D5.4 Demonstrator for using of e-learning platforms

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Abstract

The purpose of this task is to coordinate with the e-platforms providers (ESRF for PaNOSC and EGI for EOSC-hub) to jointly define the prerequisites to maximise and expand the use of the platforms as appropriate. WP2, WP3 and WP4 will work closely with WP5 and WP6 to deliver a tailored specification for each of the online training modules. The output will be a definition of the most suitable training materials in accordance with the requirements and recommendations made by the targeted e-platform providers. A demonstrator for the e-learning platforms will be developed and provided.

Executive Summary

In this deliverable we define the methodology and criteria for selecting, structuring and linking platforms for online training. We will introduce use cases, the involved stakeholders, their specifications and requirements for a common Photon and Neutron Science (PaN) training portal, e-learning courses and a training material catalogue. We will introduce possible target platforms for a PaN training catalogue taking the recent developments and findings from the PaNOSC project into account. Similar developments are presented, and assessed against each other.

In this document our concept of a joint ExPaNDS/PaNOSC PaN training portal is presented, the platforms features will be introduced and the integration into the joint PaNOSC / ExPaNDS PaN training portal is encouraged. We discuss how we extend PaNOSC's e-learning platform with a material catalogue collecting PaN related training material. Both platforms are of equal value and intended to complement each other using an overall portal as an entry point for our training resources. Visitors of our catalogue can filter PaN related training materials (metadata), such as wikis, repositories, e-learning courses (Moodle), videos or websites in one central location. Our demonstrator for the PaN training material catalogue gives a first impression of our developments in the ExPaNDS project.

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1. Introduction

Besides improving the establishment of the FAIR principles for data and meta data, access portals and analysis pipelines of national PaN facilities, one important aspect of ExPaNDS is to establish an e-learning or training portal supporting our PaN community by providing training material. The portal itself is intended to be a uniform access point for different training resources which can be interesting for the international PaN community. It quickly became apparent that the portal is not only an e-learning platform, but rather additionally a superior registration point for different kinds of already available material.

During the first half of the project, we have identified what we will do to move forward and in particular where synergies with other related projects and initiatives are, whilst also understanding where the knowledge is already available, well-established services may be used in developing a common portal. We work closely with WP8 of PaNOSC responsible for staff and user training to define the requirements, determine the stakeholders and to finally establish a common sustainable PaN training portal.

We plan to expand PaNOSC's e-learning platform with a catalogue collecting PaN related training material. Both platforms are of equal value and intended to complement each other using an overall PaN training portal as an entry point for our training resources. Our demonstrator for a PaN training material catalogue gives a first impression of our developments in ExPaNDS WP5. Future visitors of our catalogue can filter PaN related training materials (metadata), such as wikis, repositories, e-learning courses (Moodle), videos or websites in one central application.

1.1 Background PaN Training Portal

Immediately after project start a Training Task Force (TTF) was set up between ExPaNDS WP5 and PaNOSC WP8 leaders and co-leaders. Monthly meetings were established by this task force to follow up on the actions carried out by both projects, especially on the PaN e-learning platform's development and migration by PaNOSC. In the PaNOSC project the use of the learning management system Moodle[1] was determined in the PaNOSC proposal[2], together with a MediaWiki and a virtual facility. The website "e-neutrons.org" and the content developed in the *Science & Innovation with Neutrons in Europe* programme by the University of Copenhagen and the Technical University of Denmark was a starting point to ensure sustainability for a PaN related e-learning platform.

In the PaNOSC project ESS (European Spallation Source) started a domain migration to the ESS infrastructure and the new domain "https://pan-learning.org/" which is available since April 2020. Further content was developed like the IllumiDesk[3] integration of Jupyter

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[1] Moodle – The world's most popular learning management system: https://moodle.org

[2] PaNOSC Project Information on CORDIS: https://cordis.europa.eu/project/id/823852

[3] IllumiDesk – Interactive Learning Environments for Data Heroes: https://www.illumidesk.com

Notebooks for learning management systems that is used to provide additional Python based learning features.

The evaluation of a survey has shown that the work packages WP2, WP3 and WP4 require a solution where they can add training resources in different ways. Together with PaNOSC we identified the need for an additional training content registry or catalogue to extend the existing e-learning platform. To present the platforms in a comprehensible way the starting point for each visitor is thereby a common PaN training portal.

1.2   Use Cases and Stakeholders (PaN Training Portal)

One major question in developing a common PaN training portal is how potential future users interact with our portal to find, access and provide training material. On the level of the portal itself it should be clear that our approach is divided into two complementary parts:

- A training catalogue where (external) material is provided;
- An e-learning platform with (internal) blended learning courses.

Therefore, it is essential to provide these different facets on a common PaN portal or landing page to guide our PaN scientists and further interested groups directly to the resource they expect. Furthermore, it is necessary to direct users to the other system by linking resources at certain points where it is appropriate.

Our various use cases are highly depended to the involved stakeholders of our PaN training portal. At this point we will focus on the portal itself and on the training catalogue. The requirements for the e-learning platform are summarised in section 2.1. In the following list, we assign and describe the use cases for these different stakeholders:

   I.   Portal user (PaN or RI scientist/student, facility user or non-specialist visitor, …):
- a. Visitors or also funding/government agencies can filter PaN related training materials (metadata), such as wikis, repositories, e-learning courses (Moodle), videos, training events or websites based on keywords, authors, abstracts, material type, content providers (RI);
- b. PaN scientist or student can search for training events (calendar), learning resources or materials based on keywords, authors, abstracts, material type, or content providers (RIs);
- c. Attend blended learning courses in a learning management system with guidance, quizzes, examples and step-by-step tutorials;
- d. Scientist interested in self-studying and advanced material.

  II. Content provider[4] (scientist, teacher, research facility staff …):
- a. One of the members from our PaN community wants to add material which can be used for training;

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[4] The separation into content provider and trainer was taken because within the catalogue the point of view changes from (specialised) trainers to a wider group of interactors who want to add materials. The transition from visitor to content provider is fluently and performed in the end by simply login with his PaN credentials.

      b. A provider wants to define a simple sequence of training steps or dependencies between materials in form of a training workflow in a simple and intuitive way;

      c. The organisation of a workshop as part of our projects should be supported by the portal;

      d. Overview of all resources available through the PaN training portal with the possibility to filter the content;

      e. Show available events (past and present) in an events calendar;

      f. The catalogue must provide harvesting (existing) content from various resources (Moodle, website, …) and national Research Infrastructures (RIs);

      g. The description of dependencies between (different) materials should be possible.

III. Trainer (on the e-learning platform):

      a. A trainer/teacher wants to promote or add material to the catalogue or the e-learning system and needs assistance in choosing the right one;

      b. In a subsequent step the trainer/teacher wants to add the content in an easy and intuitive way.

IV. Portal or content administrator:

      a. A provider wants to manage authorisations on both systems;

      b. And needs also the permission to maintain or curate the content.

V. IT administrator:

      a. Maintains the technical aspects of the training portal (not content related).

Based on the use cases a separation in the two complementary parts with an overarching guiding portal is obvious to direct every visitor to the right system or functionality. The PaN training catalogue has therefore similar requirements and can eventually directly be used as PaN training Portal, but this will be detailed in chapter 4.1.

An events or training course calendar is available at the PaNOSC website[5], but due to access restrictions a central calendar with content and access management at the level of the training portal or at the catalogue is necessary to provide content from various providers. This concept will be further discussed in section 3.1.

2. Evaluation of E-Learning Platforms

The PaNOSC project started one year prior to the start of ExPaNDS and had already developed concepts for an e-learning platform. In PaNOSC the use of the learning management system Moodle[6] was determined in the initial proposal[7], together with a MediaWiki[8] and a virtual platform. The methodology and criteria to choosing platforms for online training are very different and strongly dependent on the perspective of the user, visitor, content provider or trainer. For us an essential goal is to provide a system which can be used intuitively and provides many different ways to describe a blended learning course with the

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[5] PaNOSC Training Courses Calendar: https://www.panosc.eu/training-courses-calendar/

[6] Moodle – The world's most popular learning management system: https://moodle.org

[7] PaNOSC Project Information on CORDIS: https://cordis.europa.eu/project/id/823852

[8] MediaWiki: https://www.mediawiki.org/wiki/MediaWiki

possibility of varying types of presentations (e.g. video, text, questionnaire …). For the long-term availability, it is also necessary to choose a preferably open-source platform with a stable number of programmers, being used in multiple active projects.

2.1 Requirements for the e-learning Platform

The requirements on the e-learning platform were discussed in a workshop on use-cases together with PaNOSC. The workshop focused on blended learning courses and the learning management system Moodle. The following requirements based on feedback from the stakeholders were identified (overlapping's with section 1.2 intended):

I. Portal user (PaN scientists and students/trainees, non-specialist visitors …):
    a. Visitor is interested in PaN science and available learning resources or requires information of what the website provides;
    b. PaN scientist or student is searching for dedicated learning resources or materials based on keywords, authors, abstracts, material type, content providers (RI);
    c. Attending blended learning courses in a learning management system with guidance, quizzes, examples and step-by-step tutorials;
    d. PaN scientist interested in self-studying and advanced material;
    e. Login with existing credentials.

II. Content Provider or Trainer:
    a. A content provider adds content in order to prepare courses or to add additional information, documentation or workflows;
    b. A trainer/teacher wants to promote or add their course content and material to a learning management system in order to prepare blended learning courses;
    c. The trainer/teacher wants to guide and grade students in an easy and intuitive way;
    d. A trainer/teacher wants to upload training material;
    e. Offer, evaluate and grade courses in Jupyter notebooks.

III. Content administrator:
    a. A provider wants to manage the courses and assign or provide access for students to the courses;
    b. And requires also the permission to maintain or curate the content itself.

IV. IT administrator:
    a. Maintains the technical aspects of the e-learning platform (not content related).
    b. Wants to manage the computing resources available for the notebooks.

2.2 The Learning Management System (LMS) Moodle

The use of Moodle in the PaN community was successful in previous projects and there is high quality content available. The Moodle platform is an open-source learning management system (LMS) distributed under the GNU General Public License, developed and actively maintained since 2002. The Moodle Project is led and coordinated by Moodle HQ, an Australian company with 50 developers which is financially supported by a network of eighty-

four Moodle partner service companies worldwide. Moodle's development has also been assisted by the work of open-source programmers[9] and because of that, updates should be available in the long-term.

Most of the requirements previously mentioned are met by the Moodle system. The requirements regarding the integration of Jupyter notebooks and the grading based on the notebook cells are fulfilled by several open-source plugins.

Figure 1 gives an impression of a blended learning course in a Moodle test instance at HZDR. The course starts with a page on learning goals, a short quiz is used to show the student which minimum knowledge is required to succeed in this course. To gather some background information a short survey is used to evaluate the student's background knowledge. The specific content is embedded into self-learning materials based on reading resources in form of an online book, a glossary for references and also external websites.
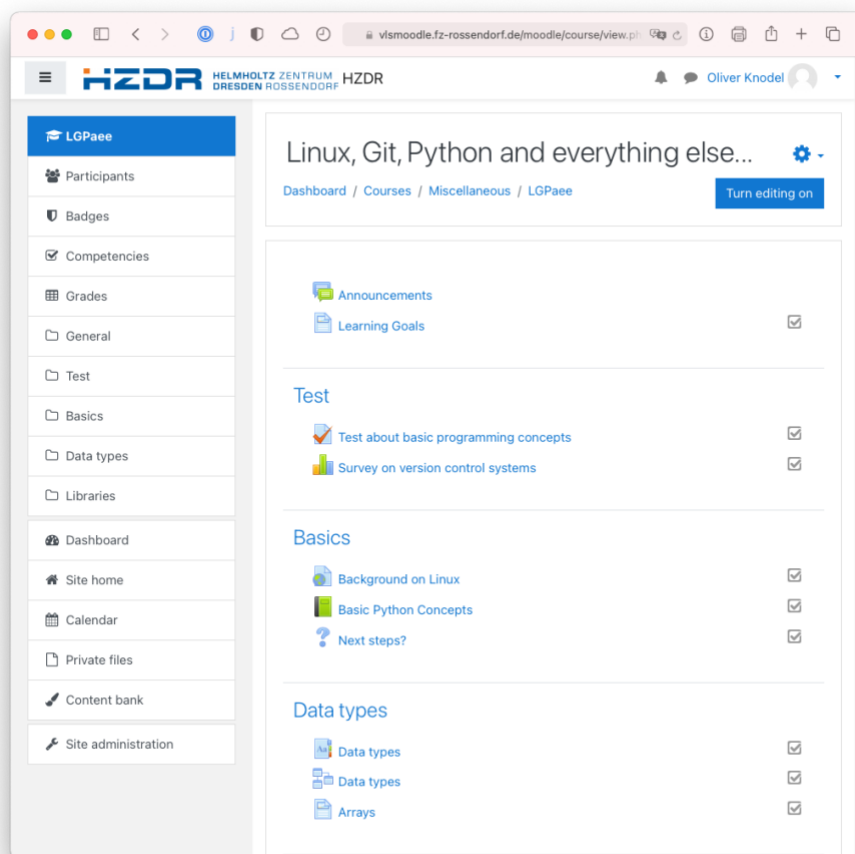
Figure 1: Screenshot of a simple course in a Moodle test instance.

