the importance of research as a plus for their academic careers. Some questions leap out right away: How can I reach them? What can I do to gain their attention? Could I get support from the researchers and lecturers to the open access policy?

Although, in Portugal we still are somewhat behind, what I find is, in most cases, a willingness to learn, a collaborative and understanding attitude.

What do I do?
I started to develop workshops in order to facilitate learning about research methods among the students, especially those who are doing their master's degree, and providing them with the tools to do so. At the same time, I initiated advocacy work across the school, aiming to win the researchers over to the importance of open access databases, such as our institutional repository. At present, at the beginning of each academic cycle, I go to a class of each course to deliver a training session about databases and open access content. The outcome is positive and, lately, the teachers started asking for it.

Among the researchers and teachers I hold a session once a year promoting Open Science, highlighting its benefits for all. My perception is that they are aware of the benefits and open minded to the practice of sharing information and data, in order to obtain more value and citations. This is assisted by the Institutional Repository, where the information is clearly attributable and accountable. The adoption of ORCID identifiers which distinguish researchers and their research outputs, make them feel they are part of the process, contributing to access to papers, research data and information, more than ever.

In my case, the most successful training event was my participation in the Portuguese version of the Open Science training handbook.[35]

2.3.4. Open Science Advocacy by Katerina Lenaki, Greek Ministry of Education, Research and Religious Affairs

Open Science is one of my priorities in recent years, so when I came across the call for applications to the FOSTER Bootcamp of April 2018, I was really

excited. At the time, I had just been moved from the University of Crete Academic Library to the central administration of the Greek Ministry of Education, in Athens. I thought that it would be important to find a way to promote Open Science culture in this environment too, so it would be important to evolve my training skills and methodology. On the other hand, in such an environment it is not possible to plan and offer training like a standard Open Science trainer and the challenges were many.

Facts

- I was placed at the Directorate General for Higher Education, Department E΄ – Liaison with the European Higher Education Policy.
- The Ministry is not an academic environment and all matters are approached from a more administrative point of view.
- Although the Minister of Education has mentioned open access support in general and the Greek legislation has complied with the European directives for open data, the Ministry's internal environment is not familiar with open culture and practices.
- Academic libraries and scholarly communication in Greece, although sponsored, are not monitored by a specific Department in the Ministry. The National Documentation Center[36] and the Athena Innovation Center[37] as well as the consortium "Hellenic Academic Libraries Link"[38] are basically the actors in Open Science and act independently from the Ministry.

My Goal

My goal was to inform people who could play an important role in launching Open Science policy goals at the national level, in supporting Open Science initiatives in the Greek academic environment with funds and in promoting such communication within the European Higher Education Area (EHEA), but have no idea what it is all about. So, I had to start from zero to develop an understanding within the Directorate General for Higher Education for which standard methods were not applicable.

My Story

Since my first weeks at the Directorate General, I had made sure people in my working environment became aware of the term 'Open Science' and my availability to explain more on the subject. It is worth mentioning that when I received permission to attend a FOSTER Bootcamp, we agreed to organize

a short introductory presentation when I would be back. Unfortunately, although I tried to plan it, the summer was over and it never came about, it was never a priority. By the end of the summer, I was disappointed.

A couple of months later, I ran across the announcement of the Symposium Open Science in the Greek Research Ecosystem: Research Data, Procedures and Collaborations, organized by OpenAIRE and RDA Europe 4, projects of Athena Research Center. So, I decided to ask for permission to attend, by writing to my director, explaining and describing the content of the conference and its relevance to the Universities and the European Higher Education Policy. The day before the symposium I got a positive answer. I was determined to promote Open Science to the Directorate General and this time I would try a different path, through written texts. When I came back, I prepared my report, that included an easy to read description of the conference programme and discussions (among others for the benefits and activities taking place today in Greece) and a section with a series of suggestions, at administrative level, for the deployment of Open Science through our Department that relates to the European Higher Education policy. Additionally, I prepared an article on Open Science intended for the general public, that was then published,[39] presenting the main conclusions of the Symposium.

The Results
Maybe we don't have a major change in attitude of the Directorate General, but I am happy to say, whenever it is applicable, a brief reference to Open Science principles and practices are included among our suggestions in administrative documents, within the ministry and with respect to European organizations.

Concerning Open Science culture in the Greek society, we definitely have a long way to go and informal paths maybe the answer, together with the specialized and targeted campaigns.

