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D2.4 Skills4EOSC Recognition Framework first iteration

Lead Partner:	**HK-Dir**
Version:	**5**
Status:	**Submitted draft not yet approved by the EC Version before public consultation**
Dissemination Level:	**PU: Public**
Document Link:	https://doi.org/10.5281/zenodo.10447619
DOI:	**10.5281/zenodo.10447619**

Deliverable Abstract

This report describes the first version of the Skills4EOSC Recognition Framework for trainers' accreditation and recognition. The deliverable is part of the work of Task 2.5, but it builds on and consolidates the outputs of the other WP2 tasks. The recommendations in this deliverable have been piloted by Task 2.3 in their delivery of the FAIR-by-design methodology training. The recommendations will be fed to training pilots carried out in WPs 3-5 to be used in designing further trainings. Based on feedback from these WPs and from external stakeholders, a revised and final version will be delivered before the end of the project.

Co-funded by the European Union

co-funded by UK Research and Innovation

Skills4EOSC has received funding from the European Union's Horizon Europe research and innovation Programme under Grant Agreement No. 101058527 and from UK Research and Innovation (UKRI) under the UK government's Horizon Europe funding guarantee [grant number 10040140]

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DELIVERY SLIP

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Approved by:	Emma Lazzeri	GARR	31.12.2023

DOCUMENT LOG

Issue	*Date*	*Comment*	*Author*
v.1	*19.09.23*	*Started creating the document structure*	*Lars Bjønnes*
v.2	*24.10.2023*	*Version ready for review within the task group*	*Katrine Weisteen Bjerde + list above*
v.3	*20.11.2023*	*Version ready for internal review*	*Katrine Weisteen Bjerde + list above*

v.4	*13.12.2023*	*Complete document*	*Katrine Weisteen Bjerde + list above*
v.5	*23.12.2023*	*Final version*	*Katrine Weisteen Bjerde + list above*

TERMINOLOGY

https://eosc-portal.eu/glossary

Terminology	***Definition***
Digital credential	Digital credentials are the digital equivalent of paper-based credentials. A digital credential is a proof of qualification, competence, or clearance that is attached to a person.
Micro-credential	Micro-credential' means the record of the learning outcomes that a learner has acquired following a small volume of learning. These learning outcomes have been assessed against transparent and clearly defined standards [R1].
Digital badge	Digital badges are a validated indicator of accomplishment, skill, quality or interest that can be earned in various learning environments. According to Shields & Chugh [R2]:"digital badges are quickly becoming an appropriate, easy and efficient way for educators, community groups and other professional organisations to exhibit and reward participants for skills obtained in professional development or formal and informal learning".
Open Badges	Open Badges [R3] are digital credentials based on an open technical specification, the Open Badge standard [R4]. They are a type of open digital credential that is designed to recognise a variety of skills, knowledge, and experiences [R3].
Acronym	***Definition***
CC	Creative Commons
CI	Continuous Improvement
EC	European Commission
EDC	European Digital Credentials
EDEH	European Digital Education Hub
EDEN	European Distance and e-learning Network

ELM	European Learning Model
ELMO	ELMO is an implementation of the European (CEN) standards ELM-AI (European Learner Mobility – Achievement Information, EN 15981) and MLO (Metadata for Learning Objects, EN 15982). It is an XML-based format and latest version contains courses, diplomas, Micro-credentials etc.
EMMA	European Multiple MOOC Aggregator
EOSC	European Open Science Cloud
EU	European Union
EUDI	EU Digital Identity Wallet
FAIR	Findable, Accessible, Interoperable, Reusable
GDPR	General Data Protection Regulation
ICDL	International Computer Driving Licence
IT	Information Technologies
LMS	Learning Management System
LPI	LINUX Professional Institute
MIT	Massachusetts Institute of Technology
MOOC	Massive Open Online Course
MVS	Minimum Viable Skills
NASA	National Aeronautics and Space Administration
NI4OS	National Initiatives for Open Science
OBERRED	Open Badge Ecosystem for the Recognition of skills in Research Data management and sharing
ODI	Open Data Institute
OECD	Organisation of Economic Co-operation and Development
OS	Open Science
PDF	Portable Document Format
QR code	Quick Response code
RDA	Research Data Alliance
RDM	Research Data Management
TOPS	Transform to Open Science
UNESCO	United Nations Educational, Scientific and Cultural Organization
URL	Uniform Resource Locator