The teacher or trainer has a handful of possibilities to design a blended learning course and also to motivate the students to work on their own. It is possible to design a complex course with different kinds of activities or resources as shown in Figure 2. The integration of interactive learning environments and the grading of students based on their solutions is also possible via third party plugins such as IllumiDesk[10].

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[9] http://opensource.com/life/15/4/how-moodle-manages-community-feedback
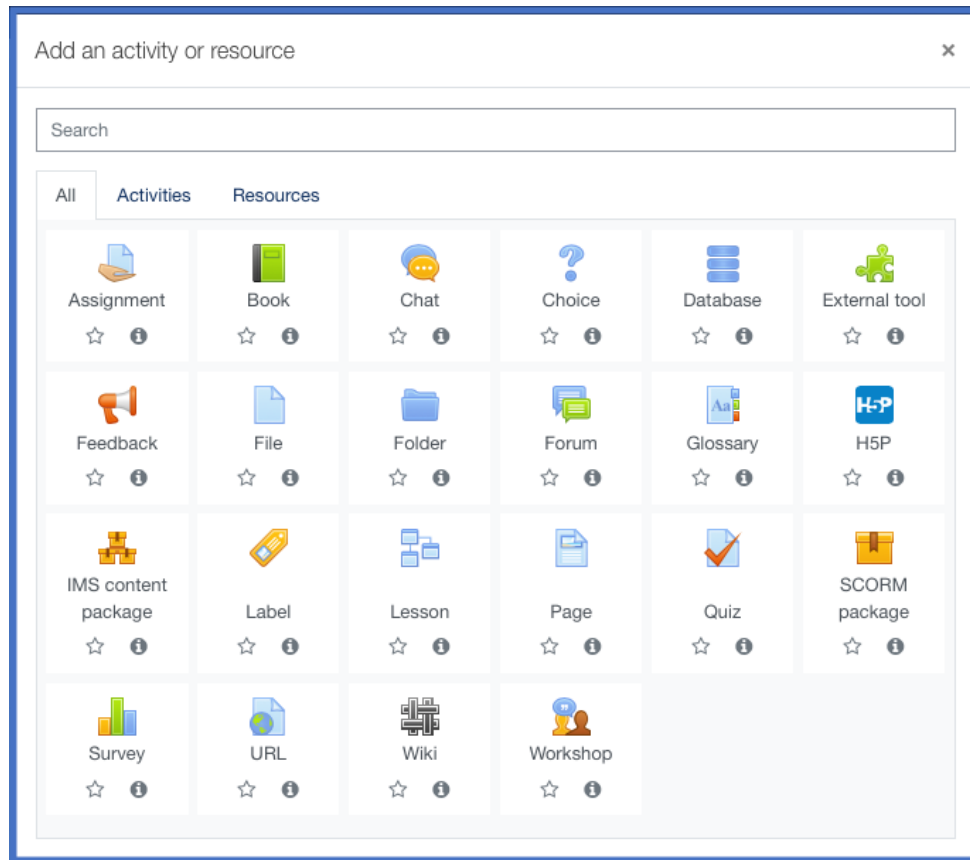[10] https://www.illumidesk.com

Figure 2: Possible activities and resources in a Moodle course.

Even if other open source learning management systems exist, we stick to Moodle LMS due to its high flexibility and because https://pan-learning.org/ provides PaN related content on the ESS infrastructure which is already adapted to the PaNOSC and ExPaNDS projects.

3. Evaluation of Appropriate Catalogues

Similar to the e-learning platform it is an essential goal to provide a catalogue which can be used intuitively and offers simple required fields to describe the material, but also the possibility to add further keywords or metadata. Furthermore, the description of dependencies between training steps in a simple training workflow would be desirable. For the long-term availability it is also necessary to choose a preferably open-source platform with a stable number of programmers and which is ideally used in multiple active projects.

3.1 Requirements for the Training Catalogue

The requirements for our training catalogue are based on the use cases discussed in section 1.2 and our observations in the "PaNOSC/ExPaNDS Train the Trainers (TtT) workshop"[11] held in February/March 2021. The scope of the workshop was to train potential content and training providers on how to best use the platform https://pan-learning.org for their needs, with the aim of developing hands-on content for the e-learning portal. The content can be in the form of text (wiki), quizzes, videos, annotated videos and slide shows.

During the event we realised that the design of a course requires deep knowledge of the concepts of blended learning and the Moodle system. Moodle itself provides unique features, but for most of our requirements on catalogues for training material, Moodle is too complex. Our requirements on the catalogue, as an extension of the e-learning system in section 2.1, is similar to the PaN portal requirements in section 1.2. The catalogue and the portal can therefore be realized as one single system.

3.2 Evaluation of Training Catalogue Applications

There are multiple different catalogues or systems which can be used to store training information with related metadata available. Such systems which can be used as a basis for our training material catalogue are for example:

- Invenio Framework (https://inveniosoftware.org):

    An open-source project that was initially developed by CERN. Invenio covers a suite of currently three main products developed by the Invenio community: InvenioRDM, InvenioILS and Invenio Framework - a code library to build large-scale information system. The open access data repository Zenodo, built on the Invenio Framework Zenodo is very popular for archiving all kinds of digital objects. Metadata based on DataCite, keyword search and filtering.

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[11] Trainiers (TtT) workshop 2021 https://indico.esss.lu.se/event/2499/

- DSpace (https://duraspace.org/dspace/):

    An open-source dynamic digital repository maintained by the non-profit organisation DuraSpace, which is now part of the academic consortium LYRASIS[12]. The repository allows to preserve all types of digital content and large datasets. All files or digital objects and the describing metadata are stored in a relational database.

- GeoNetwork (https://geonetwork-opensource.org)

    A more specific repository for geospatial data and describing metadata in Dublin Core standard. The repository also allows teachers to share datasets linked to an educational resource.

- CKAN (https://ckan.org):

    Another open source data management system for datasets and public data. Very similar to Invenio and focused on large datasets. Definable metadata, keyword search and filtering as well as visualization features.

- AtoM (https://www.accesstomemory.org/):

    Provides *Access to Memory* with a web-based open source application. More focused on archival description that allows users to tag files and describe objects using build-in metadata standards.

- Islandora (https://islandora.ca):
    An open source framework providing digital asset management. Allows collaboratively managing and discovering digital objects. The metadata itself is not accessible to users.

The above applications provide useful characteristics. However, our use case does not require the upload of datasets. Which is in most of the systems unavoidable and even if the upload is not required the systems are designed for large datasets and therefore not the best choice for our catalogue.

In the following chapter, applications which are already used for training material are introduced in more detail regarding application areas, usability as well as overall design. The seven systems are chosen based on our requirements defined in section 1.2. These catalogues are already used to collect references to (training) materials and present these with different approaches.

3.2.1 EOSC Pillar

The EOSC-Pillar consortium covers France, Germany, Italy, Austria and Belgium, which are among the European countries that are supposed to bring major contribution to the co-building of the EOSC[13]. The EOSC-Pillar gateway therefore offers the EOSC-Pillar Catalogue[14] and

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[12] https://www.lyrasis.org/
[13] https://www.eosc-pillar.eu/consortium
[14] https://eosc-pillar.d4science.org/catalogue-eoscpillar

also, research environments for 34 so-called organisations from the areas marine, costal and agricultural ecosystems as well as biodiversity. Figure 3 gives an overview on the frontpage of the research catalogue.
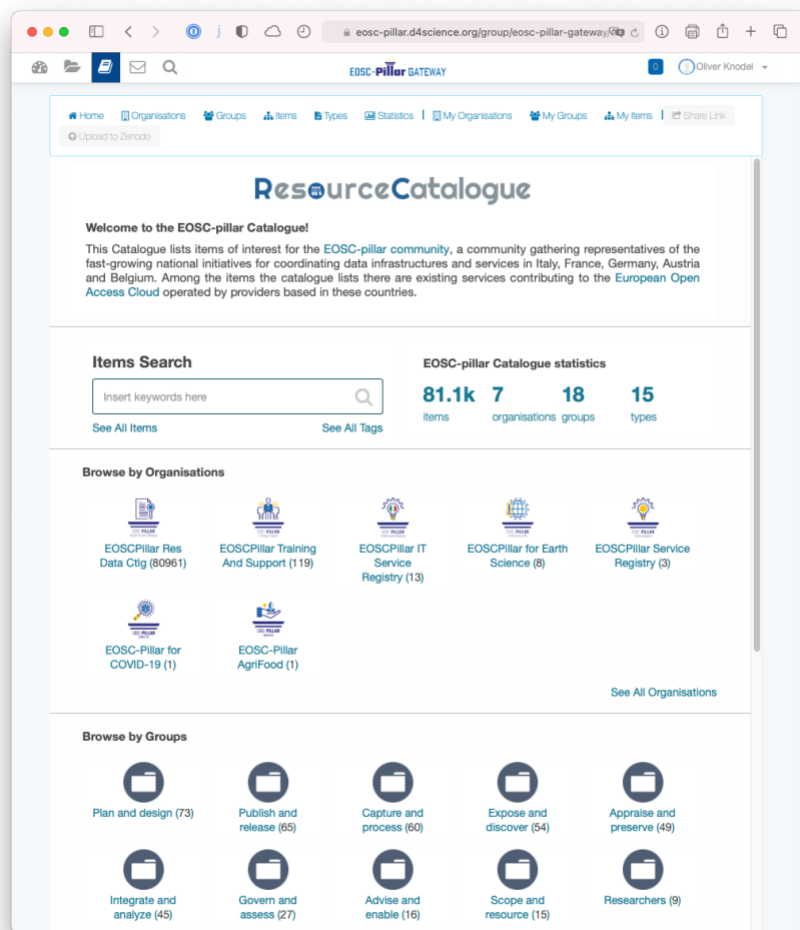

Figure 3: Screenshot of the EOSC-Pillar resource catalogue. https://eosc-pillar.d4science.org/group/eosc-pillar-gateway/data-catalogue

The catalogue allows browsing organizations, groups and types of digital objects (e.g. websites, courses, resources datasets, …). The search can be based on keywords and tags and other provided metadata. Figure 4 shows items or material with the category website which is also intended for our PaN catalogue.

The list of tags or metadata on the left side in Figure 4 gives an impression of available metadata in the catalogue and allows efficient search queries. The catalogue itself is powered by the data repository CKAN[15] and gCube[16], an open-source software toolkit used for building and operating data infrastructures enabling the dynamic deployment of Virtual Research Environments (VREs).

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[15] https://ckan.org
[16] https://www.gcube-system.org
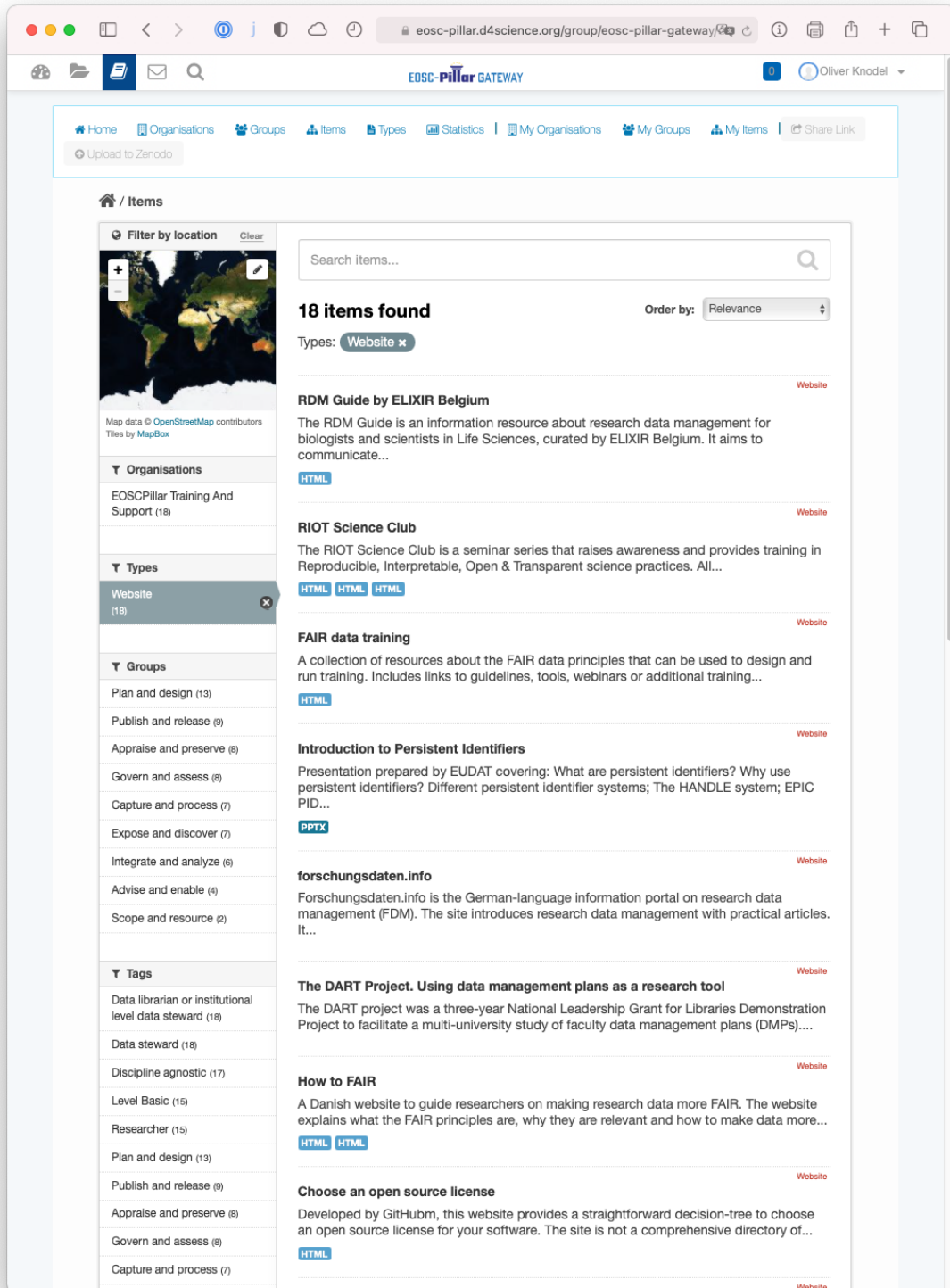
Figure 4: Screenshot of the EOSC-Pillar resource catalogue items with type website. https://eosc-pillar.d4science.org/group/eosc-pillar-gateway/data-catalogue/