3. FOSTER Resources for Open Science Trainers

FOSTER Plus promoted the practical implementation of Open Science with different training approaches. One training approach was face to face, at

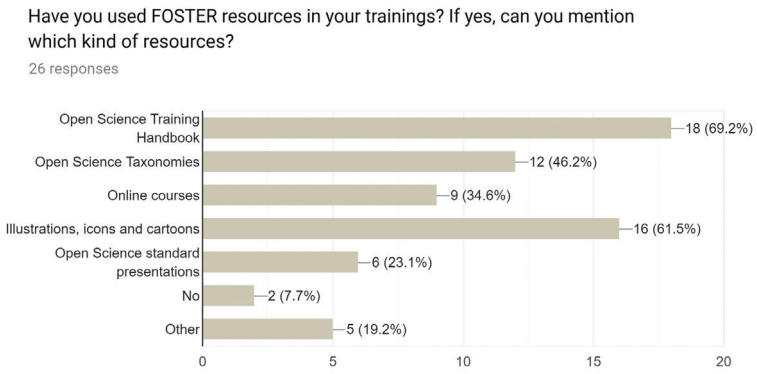
institutions or events, but this approach limited the project outreach to other stakeholders. To complement the face-to-face training approach, the FOSTER project maintains a platform,[40] which serves many purposes and contains plenty of Open Science training materials. During the first FOSTER project the platform hosted a variety of training resources, such as events and their presentations, a trainers directory, related papers, video resources and the first FOSTER courses (Pontika, Knoth, Cancellieri, & Pearce, 2015). Through the lifespan of the FOSTER Plus project, the platform was enriched with more Open Science related content, new trainers, and ten new courses, which were organized in the form of a toolkit.

3.1. Resources for (re)use

The FOSTER platform[41] serves as an educational Open Science database, where prospective trainers, and other learners interested in the topic of Open Science, can access about 3,300 training materials with an open licence, which are ready for re-use.[42] Figure 3 shows that the materials available on the FOSTER portal are being used by bootcamp participants.

The past couple of years, following the bootcamp activities, the trainers directory[43] was populated with 68 Open Science trainers from all over Europe, broadening the FOSTER training expertise in the Open Science subtopics, but also in the number of languages used by the presenters and the target

Fig. 3: Responses to bootcamp feedback survey.



audiences. Trainers can use the directory to maintain a profile highlighting their training skills and activities.

The platform supports an extensive calendar of events across Europe, and serves as an excellent example and source for inspiration to those planning events in the related fields, being the main point of access among those interested in Open Science related events. FOSTER trainers can use the calendar to create an access point for their event including all relevant information and materials.

3.2. Online Courses

FOSTER Plus focused on online training activities that can be organized into two different learning modes: self-learning and moderated.

The self-learning approach allows each individual user to take a course, following his own rhythm and be totally independent. The project created a set of ten online courses, the Open Science toolkit, covering key topics following the self-learning approach (see Chapter 3.2.2).

The moderated approach defines a specific public to take a course at the same time. During these courses a moderator accompanies the trainees, provides help on the forum and creates online or chat sessions. In the moderated context, the course is created, managed and restricted to the users who register and attend the specific edition of the course. In order to implement these specific functionalities FOSTER Plus implemented a learning management system (LMS).

3.2.1. Learning Management System

Considering the know-how of the consortium and other experiences in online training, the project team concluded that the LMS Moodle[44] fits the specific requirements of FOSTER's training strategy. Moodle provides an open-source software with a strong community, which ensures long-term sustainability, flexibility and additional plugins needed for the tailored configuration. The LMS is web-based and thus can be accessed from all over the world. With a

default mobile-compatible interface and cross-browser compatibility, content on the Moodle platform is easily accessible and consistent across different web browsers and devices. Some other functionalities have been considered as important such as the multi-language interface, the management of the courses to replicate new instances and the flexibility to allow different types of courses and the possibility of integration with other tools and standards.

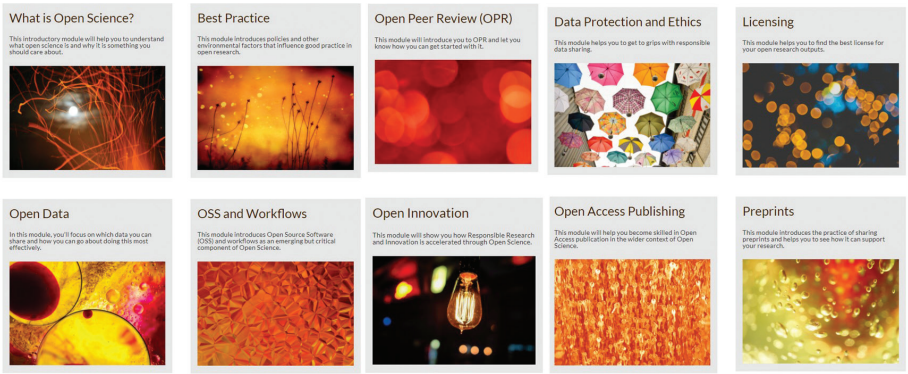
The FOSTER Plus LMS hosted several courses created in collaboration with different initiatives or groups from the Open Science community. In order to promote consistency of the learning strategy, a course template has been created to demonstrate the structure, configurations and pedagogic model to be used in the context of the FOSTER Plus project. Additional actions, such as providing webinars and factsheets, have been taken to support course creators to create high-quality courses. FOSTER Plus supports the creation of further relevant courses on the platform and provides technical support for the implementation.