Contents

Executive summary

As learners engage with Open Science training, the credentials that recognise that learning and the trainers delivering the learning also become increasingly important. In order to achieve a harmonised approach across Europe, the trainers must be able to document their training skills within different areas of Open Science. It must be possible to present this documentation to different institutions and organisations across Europe. This document is the first version of deliverable 2.4 from Task 2.5 in the Skills4EOSC project that seeks to develop a recognition framework for Open Science trainers.

Chapter 1 focuses on what a recognition framework is and its purpose. In this chapter, we also describe the connections between this framework and other outputs of Skills4EOSC.

Chapter 2 describes a targeted review undertaken of existing trainer accreditation approaches in Open Science and RDM and gives a summary of the main findings. We also explore in greater detail some of those that have informed the recommendations in this report. These include the OBERRED project, the NASA Open Science Certificate, and EC work on micro-credentials.

In Chapter 3 the proposed solution for digital credentials from the Skills4EOSC courses, Open Badges, is presented in greater detail. The reasons for choosing Open Badges are discussed and we describe how these have already been piloted in the Skills4EOSC project. The evaluation findings from the pilot are also presented.

Chapter 4 presents the risks in the choices we have made and opportunities going forward. We discuss how the Skills4EOSC Recognition Framework can be sustained after the project ends. Measures include ensuring long-term maintenance, certification criterion, and setting up a trainer registry. The proposed organisation is to use the Skills4EOSC Competence Centre Network and connection to the EOSC Association. We also discuss possible measures to increase the uptake in institutions beyond the Skills4EOSC project. We look at the recent developments in European Digital Credentials and the

possibility of using this as the technical solution instead of or in addition to Open Badges.

Chapter 5 summarises the recommendations that are made throughout the report with regards to recognition and certification of trainers.

Chapter 6 contains an outline for a set of guidelines around the recognition framework that can be used by project partners to implement the recognition framework. This chapter will be expanded significantly for the final version of this deliverable.

1 Introduction

1.1 Purpose of the Recognition Framework

The widespread availability of highly skilled Open Science and data professionals is a pre-condition for the paradigm shift towards Open Science. For this to happen, such skills must be recognised and rewarded. This is reflected in the first General objective (GO1) of the EOSC Partnership Monitoring Framework [R5]: *Open science practices and skills are rewarded and taught, becoming the "new normal'*.

One of the call objectives of the INFRA-EOSC call that Skills4EOSC stems from is to "Engage with the relevant stakeholders to co-create, promote, broker and ensure the recognition of digital career profiles specifically related to OS." This is reflected in Objective 1 of the Skills4EOSC project description:

> *O1 - Map career profiles related to Open Science and define, through co-creation, the "Minimum Viable Skillset" (MVS) for each of them; create a shared framework for the recognition of competences acquired by university students, trainers, and new professionals as a part of an academic path or a lifelong learning process.*

The development of the Skills4EOSC Recognition Framework contributes to fulfilling these key objectives.

Trainers trained either during the project's lifetime or later should be able to document their skills to institutions and organisations across Europe. In this deliverable, we recommend a method for providing such documentation through digital credentials awarded after completion of Skills4EOSC training courses.

We welcome your feedback on the approach described in this paper, including the choices recommended, the risks and the work foreseen before publishing the final version of the framework in February/March 2025. Please use our EU Survey questionnaire to give us any comments you may have.