3.2.2 ENVRI Training Catalogue

The large number of already available training resources was a starting point for developing a training catalogue[17] at ENVRI. ENVRI itself is a community of environmental research infrastructures working together to observe the earth as one system[18]. The community provides environmental data, tools and other services that are Open and FAIR, and can be easily used by anyone for free. The training catalogue should contain educational resources through third-party platforms, such as wikis, websites or learning management systems like Moodle. Figure 5 gives an impression of the frontpage of the ENVRI training catalogue.
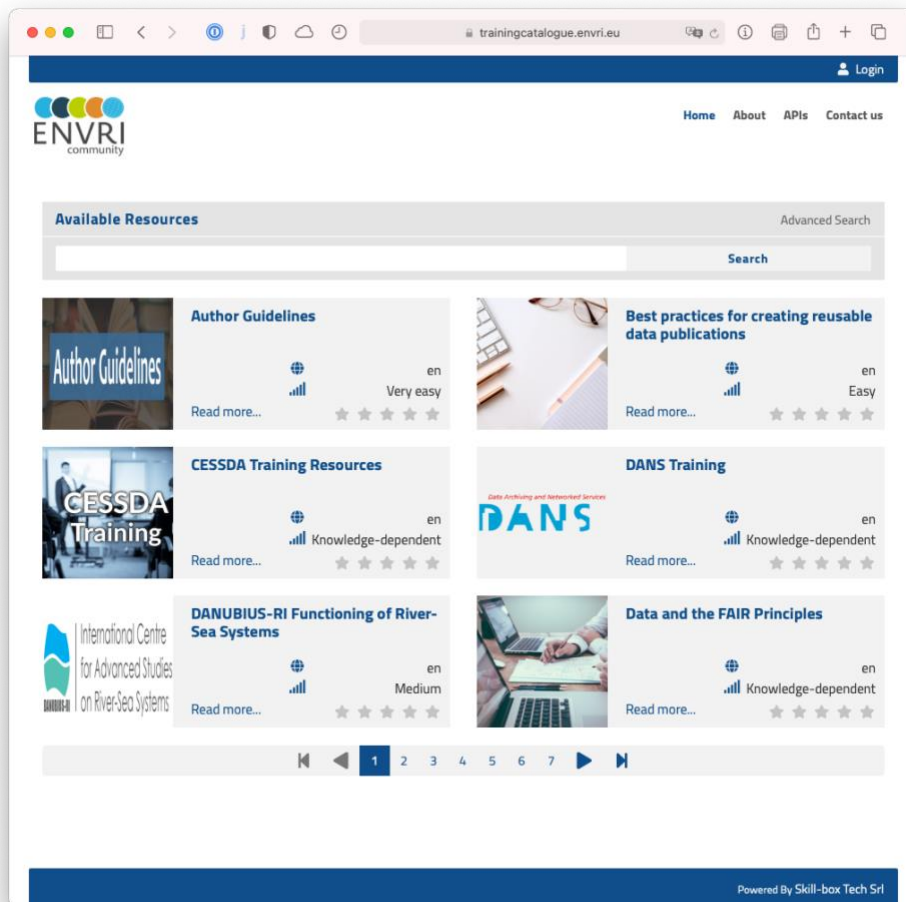
Figure 5: Screenshot of the front page from the ENVRI training catalogue. https://trainingcatalogue.envri.eu

The catalogue allows filtering the entries and their metadata based on an advanced search, working on metadata based on a customised profile of the IEEE Standard (IEEE 2002) for Learning Object Model (LOM)[19], which is the basis of the catalogue. Figure 6 shows an entry for training material. The material itself is accessible via a URL to the (external) resource. While simple search is possible for everyone, registered users can access a private area, leave comments and rate resources. Only contributors can create new resources called

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[17] https://trainingcatalogue.envri.eu
[18] https://envri.eu
[19] ENVRI-FAIR MS22 Document: https://doi.org/10.5281/zenodo.3903340

learning objects. It is also possible to upload images for the learning object's resource page. If there is no external URL available, it is also possible to upload a ZIP archive containing the learning resource. Most of the metadata fields are mandatory, which leads to high-quality metadata.
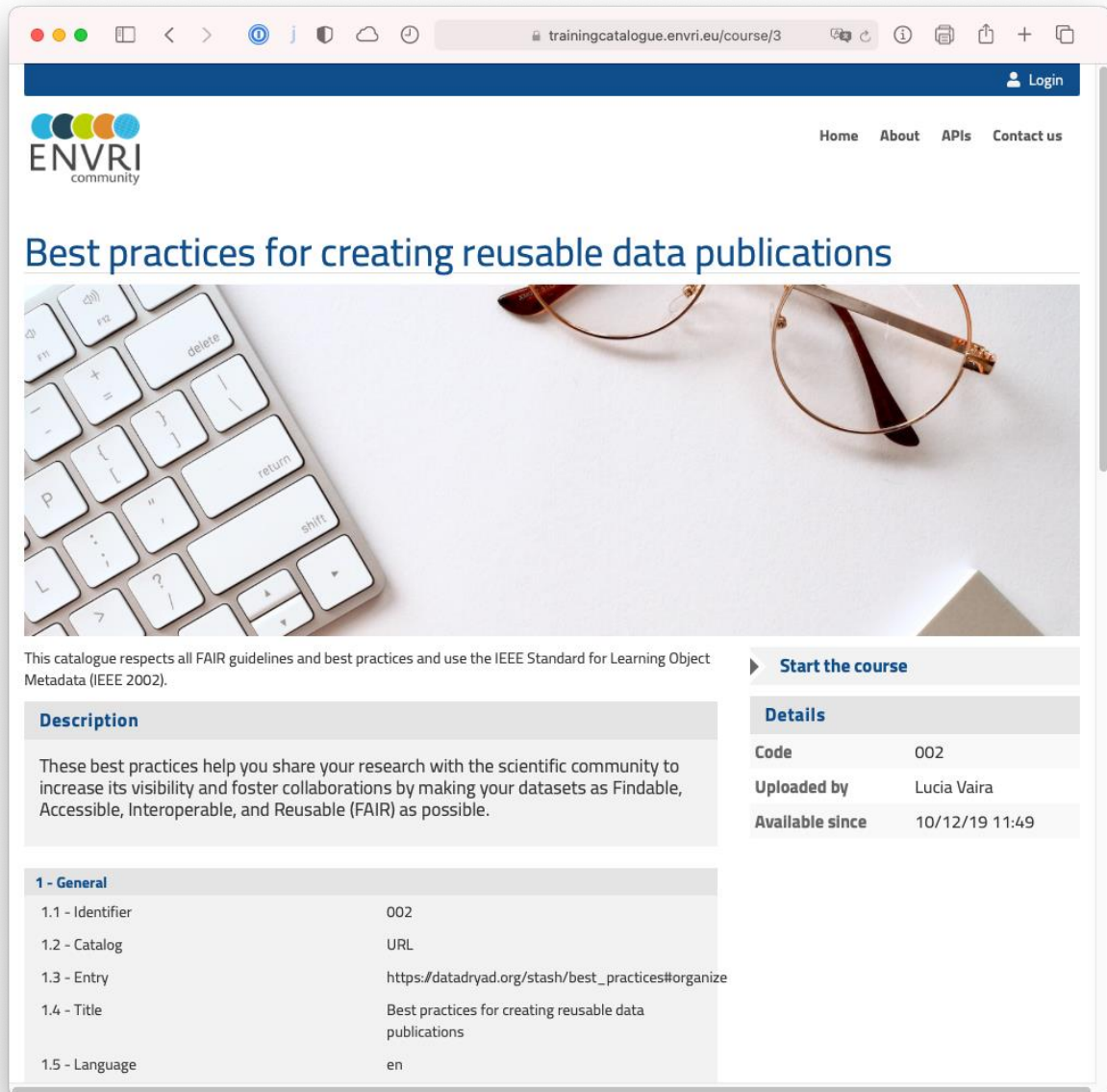
Figure 6: Landing page of a record in the ENVRI training catalogue. https://trainingcatalogue.envri.eu/course/34

3.2.3 TeSS Training Catalogue

TeSS[20] is ELIXIR's[21] training platform, providing a one-stop shop for trainers and trainees to discover online information and content, including training materials, events and interactive tutorials. For ELIXIR Nodes, TeSS provides opportunities to promote training events and

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[20] https://tess.elixir-europe.org/about
[21] https://elixir-europe.org

news, and to contribute to a growing catalogue of materials; for trainers, the portal offers an environment for sharing materials and event information; for trainees, it offers a convenient gateway to identify relevant training events and resources, and to perform specific, guided analysis tasks via customised training workflows. ELIXIR brings together Europe's leading life science organizations in managing and safeguarding the increasing volume of data being generated by publicly funded research. Figure *7* gives an impression of the frontpage.
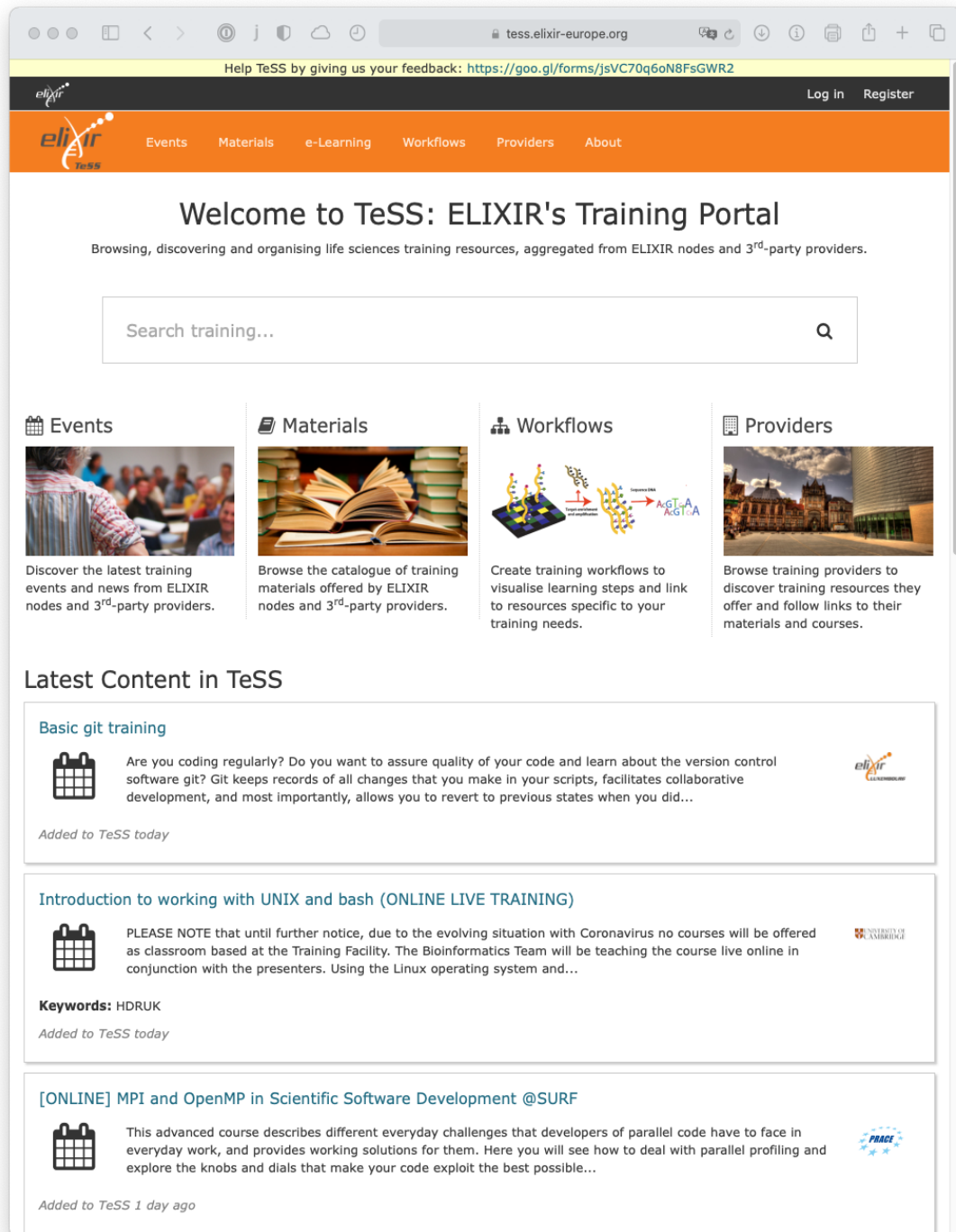
Figure 7: Screenshot of the TeSS training catalogue providing collections for events, material, training workflows and training providers. https://tess.elixir-europe.org

The four types of materials in the TeSS training portal are shown under the central search field in the form of the tiles: events, materials, training workflows and content providers. The materials pages (Figure 8) and the provider overview are very similar to those in the catalogues introduced before.