3.2.2. An Open Science Toolkit

FOSTER Plus developed the Open Science Training Toolkit,[45] which is a set of ten freely accessible courses addressing key Open Science topics to support users on how to put Open Science into practice. Users can navigate through the content at their own pace and in any order they wish. The courses are targeted towards early career researchers but are intended to be re-usable by Open Science trainers as well. As there is no prescribed pathway through the courses, the toolkit can be expanded over time to include additional content as new topics and themes emerge. The set of courses include (see Figure 4):

- What is Open Science
- Open Peer Review
- Open Access Publishing
- Open Licensing
- Open Source Software and Workflows
- Managing and Sharing Research Data
- Best Practice in Open Research
- Open Science and Innovation
- Sharing Preprints
- Data Protection and Ethics

Fig. 4: The Open Science toolkit.



To develop the courses, we have re-used open content wherever possible, and have worked with discipline-specific partners representing ELIXIR, CESSDA and DARIAH to provide pointers to relevant tools and resources for the Life Sciences, Social Sciences and Arts and Humanities.[46] Each course takes between 1 and 2 hours to complete and participants are awarded a badge upon successful completion. Overall, 540 badges have been awarded to those completing the Open Science Toolkit courses by the end of the project. The toolkit courses have been translated into Spanish and into Arabic.[47] FOSTER welcomes future collaborations with those wishing to develop additional translations.

As noted, we also wanted to ensure that the courses are available for re-use to help those tasked with delivering Open Science training. To this end, Open Science trainers can either point researchers directly to the courses as they are or they can download them as SCORM packages and tailor them for local reuse (see Figure 5).

For Open Science trainers wishing to download and adapt content, a dedicated training course has been developed in the FOSTER LMS.[48] This course demonstrates different ways to reuse the contents of the toolkit like a translation, on a website or on an LMS that is SCORM compliant.

Figure 6 shows the topics of the course including how to reuse the toolkit on a website, in an LMS and how to update the toolkit.

Fig. 5: Download toolkit courses into SCORM.