1.2 Relation to other parts of Skills4EOSC

Skills4EOSC is designed with eight interconnected work packages in which all inform the others in support of project objectives and outputs. The title of Task 2.5 is **Skills4EOSC Recognition Framework for learning materials quality assurance, certification, and trainers' accreditation**. The task description says we would work towards a harmonised approach to certification of materials and trainer accreditation. The focus of this deliverable is trainer accreditation, as certification of materials is seen to be covered well by task 2.4.

The Skills4EOSC Recognition Framework is created based on the following deliverables from other tasks in the project as depicted in Fig. 1:

- The set of profiles for various EOSC actors that might need upskilling in Open Science, which are mapped to Minimum Viable Skillsets (MVS) for each such profile (delivered by task 2.1) [R6]
- The FAIR-by-design methodology for developing training materials (delivered by task 2.3) [R7]
- The method for quality assurance of training materials (delivered by task 2.4) [R8]
- The actual learning material for trainers of the different profiles (to be delivered by work packages 3, 4 and 5 and developed according to the FAIR-by-design methodology and the criteria for quality assurance of training materials)
- The learning platform of Skills4EOSC available at https://learning.skills4eosc.eu/

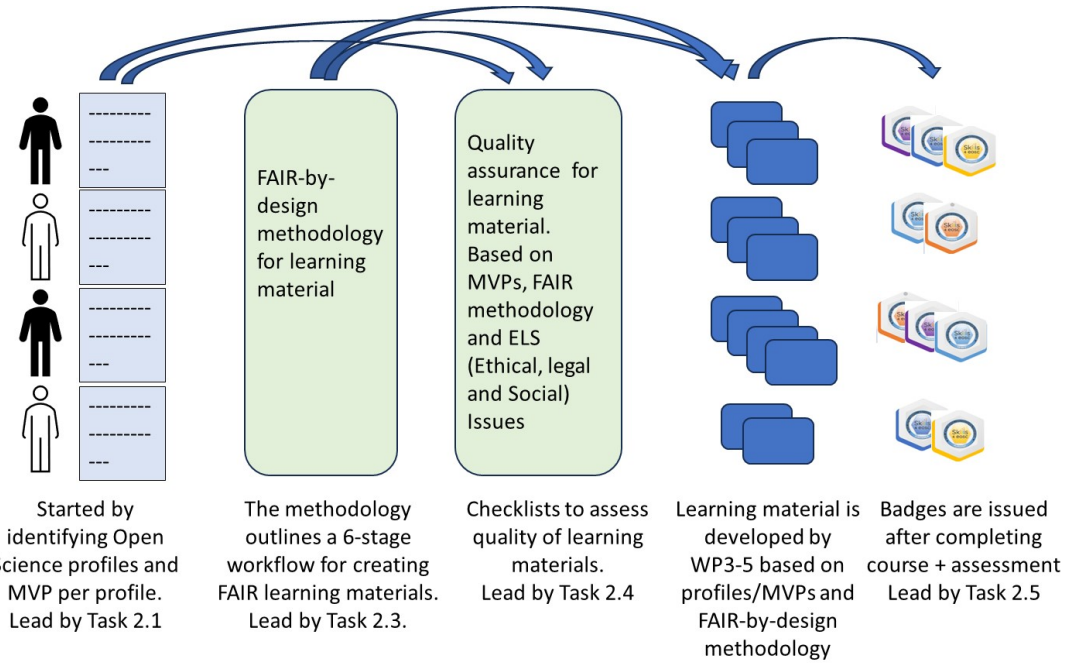

Fig. 1 - Relationship between the different outputs from Skills4EOSC

Via the Skills4EOSC Learning Platform, we will issue a digital credential for each course to document the acquired skills as described by the learning objectives. The credentials are currently planned as "one-off", i.e. there is no validity period and recipients are not required to renew them after a certain period.