Figure 8: Screenshot of a material landing page in the TeSS training catalogue. https://tess.elixir-europe.org/materials/elaboracion-de-un-plan-de-gestion-de-datos-dmp-teoria-y-practica

A unique feature is the possibility to create workflows as shown in Figure 9. With such workflows, it is possible to render complex coherences and dependencies in performing simulations or analysis and every node includes a description and URLs to external resources.
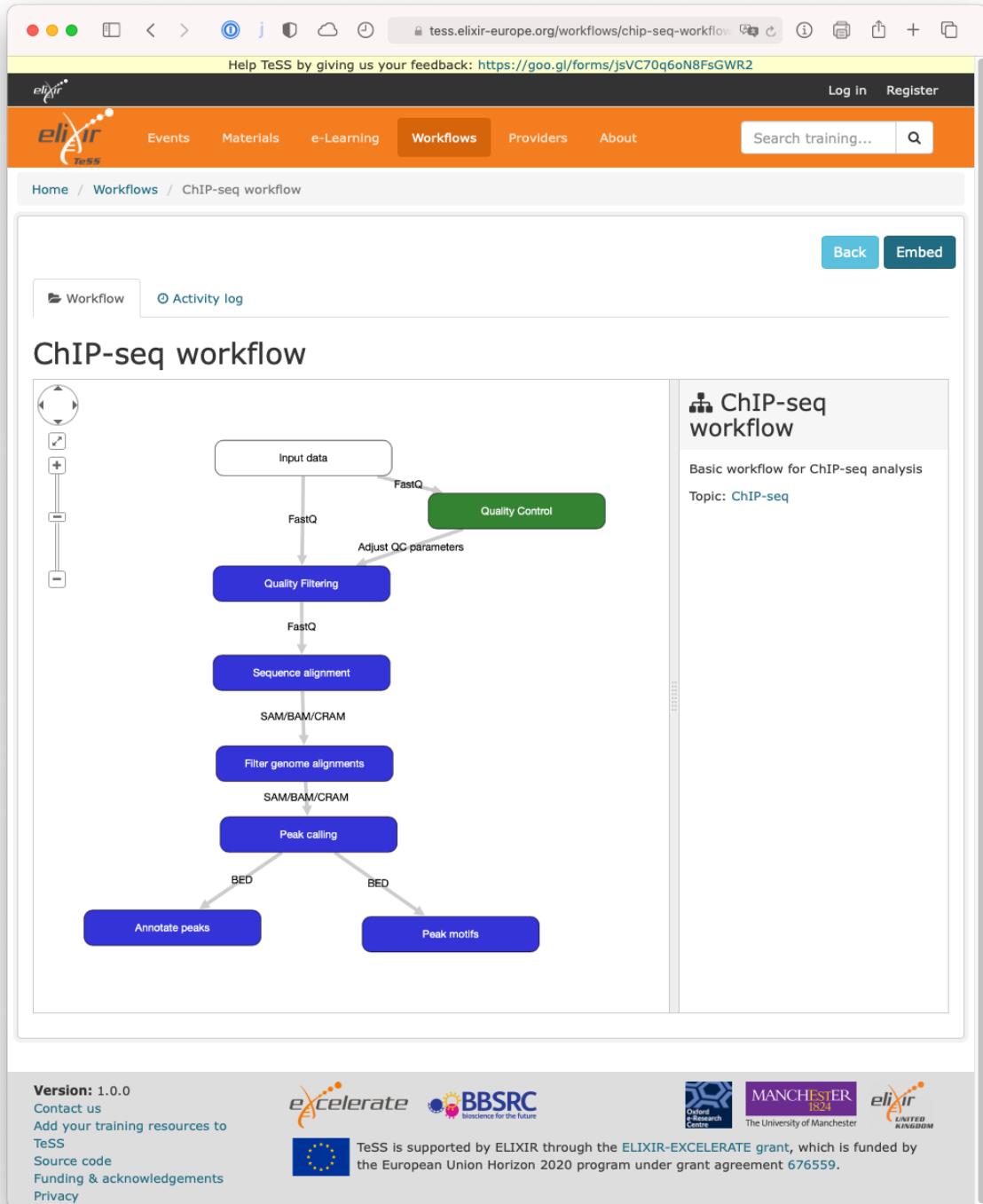
Figure 9: Screenshot of a ChIP-seq workflow in TeSS. https://tess.elixir-europe.org/workflows/chip-seq-workflow

3.2.4 EOSC-hub Training Material

The EOSC-hub provides furthermore the EOSC-hub on training material[22]. The system provides training material and a training calendar similar to EOSC Pillar (3.2.1) and the Tess Training Catalogue (3.2.3). Figure 10 gives an impression of search results and available metadata fields. Most of the metadata fields have a controlled vocabulary, which simplifies grouping and search of keywords. The landing pages for each entry provides an additional description and the URL to the resource.
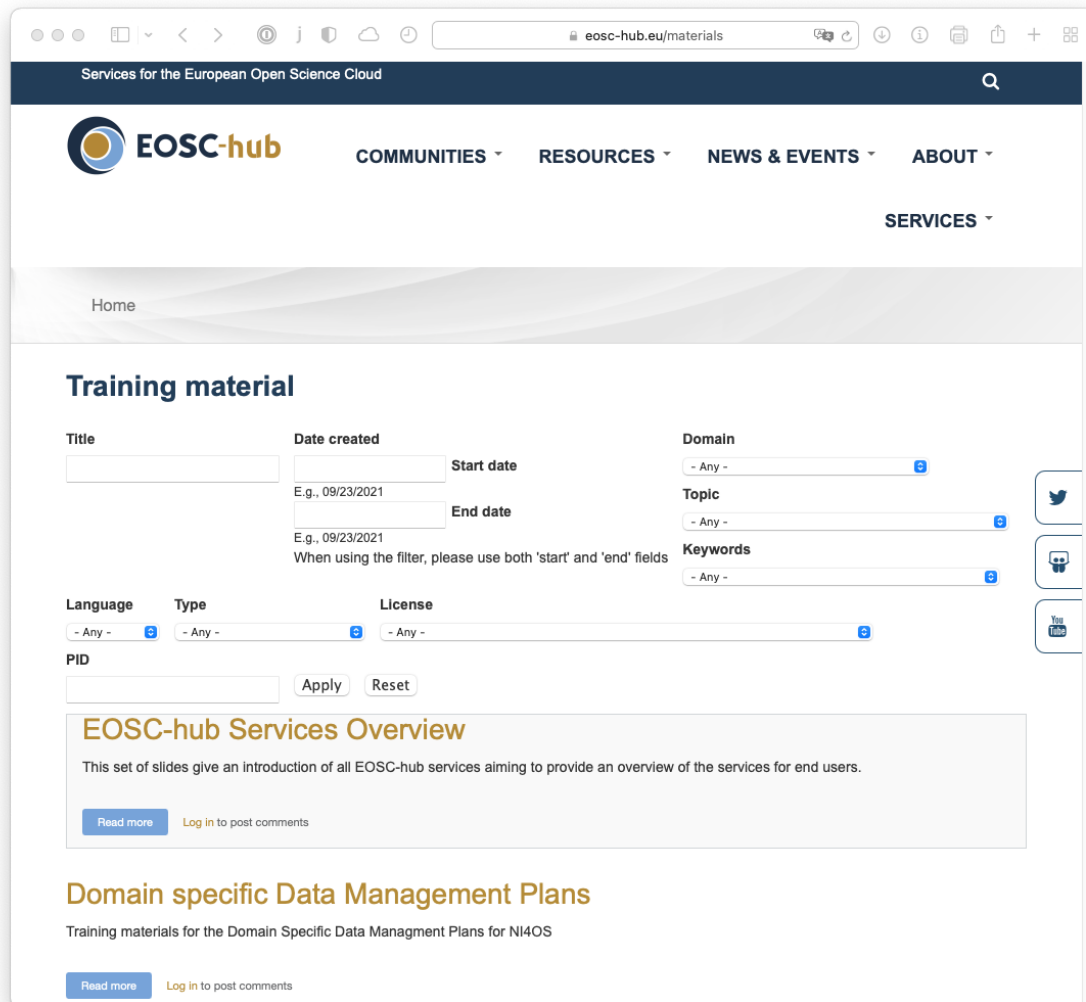
Figure 10: Screenshot of search results of the EOSC-hub on training material. https://eosc-hub.eu/materials

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3.2.5 FAIRsFAIR Training Library

FAIRsFAIR[23] provides a training library[24] with training material on practical solutions for the use of FAIR data principles. The system is very similar to the system introduced before. A major difference is that the system does not provides landing pages as shown in Figure 11. All relevant information for a material is displayed directly in the list of search results what makes it easy to access the external resource directly.
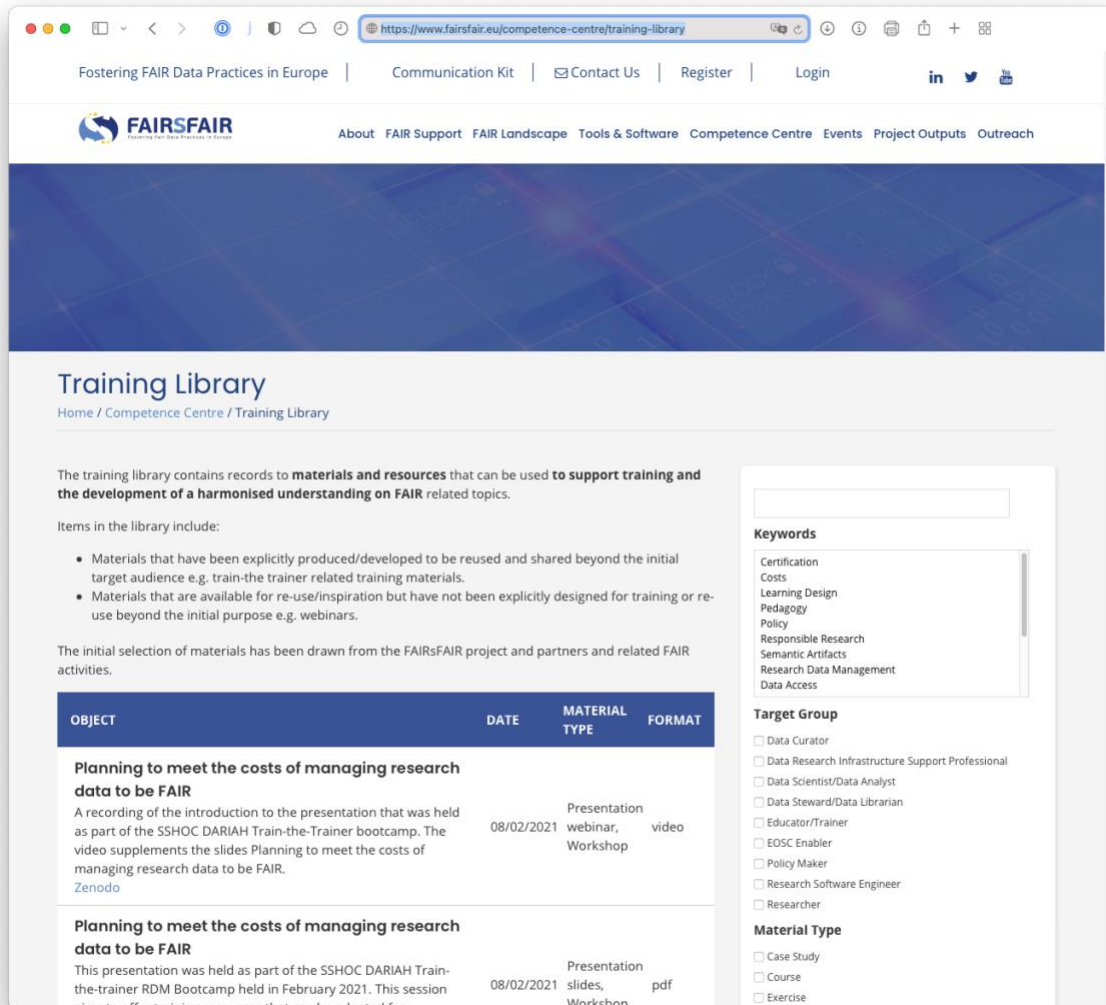
Figure 11: Screenshot of search results in the training library provided by FAIRsFAIR project. https://www.fairsfair.eu/competence-centre/training-library

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[23] https://www.fairsfair.eu
[24] https://www.fairsfair.eu/competence-centre/training-library