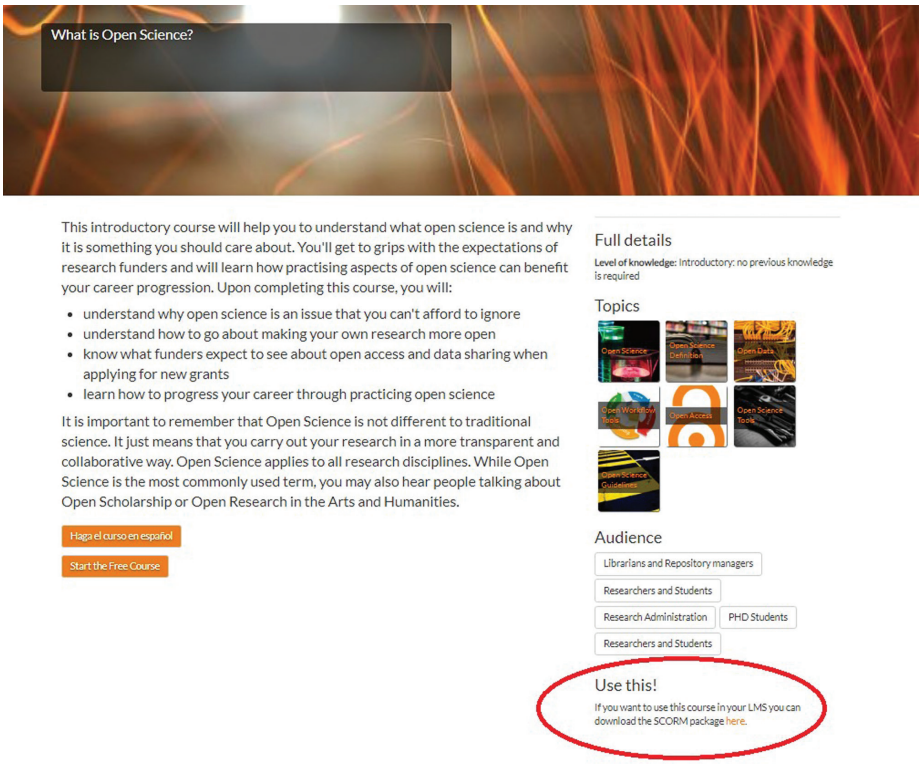
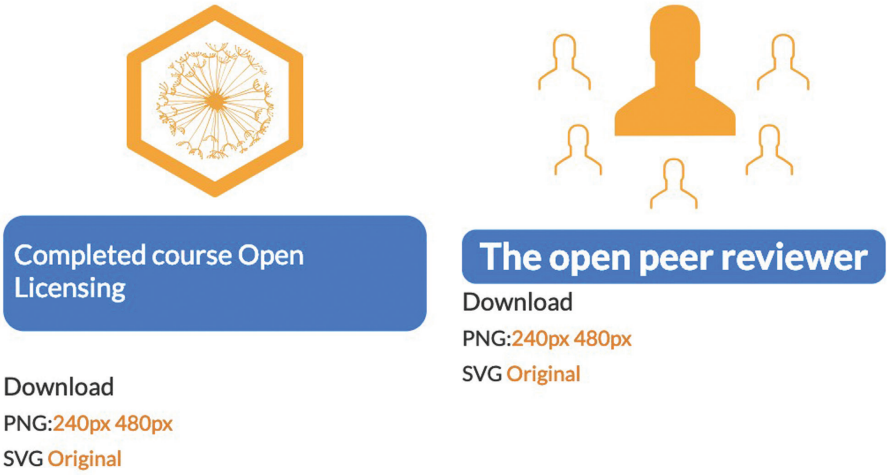


Fig. 6: Content of the course "Reuse the OS toolkit."

Fig. 7: Example badges.



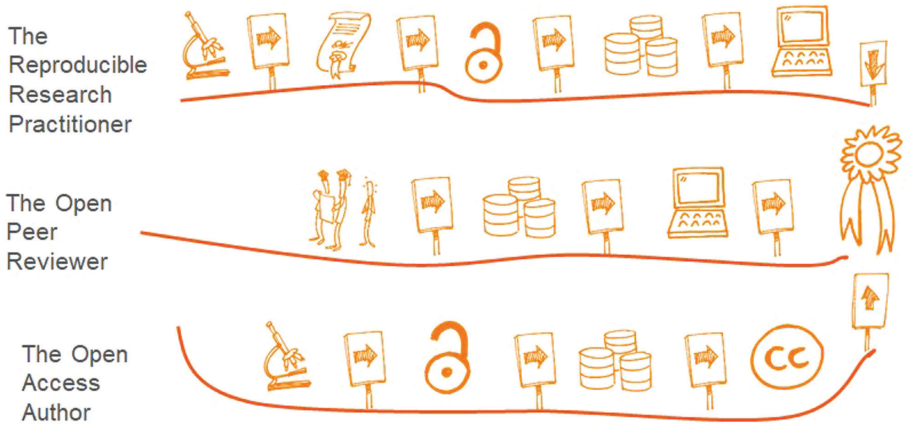
3.3. Incentivising Open Science Training

FOSTER developed a reward mechanism following an open badges standard system,[49] which enables users to create a cross-platform portfolio and disseminate their achievements via social media and other research networking services. The badges can be awarded to trainers, trainees and platform users, who can gain them after completing a variety of tasks (Figure 7). Badges are also awarded when users complete FOSTER toolkit courses, in a moderated or self-paced way, or when they acquire a new specialization by completing a learning path.

A learning path has the benefit of training users on a specific topical domain and allows them to demonstrate and receive recognition for their expertise in the topics of Open Science. In addition, the learning paths allow learners to navigate and discover the rich content of the platform in a more structured way (see Figure 8).

As a result, five learning paths were created: *Open Peer Reviewer, Responsible Data Sharer, Reproducible Research Practitioner, Open Innovation Accelerator* and *Open Access Author* — with each consisting of a set of courses. FOSTER learners can take all the courses of a learning path and after their completion

Fig. 8: FOSTER learning paths.



advance their knowledge and even become experts in one or more Open Science fields.

3.4. Lessons Learnt

The FOSTER Plus project was built on the existing FOSTER portal and the planning, implementation and adoption of some of the aforementioned portal functionalities has been challenging for us. In the sections below, we present the lessons we have learnt about how a technical infrastructure can be used to facilitate and sustain a community/network of Open Science trainers. The aim of the work has been to create not only a portal with training materials in Open Science, but also an e-learning platform, which combines open badges and learning paths.