3.2.6 EUDAT Training

The EUDAT Collaborative Data Infrastructure (or EUDAT CDO) provides a collection of training material on their website[25]. The didactical sequence of learning steps is visualised in a simple diagram as shown in Figure 12 and the resources can be accessed directly. The concept is perfect to introduce a specific topic and the learning steps in the form of a workflow and would meet our requirement on dependencies between training material, but the system is static and not designed to add additional resources.
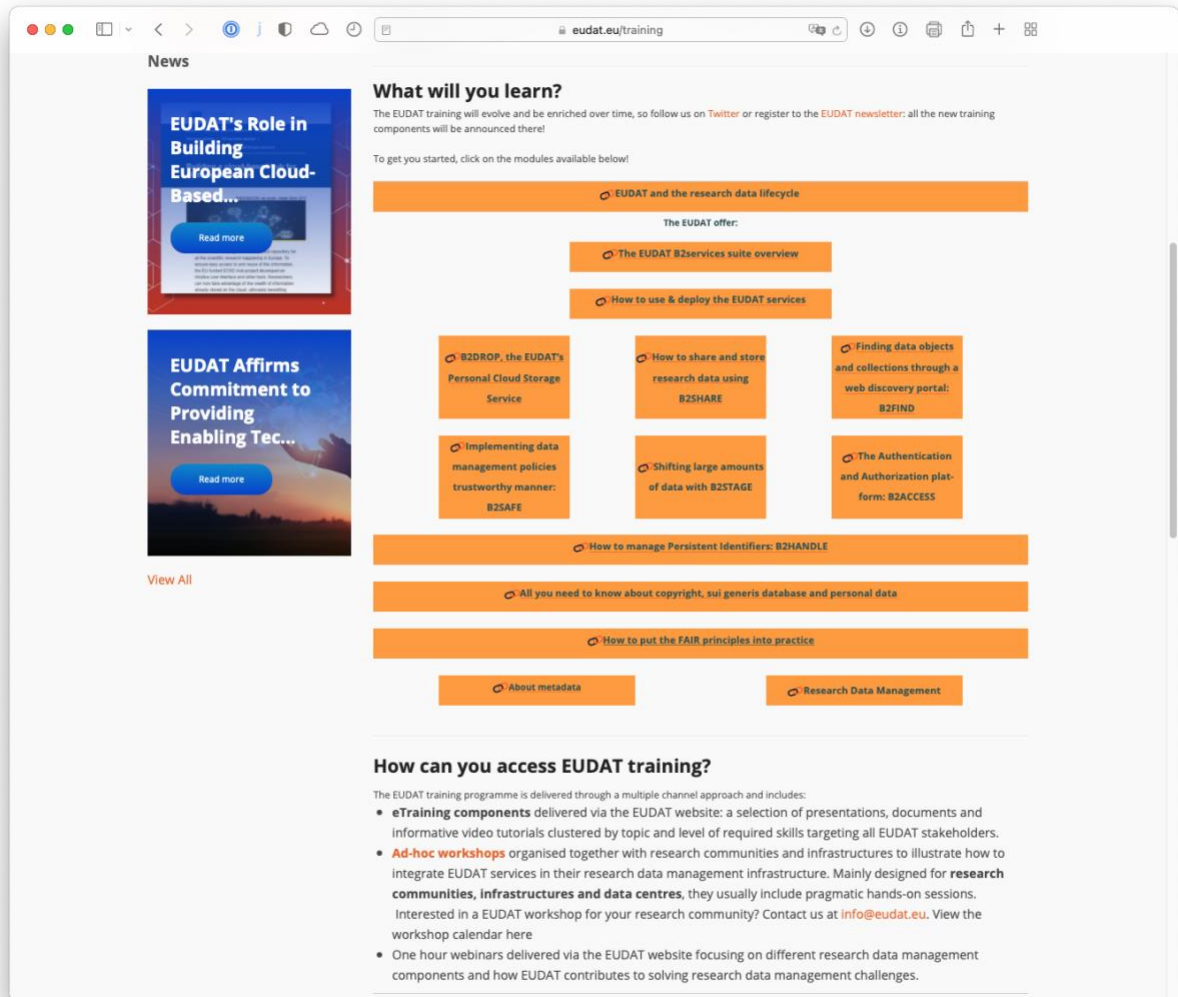
Figure 12: Screenshot of the training section on the EUDAT website. https://eudat.eu/training

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[25] https://eudat.eu/training

3.3 Conclusions

Based on our detailed evaluation of the catalogue applications which could be used for our PaN training material catalogue, we choose the TeSS training catalogue. The system developed by Elixir provides various features, meets our requirements defined in section 3.1 and is open-source under the BSD 3-Clause License[26]. Also, its ease of use and its clear design are essential reasons why we choose the TeSS catalogue. The possibility to design workflows are also a main feature that is missing in all the other candidates. The customisation and further use of the catalogue for other projects was not intended by Elixir and is therefore laborious, but possible.

The metadata scheme used in the ENVRI Training Catalogue is ideal to describe the training materials regarding the FAIR principles and we therefore plan to use a similar metadata scheme in our catalogue.

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[26] https://github.com/ElixirTeSS/TeSS/blob/master/LICENSE

4. PaN Training Portal

In the following chapter, we discuss our concept of a portal architecture providing uniform access to the resources developed by ExPaNDS and PaNOSC. The portal is designed as a common and easy to use webpage providing access to our PaN related training materials. We detail our concept for a portal architecture in section 4.1, our demonstrator for a training catalogue in 4.2 and the e-learning platform developed by PaNOSC in 4.3.

4.1 Concept for a Common PaN Training Portal

Together with PaNOSC, we decided to deploy a common portal to introduce our PaN related training concepts. The portal itself has the important role to guide the visitor to the right resource. Typically, the difference between the e-learning platform and the training catalogue must be represented in a comprehensible way. For a visitor it must be clear where to find, but also to add training material. Figure 13 gives an overview on our initial concept for the PaN training portal architecture from the beginning of 2021. It is also intended to register the PaN Training Portal in the EOSC marketplace.
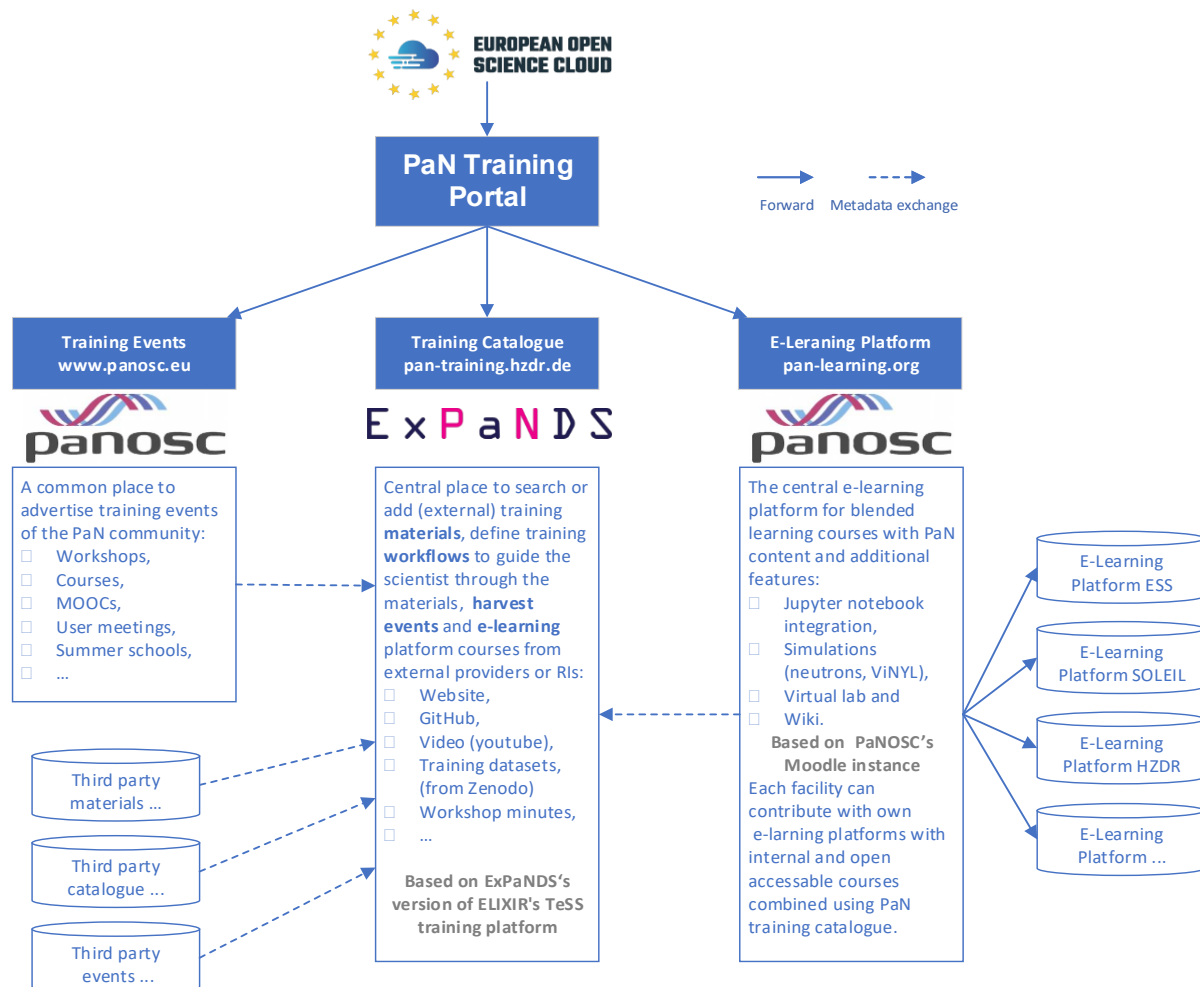
Figure 13: Initial concept of our training ecosystem with an overarching PaN training portal as uniform access point introducing our subordinate components: the e-learning platform developed by PaNOSC and the PaN training catalogue developed by ExPaNDS. The training events calendar can be synchronised with the training catalogue as well as the courses from the e-learning platform.

The landing page itself fulfils the task of introducing our common PaN training efforts to interested visitors or scientists from our PaN community. Another important task is to guide visitors to subordinate resources:

1. Training Events Calendar (integrated in our catalogue),
2. Training Catalogue (hosted at HZDR) and
3. E-learning platform (hosted at ESS).

Visitors come to our PaN portal with various intentions as described in section 1.2 on Use Cases and Stakeholders. Therefore, it is necessary to guide the visitor to the expected and required resource. Our training catalogue is intended to provide all courses from the PaN e-learning platform through synchronisation of the metadata, therefore we can redirect all searches from our catalogue to the e-learning platform.

The more challenging part is the creation of material. If the visitor would like to add simple external materials or create a training workflow based on external resources our catalogue is the right place. If the development of a full blended learning course or own training material is intended, we forward the user to the e-learning platform to create a course in our LMS Moodle.
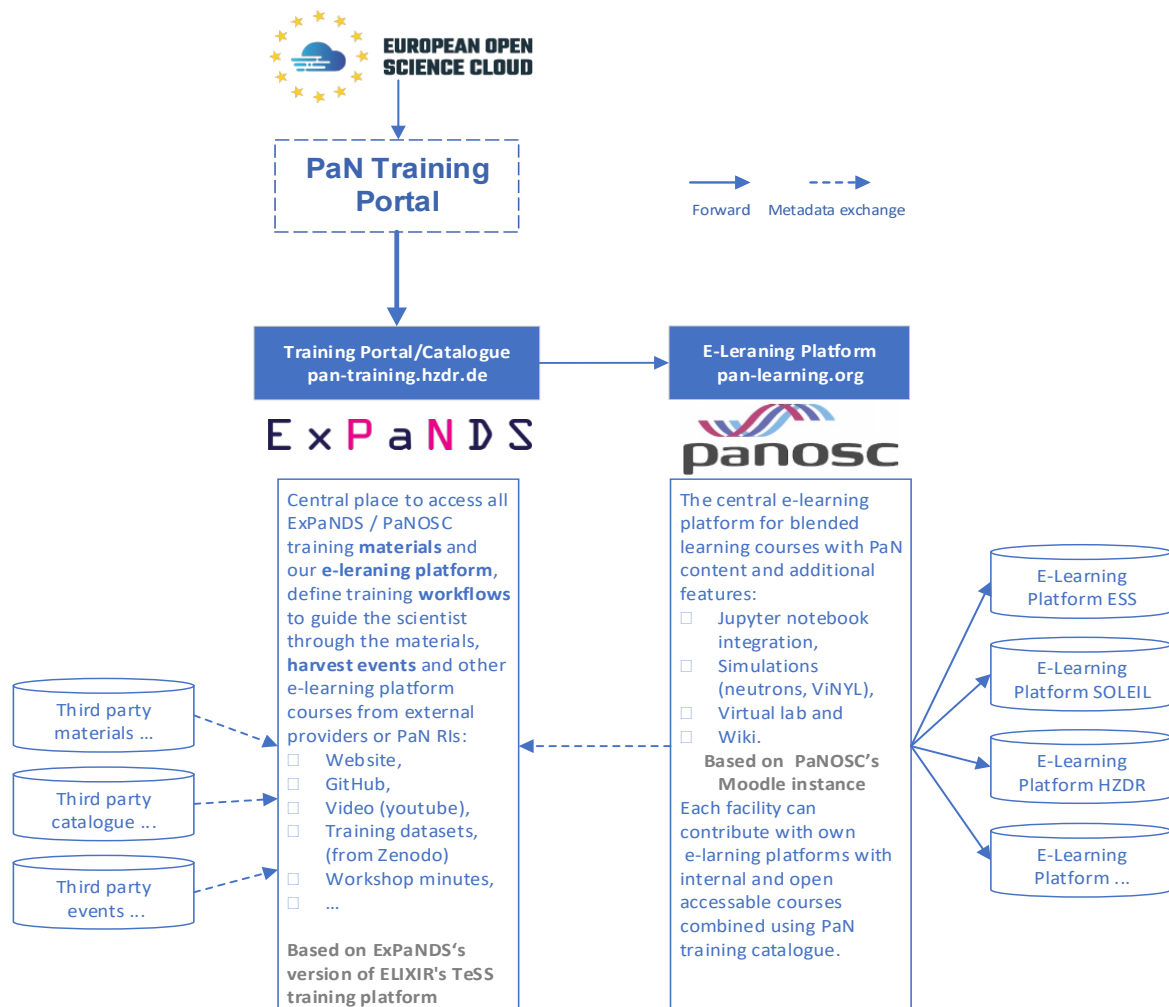
Figure 14: *Concept of our recent training ecosystem with our PaN training catalogue used as central portal. The courses from the e-learning platform are synchronized to the material database but in addition the e-learning platform can also directly accessed from the frontpage of the portal.*

Figure 14 shows our current approach for a common PaN portal as entry point to all our training and learning resources. With that approach all external and internal (e-learning system) material is presented directly at the portal in a common user-friendly way. The e-learning system can be accessed through the catalogue but also through a direct link on the catalogue's frontpage. The usability is much higher and an additional portal becomes obsolete. Here, it is of particular importance to introduce the e-learning platform developed by PaNOSC not only through the materials, but also directly on the frontpage. An additional training courses calendar is thereby not necessary and can be integrated into the training catalogue.

At project start the concept of a standalone portal navigating the user to a catalogue or the e-learning platform seemed to be a promising solution. After feedback from other work packages and a survey at the beginning of 2021, we came to the decision that our catalogue can also be used as main entry point to our PaN training services. As at the time of the publication of this document, the decision had not been made, we have demonstrated both options.

4.2   PaN Training Catalogue (Demonstrator)

In section 3 we evaluated different catalogues and decided to use the TeSS[27] catalogue for our projects. The ExPaNDS WP5 demonstrator is forked from the original TeSS project on GitHub[28] and added to our joint GitHub organisation *PaN-Training*[29] as a separate project under the name *pan-training*[30]. We noticed that most of the features described in this chapter have been developed in the TeSS project during the last six years. The catalogue is written in "Ruby on Rails" and for our initial version we modified layout, design and overall occurrence to create a unique system matching the ExPaNDS/PaNOSC design and style.

4.2.1 Frontpage

The first impression of a portal or catalogue is essential to motivate the visitor or user to interact with the content of a webpage. The frontpage is shown in Figure 15 and it begins with a large centred text input field with the text "Search PaN training…" to show the primary function of the website. The different kinds of top-level resources are introduced with images and descriptive text to guide the visitor to the resources. Underneath, the most recently added material is displayed to show the diversity of material in our catalogue.

Next to the main types of resources - Events, Materials and Workflows - Providers are also listed on our frontpage to show the members of our joint projects PaNOSC and ExPaNDS. The link to the e-learning system (pan-learning.org) is integrated as a central tile between the other catalogue resources.

Header and footer contain links to further information of the catalogue, our funding projects, source code, contact and privacy information. A separate *About* page provides information on the background and usage of our catalogue.

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[27] https://tess.elixir-europe.org
[28] https://github.com/ElixirTeSS/TeSS
[29] https://github.com/pan-training
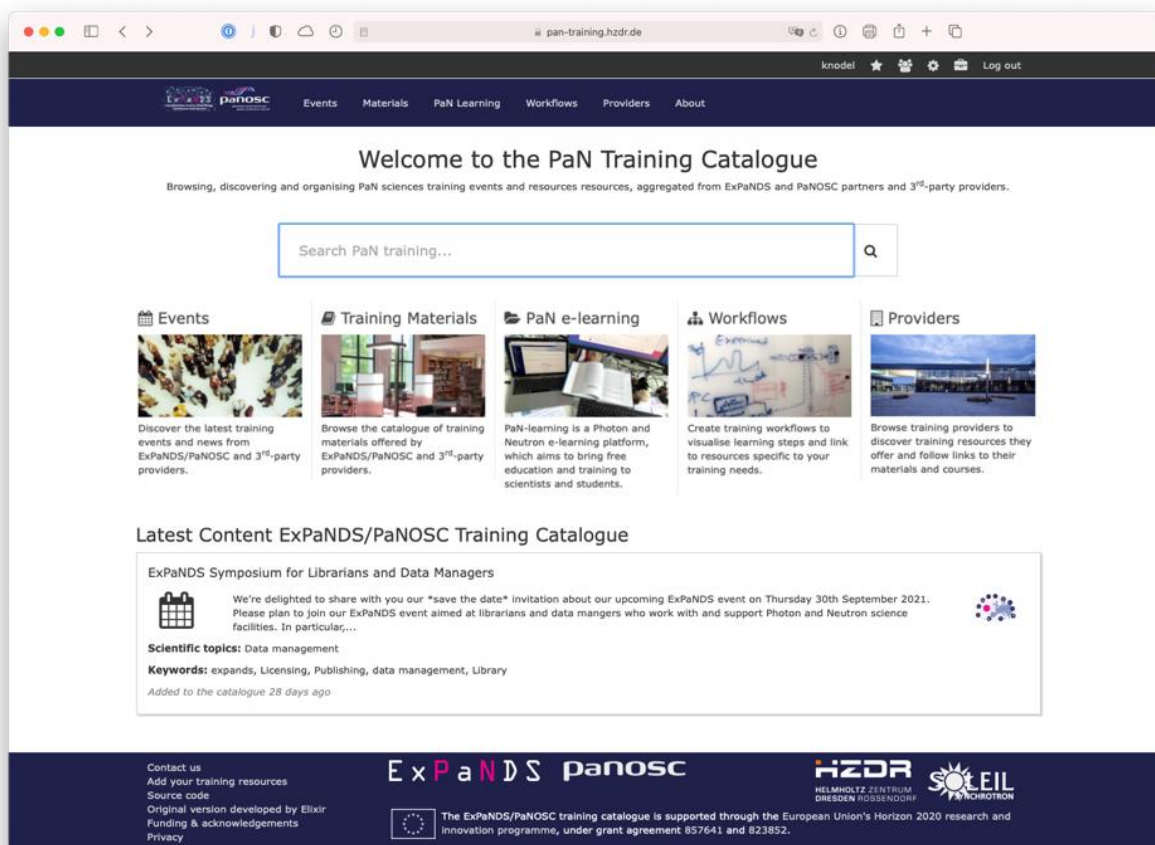[30] https://github.com/pan-training/training-catalogue

Figure 15: Screenshot of the frontpage of the ExPaNDS/PaNOSC prototype used as central PaN training portal. The search field is the central component and the five main functions Events, Materials, the reference to our e-learning system developed by PaNOSC, Training workflows and Providers.

4.2.2 Events

The registration of events in our catalogue gives us the unique opportunity to bring together all PaN related events with training character in one central place. A scientist has the opportunity to register an event directly in our catalogue and describe it with relevant metadata and a short description. An interesting feature is the possibility to provide additional reports after the event, only visible to privileged users. Figure 16 shows an online event with metadata and additional report added after the event.

In addition to the manual registration of an event it is also possible to automatically register events available on external target websites or calendars. To register events in our training catalogue automatically, we develop scripts or scrapers extracting data from websites in a reliable way. That is possible for every website including structured data. The scripts run every night, adding new or updated resources to our catalogue.

Figure 16: Screenshot of an online event with further information added after the event in form of a report, visible only to privileged users.

Events can be searched by anonymous visitor using filters on metadata fields (similar to materials as shown in Figure 17). Furthermore, it is possible to subscribe via mail (daily, weekly or monthly messages with events for registered users) or import the events directly in a personal calendar via URL.

4.2.3 Training Material

The training material in our calendar can be searched using filters as shown in Figure 17. A subscription for mail notification on customisable messaging frequency and metadata fields is

possible for registered users. Registered users can also add new material manually. Similarly to events, materials can also be synchronised to our catalogue with scrapers in the background. The synchronisation with courses from our e-learning platform developed in the PaNOSC project is also planned. For that, it is necessary to extract the necessary metadata from the Moodle LMS via its API. With the catalogue we provide the possibility to search Moodle courses in a more efficient way.
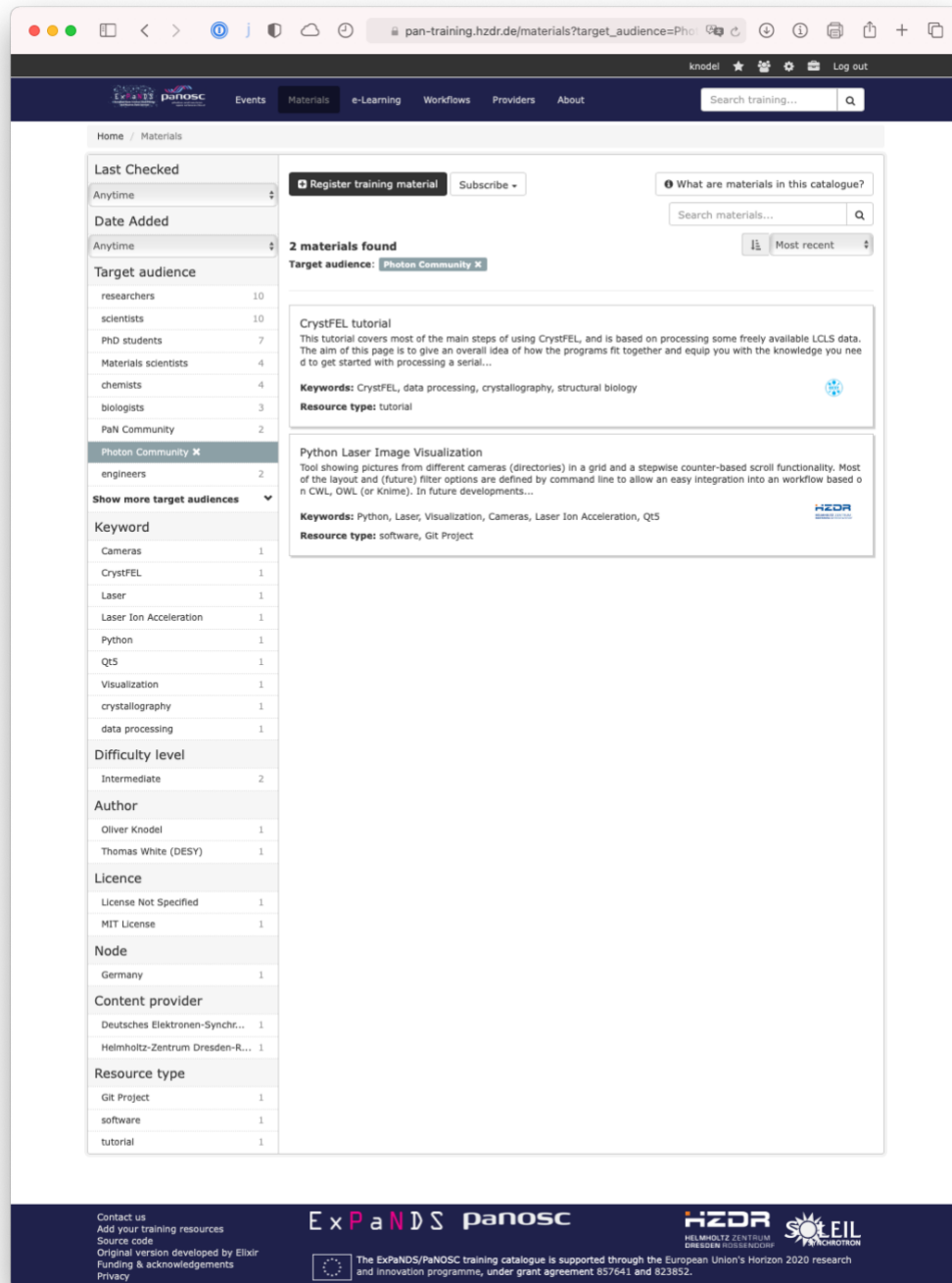
Figure 17: Screenshot of the material search view with the different categories and keywords to easily search for particular topics and materials.