Sustaining the Community Through Content Reuse

The adoption of a specific learning management system for the project defined a new level of possibilities and support for moderated learning processes. Additionally, the platform provides extended interoperability and a set of functionalities that will allow to embed, e.g., toolkit modules as components of the courses.

Additionally, it provides the possibility to develop new courses, and then create new editions, with updates if needed, without the need to start from scratch.

The multi-language feature of the platform allows course creators to implement the course completely in their native language: Not only the course content, but also the LMS itself. This feature perfectly fits the multi-language context of the European Research Area.

All FOSTER courses can be exported and re-used in other learning management systems. This means that the time and effort spent by FOSTER course creators now extends its purpose and outreach, since Open Science trainers with little time, expertise or the right tools, can now embed and re-use these courses on platforms of their preference. The self-learning courses are also available using the SCORM standard, which is supported by a vast majority of learning management systems and enables trainers to import and run the courses as a moderated training session.

Sustaining the Community Through Reputation

In the era of social media and research networking services where sharing information with accreditation is preferred, the FOSTER platform provides digital credentials via the open badges which are collected after a course or a learning path completion, the content of which was built by recognized experts in the field. The FOSTER platform and badges will be maintained and offered even after the completion of the project, enabling users to gain Open Science badges and attract new users to the platform in order to achieve the same recognition. Our original goal was to build the badges in a way that would foster interoperability and allow the creation of a cross platform portfolio, which was originally achieved by using tools such as the Mozilla Backpack.[50] Unfortunately, Mozilla's backpack project was discontinued, making the future of open badges insecure. From August 2018 the Mozilla backpack content was moved to a new website called Badgr.[51]

Sustaining the Community Through Analytics

The portal offers a Course analytics functionality that helps sustain the quality of the resources by displaying any related feedback on the learning effectiveness of a course. For example, if there is a technical or educational issue with some parts of the course, i.e. a quiz does not function properly or a question is not presented in a clear manner and leaves room for interpretation,

this can be spotted visually by observing the amount of users dropping out from the course or not completing specific sections. Thus, the course analytics serve as a perfect certificate to course creators who would like to measure the success of their courses.

4. Conclusion

In 2014, FOSTER started to spread the seeds of Open Science by organizing 125 events in 26 countries targeting 5,258 persons. In the follow-up project FOSTER Plus, we built on this achievement and aimed to contribute to a real and lasting shift in the behaviour of European researchers towards Open Science. We enhanced existing materials and produced new training content focusing on selected disciplines and on how to put Open Science into practice. In addition, we considered approaches on how to reach an even bigger community, resulting in a train-the-trainer approach, collaborations with research infrastructures, and a focus on online courses which reached 8,211 persons from May 2017 to May 2019.

After almost five years of Open Science training, the FOSTER portal is an access point for people who want to learn about Open Science, offering courses and resources as well as linking to events related to Open Science topics. From 2017 to 2019, the platform supported 320 events and hosted 59 webinars and nine e-learning courses (see Figure 9). Moreover, the portal is a hub for Open Science trainers to share materials and exchange inspiration and experience.

The platform counts more than 20,800 toolkit users since its release in November 2018. In total 744 badges have been awarded (as of July 2019). These numbers are increasing even since the project ended in April 2019. They can be seen as indicators for a high interest and an ongoing need for Open Science training.

Our activities are closely linked to the ongoing developments in the field of Open Science. The European Open Science Cloud[52] is aiming to interlink researchers, data and publications, projects and organisations as well as services and training. Furthermore, several discipline-specific research infrastructures such as ELIXIR,[53] CESSDA[54] and DARIAH-EU[55] provide training for their research communities.

Fig. 9: FOSTER Plus training numbers.

From 2017 to 2019, FOSTER reached 8,211 people, including researchers from different domains, policy makers, research administrators and Open Science trainers in 41 countries (see Figure 9). In particular, the community of Open Science trainers, which was established around the series of ten bootcamps and the Open Science Training Handbook, will support the continuation of Open Science training across the European research area by spreading the word about Open Science in their own institutions and communities. Continuously being nourished with new materials by the community, the FOSTER portal will continue and grow to be an important access point to learn how to put Open Science into practice. Collaborations with various networks like OpenAIRE's community of practice[56] and the use of the FOSTER portal by several other projects such as the FIT4RRI project[57] and the OpenMinTed project[58] contribute to sustaining the platform for the Open Science community.

Acknowledgement

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