A typical landing page for a training material entry is shown in Figure 18. All provided metadata is displayed as well as the description of the content provider. The URL of the external training resource is located directly between title and description. The Button *View Material* leads to the same external resource.
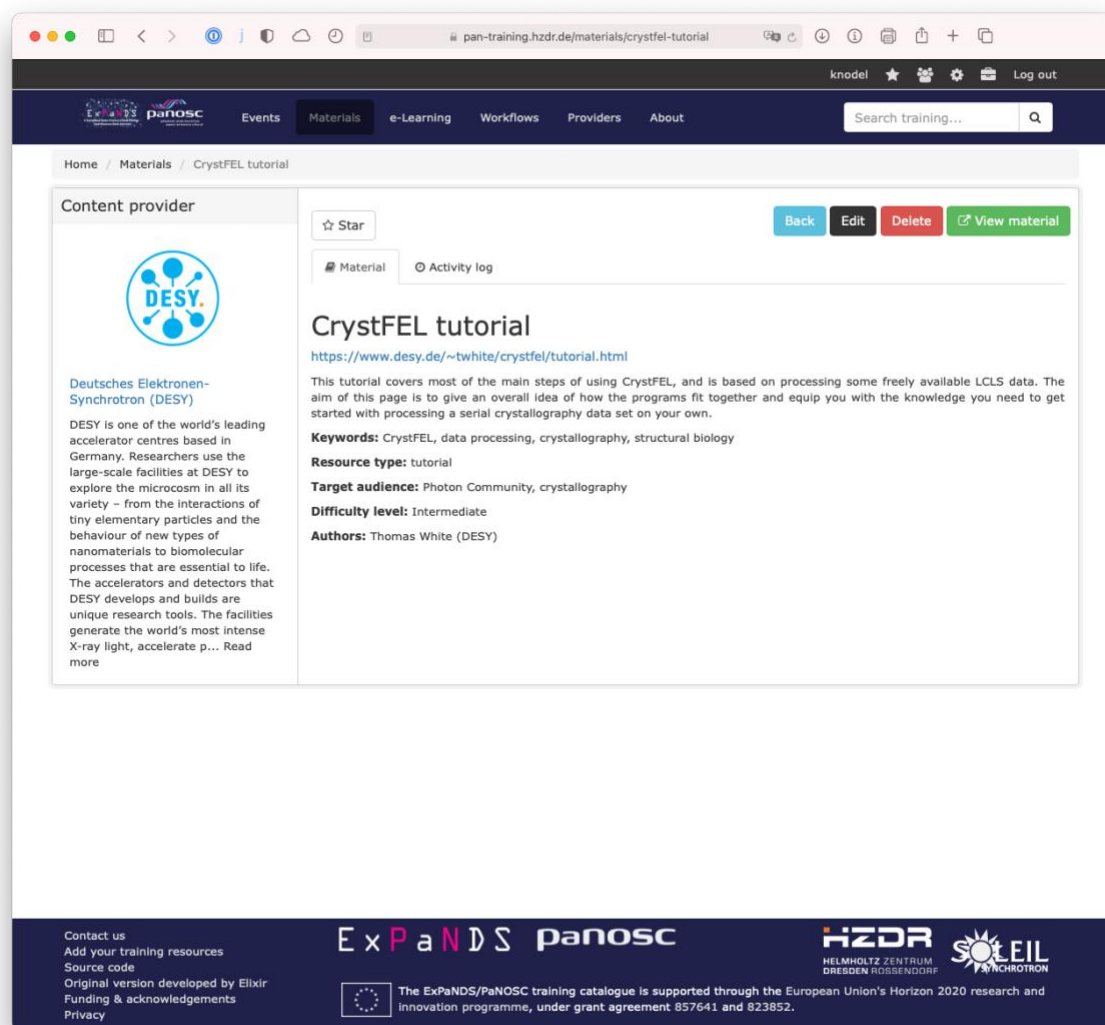
Figure 18: Screenshot of the landing page for a material record in our catalogue. The content provider with logo and description is provided at the left side of the page.

Figure 19 gives an impression of the interface for manual registration of an external resource. Mandatory fields are Name, Description and the URL of the training material. All other metadata fields are optional (full metadata list in 4.2.7). We discussed if additional fields should be mandatory, but it should be as easy as possible to add new materials. The curator of the catalogue has always the opportunity to complete the metadata based on the link or reference to the learning resource.

The fields Content provider, licenses and difficulty have a fixed vocabulary represented with drop down lists. As many keywords can be attached as necessary and suggestions from within the database are presented during typing to lead the free formatted keywords into a more uniform style.

Figure 19: Screenshot of the New Material page in our catalogue. Title, the link to the resource and a short description are mandatory for every entry. Further descriptions like type, keywords, authors, audience or difficulty level are optional.

4.2.4 Training Workflows

An essential feature why we choose the TeSS catalogue is the possibility to create workflows and lead the students or scientists through a sequence of steps. A simple workflow demonstrating the dataset and notebooks used to demonstrate a PaN experiment in the

context of the ExPaNDS project is shown in Figure 20. The top-level workflow can be created directly on the website and the process is similar to the creation of new training material. Metadata can also be attached to allow an easy search based on filters in our catalogue.
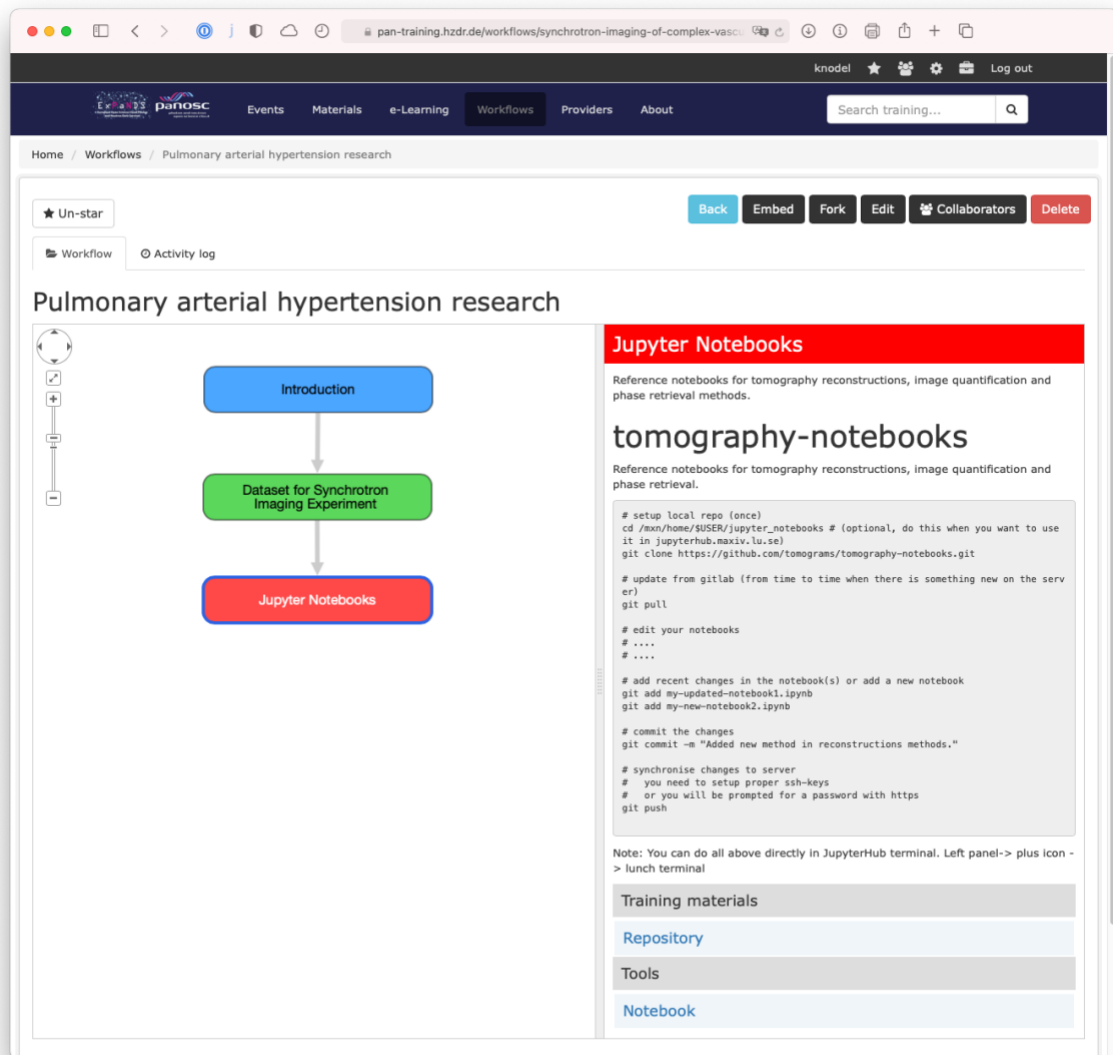

Figure 20: Screenshot of a training workflow on "Pulmonary arterial hypertension research" developed to demonstrate the outcome of WP4. On the left side the sequential steps and on the right the description of the selected node with the references to the material.

Each node is described in a separate webpage and can be configured as introduced in Figure 21. The screenshot shows the workflow configuration page of the *Jupyter Notebook*s node from Figure 20. The description text can be formatted in Markdown[31] to structure the content in a user-friendly way. Further materials and tools can be added to the description to guide the student directly to the resources required.

Figure 21: Screenshot of the workflow configuration of the Jupyter Notebook node from Figure 20.

4.2.5 Content Providers

The training catalogue provides an assignment of material to *content providers*. A content provider in our catalogue is the research institute where the content is associated with. Not every material has to be associated with a provider. Figure 22 gives an impression of our content provider page. Currently all members of both projects PaNOSC and ExPaNDS are listed and the projects themselves are also present for materials, results or events related to the top-level projects. That is an opportunity to show that the projects work close together and that every member has the opportunity to add references to external training material in our PaN training material catalogue.

Furthermore, the page provides an overview of the number of materials and events added or assigned to each provider. The assignment of a content provider to a material is done during creation of the material as visible in Figure 19. Each provider page has a title, a description and an optional image, as well as the last added content.

Figure 22: Screenshot of our content providers from the both projects ExPaNDS and PaNOSC. Each of the providers has also an additional page with description and latest materials.

4.2.6 REST API and Synchronisation

Our catalogue provides a REST API for read access to all entries for materials, workflows, providers and events in our catalogue. The synchronisation with our e-learning platform pan-learning.org occurs using the REST API from the Moodle backend or the catalogue. To achieve high quality metadata the inbound data synchronisation is carried out by our catalogue. We parse all metadata fields from the e-learning system and map them into our catalogue's metadata scheme, introduced in the following section 4.2.7. The jobs performing the background synchronisations are running in our environment to achieve independences from other services and also in order to achieve a high quality of the metadata as well as failure safety or error detection directly in our catalogue ecosystem. In addition to the synchronised courses from the PaNOSC's e-learning platform, we can also synchronise courses or material from other sources automatically if we can extract data from target websites and some structured data is available. The information from the training calendars of PaN RIs can be synchronised, as well as dedicated materials.

4.2.7 Training Metadata

Internationally there is a growing need for the development and cataloguing of training materials. At present, a large number of educational resources are available through various platforms, such as Wikis, GitHub projects and various learning management systems (e.g. Moodle). However, such resources are not always easy to find and to integrate into a learning course, amongst others, because the required metadata is not available.

For the training material developed and indexed in our PaN training portal, we plan to use a reduced set of the metadata schema for training material developed by the RDA[32]. The approach gives us the opportunity to be interoperable with other training aggregators. The RDA schema also takes the efforts for describing training materials in life sciences from Bioschemas "A specification for describing training materials in life sciences"[33] into account and therefore is a suitable entry point.

We further consider ideas from the milestone document "Building training material for FAIR implementation"[34], which discusses the requirements on training catalogue metadata and describes the metadata concept of the ENVRI training catalogues. The final ENVRI training metadata elements are based on a customised profile of the IEEE Standard (IEEE 2002) for Learning Object Model (LOM). The original model consists of 60 optional elements that can be used to describe learning objects. The model used in the ENVRI training catalogues consists of only 27 metadata elements.

In our training catalogue, we use the RDA metadata schema as a basis and add further elements from IEEE LOM and from the ENVRI training catalogues to describe our training resources, which leads to 20 properties for our catalogue. Table 1 gives an overview on our metadata and the mapping to the generic term with additional description of the property.

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[32] https://docs.google.com/spreadsheets/d/1rpuDwCrt-tC-kY5pNiJ2pOwFL-UQppy2Fra74Jja1JA/
[33] https://bioschemas.org/profiles/TrainingMaterial/0.7-DRAFT-2019_11_08/
[34] ENVRI-FAIR MS22: https://doi.org/10.5281/zenodo.3903340

From those 20 properties only three are mandatory: Title, URL and a short description. We want to motivate our visitors to register resources with as little effort as possible. The curator of the catalogue has the option to complete the metadata based on the link or reference to the learning resource.

Table 1: Overview on the required RDA (and similar IEEE LOM) metadata properties and the mapping to our prospective PaN training catalogue metadata scheme. Mandatory fields in our PaN catalogue are marked with *. Red properties are added in a future version to our catalogue.

"Generic" Term	Description	PaN Catalogue Property
title	The name of the resource.	title*
url	URL that resolves to the learning resource or to a "landing page" for the resource that contains important contextual information including the direct resolvable link to the resource.	url*
abstract	A brief synopsis about or description of the learning resource.	short_description*
author(s)	List of full name of the author(s)	authors
author_org	Name of organisation authoring the resource.	author_org (intended)
context	Principal environment within which the learning & use of the resource is intended to take place, e.g., university, RI	target_audience
contributor(s)	List of full name of secondary person(s) contributing to the resource.	contributors
Org	Name of organisation that has been asserted as the contact for the resource in case of questions or follow-up by resource user.	content_provider
creator	The login name of the person creating the catalogue record.	creator (intended)
date_created	The date on which the resource was created.	created_at
difficulty	How hard it is to work with or through the resource for the typical intended target audience (very easy, easy, medium, difficult, very difficult, knowledge-dependent)	difficulty_level
featured_event	Course instance or event where this training resource was or will be featured. (inverse of workFeatured)	events
id	System identifier for the MD record.	id
keywords	Keywords or tags used to describe the resource.	keywords
language_primary	Language of the material	language (intended)
license	A license document that applies to this content, typically indicated by URL.	licence
	A more detailed description of the learning resource.	long_description
lr_type	The predominant type or kind that characterises the learning resource.	resource_type
resource_id_label	A globally unique label that identifies the learning object.	doi
subject	Subject domain toward which the resource is targeted.	scientific_topic

*mandatory

The Levels for difficulty (`difficulty_level`) are taken from the IEEE LOM schema and integrated into our catalogue metadata scheme[35]:

- `not-specified`:
    - title: Not specified
    - description: Difficulty level not specified
- `very-easy`:
    - title: Very Easy
    - description: The lowest level of difficulty; this content is suitable for beginners on the topic.
- `easy`:
    - title: Easy
    - description: A low level of difficulty; this content also suitable for beginners on the topic with rudimentary knowledge.
- `medium`:
    - title: Medium
    - description: Intermediate level of difficulty; suitable for people who already have some knowledge of the topic.
- `difficult`:
    - title: Difficult
    - description: A higher level of difficulty; this content is suitable for people who have a advanced knowledge of the topic.
- `very-difficult`:
    - title: Very Difficult
    - description: The highest level of difficulty; this content is suitable for people who have a substantial knowledge of the topic.
- `knowledge-dependent`:
    - title: Knowledge-dependent
    - description: The highest level of difficulty with advanced knowledge in surrounding fields; this content is suitable for people who have a substantial overview of the topic and related aspects.

Besides the difficulty the properties `license` and `content_provider` have also a controlled list of values represented by a drop-down menu. A controlled vocabulary for `target_audience` and `resource_type` is still in discussion. The values for the content providers are based on the internal and extendable list of providers in our catalogue.

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[35] The metadata field is not mandatory and we added the additional value `not-specified`

4.3 E-learning Platform PaN-Learning

The platform https://pan-learning.org/ is used as a joined platform for the training courses developed in the context of the collaboration between PaNOSC and ExPaNDS. To support more scientifically oriented training, the platform also offers a simulation tool where instrument simulations can be performed. Moreover, Jupyter is currently being integrated in order to support Python scripting and tutorials based on Jupyter notebooks. Figure 23 gives an impression of the design of the frontpage. PaN Training Catalogue and PaN-Learning have a common look and feel and logos from the two projects PaNOSC and ExPaNDS.
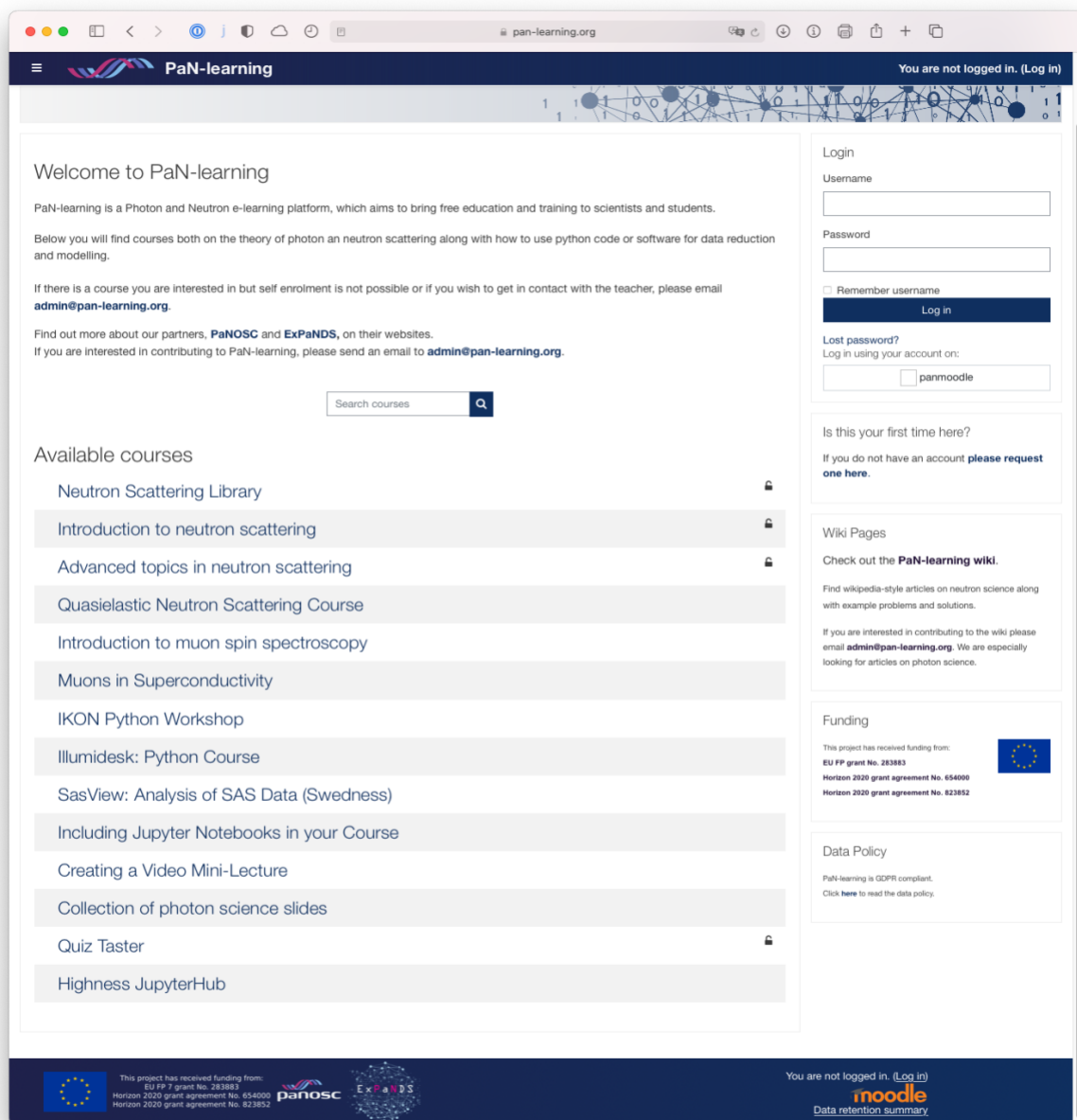

Figure 23: Screenshot of the frontpage of the e-learning platform https://pan-learning.org developed by PaNOSC and ExPaNDS.

On the frontpage of the e-learning system a list of available courses is visible for every visitor of the website (see Figure 23). Detailed information on the courses is available after login as shown in Figure *24*. With the synchronisation of the courses into our PaN catalogue, as described in section 4.2.6, we can provide further information on the courses with description and additional metadata and provide advanced search features from our catalogue. The catalogue therefore provides a rising visibility of the courses in our e-learning platform.
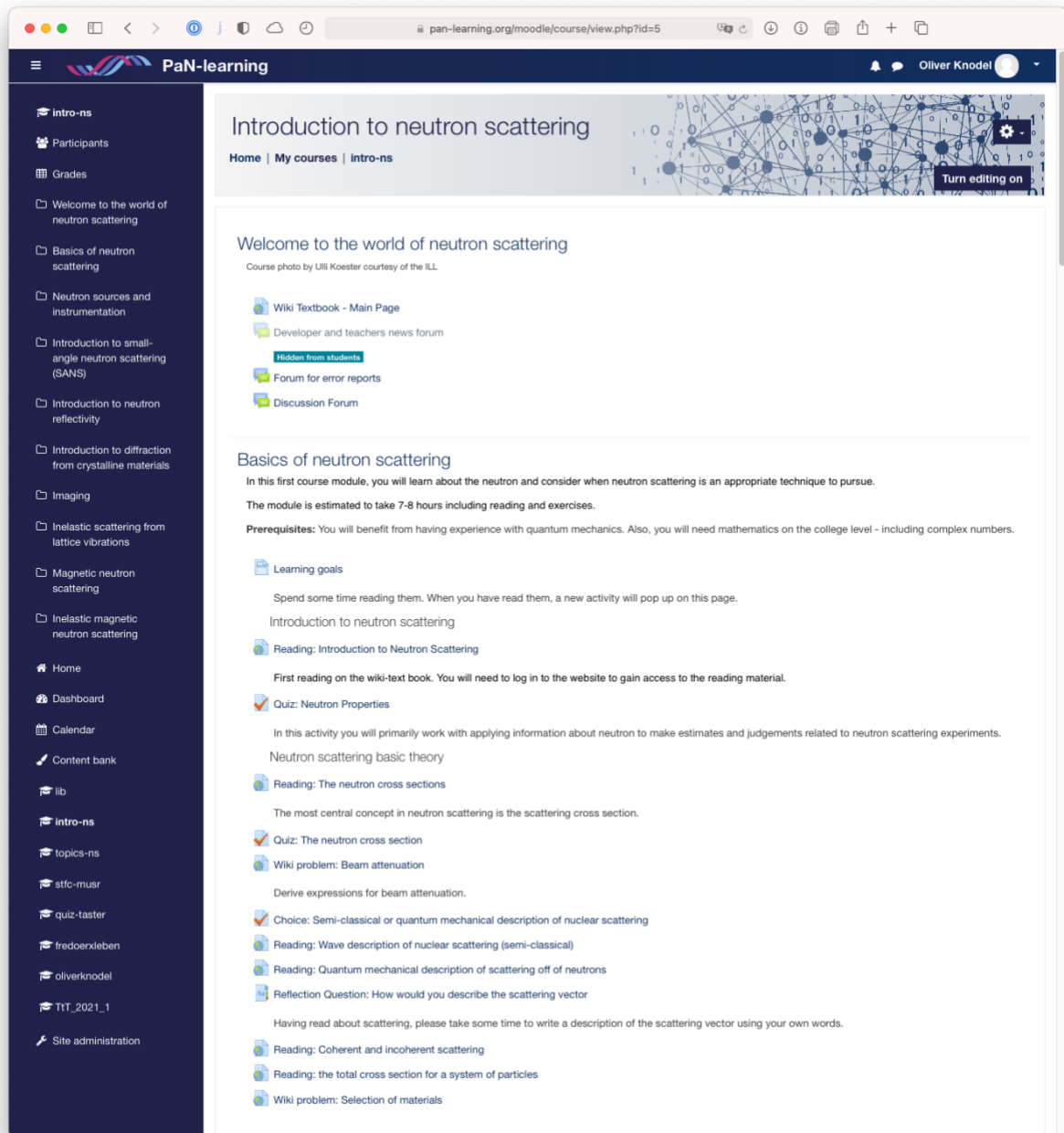

Figure 24: Screenshot of a course developed during the Train-the-Trainers Workshop hold in February/March 2021 to introduce blended learning and the design of e-learning courses in https://pan-learning.org/ (moodle).

For more details on the e-learning system itself, please visit https://pan-learning.org or refer to the PaNOSC deliverables D8.2 and D8.4[36].

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[36] Both deliverables can be found as soon as they are finished at: https://www.panosc.eu/deliverables/

4.4 Integration into EOSC

The ambition of ExPaNDS is to guide the national Photon and Neutron RIs, with their highly diverse scientific communities, towards the EOSC. The leading objective of both projects is to enable "Open Science" for the PaN community by making our training catalogues following the FAIR principles.

To ease access to our e-learning portal, the data and the corresponding metadata within the PaN portal will, in the end, be accessible through the EOSC marketplace. The metadata is accessible using a REST API as discussed in section 4.2.6 and can be further processed regarding the FAIR principles in third party portals.

5. Concluding Remarks and Open Questions

The activities described guarantee that the entire data treasure of PaN related training material can be advertised and found with our PaN training catalogue in a simple way. The PaN training catalogue will be an intuitive useable portal to access the training resources developed by PaNOSC and ExPaNDS. The metadata of the training material in our catalogue can either be reused or integrated in similar external applications to spread the contend widely using third party portals.

Various catalogues and repositories were presented in this document and based on this research a decision was made. A demonstrator was developed and customised to show our concepts in a prototype including most of the features described in this document. Our training demonstrator prototype is publicly available to show our concept and the usability of the approach. The first material entries from HZDR, DESY, CERIC, PaNOSC and ExPaNDS and two training workflows on "Pulmonary arterial hypertension research" and "Terahertz Spectroscopy" are already available in our PaN training catalogue. The events calendar is used for first announcements of ExPaNDS and PaNOSC events.

The next development steps are a profound synchronisation with our e-learning platform discussed in section 4.2.6 and the upgrade of our metadata scheme as described in section 4.2.7 planned for the end of 2021. By that time a uniform appearance of the components of both projects (domains and design) is also intended. Providing authenticated access to add material to the catalogue will be enabled by integrating the Authentication and Authorisation Infrastructure (AAI) interface for Umbrella[37] logins. We will further investigate on how to merge our training workflows and the workflows provided by WP4 and how to provide assistance in the development of training material for the other work packages in the ExPaNDS project.

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[37] Umbrella Federation for the Neutron and Proton Community: https://umbrellaid.org

Additional Resources

- PaN Training Catalogue[38]:   https://pan-training.hzdr.de
- PaN Training Catalogue Demo Video (Stream):   https://pan-training.hzdr.de/about

- E-learning platform: https://pan-learning.org
- PaN training organisation on GitHub: https://github.com/pan-training

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[38] Source Code available on GitHub: https://github.com/pan-training/training-catalogue