1.3 Characteristics of a Recognition framework fulfilling our purpose

Although the Skills4EOSC Recognition Framework is designed for use only within the lifetime of the Skills4EOSC project, it should also be suitable for use by institutions across Europe who wish to educate and give recognition to Open Science trainers. Such a framework should therefore have the following characteristics:

- **Flexible**: It should be possible for institutions across Europe to use those parts of the framework that suit their needs and to adopt the courses and the framework to their own context.
- **Inexpensive**: Ideally, use of the framework should be free or at least inexpensive. It should be possible to implement the framework within

training platforms currently in use, and cost must not prohibit people from taking the training.

- **Easy to implement**: Use of the technical parts of the framework should be as easy as possible to implement. Technical solutions should be based on open standards.
- **Trustworthy**: It should be possible for an individual to store the documentation of their skills in a safe way that allows for third parties to validate the correctness of the documentation.

1.4 Contents of the Recognition Framework

This report describes the discussions and choices made in the process to develop the Skills4EOSC Recognition Framework. The framework in its final version will consist of a broad set of digital credentials connected to courses developed for upskilling of Open Science trainers.

At this point, only one such course has been developed, namely a 3-day train-the-trainer course for the FAIR-by-design methodology. The course, the digital credentials connected to it and the evaluation of the pilot is described in more detail in chapter 3.

In the final version of the deliverable, two more elements will be added:

- A more complete framework with all the courses and accompanying credentials to be offered by Skills4EOSC.
- Guidelines (rather than just an outline) for using the framework and adopting it within an organisation. Different alternatives for publication of these guidelines will be discussed to ensure a user-friendly design.

Before publication of the final version, a co-creation and validation process will be carried out, following the methods of Task 2.6.

2 Landscaping

2.1 Landscaping process

The work in the task started by conducting a targeted landscaping review. The landscaping analysis included a mapping of existing train-of-trainer curricula in Open Science and research data management developed in other projects and initiatives and of trainer certification and accreditation approaches used in other domains.

Learning materials from over 80 initiatives were collected primarily via desk research. In addition, a substantial portion of the landscaping review was derived from task members who participated in earlier and ongoing projects. Since this landscaping exercise was influenced by participants knowledge, it was seen as a starting point for inspiration and ideas rather than a comprehensive list.

There were two main tasks the team faced while analysing the previous work. Firstly, the team had to assess the quality of the materials. This related to the relevance of the reviewed materials to the needs of the training work packages of Skills4EOSC. Quality was assessed based on the team's previous experience with the material, as well as in-depth review of the learning materials no team members had prior knowledge of or experience with. Secondly, the team categorised the training materials as either generic (concerning Open Science in general) or topic specific (about Open Science within a specific topic). Most of the analysed materials were identified as generic.

From generated list of materials, we chose to investigate further those that were fairly recent and also relevant to the recognition and certification of skills, not only pure training. Some were frameworks from other domains, some showed different ways of providing accreditation and a certificate for training, some were in other ways connected to the train-the-trainer model.

2.2 Results

Table 1 presents the list of projects/trainings that we reviewed extensively. It also presents a summary that highlights aspects particularly useful for the development of the Skills4EOSC Recognition Framework. The most relevant of these projects and initiatives are described in more detail in subsections 2.2.1 to 2.2.4.

Table 1- Results from landscaping of material relevant to recognition and accreditation

Project/Training	*Summary*	*Lessons*
RDA	The Research Data Alliance has defined several standards that are relevant for Skills4EOSC, the most relevant one being the Minimal Metadata Schema for Learning Resources [R9].	The Minimal metadata schema for learning material is already being used in Skills4EOSC.
OBERRED	OBERRED [R10] was a European Erasmus+ project aimed at creating an Open Badge ecosystem for recognising skills in sharing research data in the field of open science.	Open Badges require minimal effort to be implemented in practice, allowing every institution to easily use badges as a certification method within their courses.
The Carpentries	The Carpentries [R11] have a train-the-trainer model that is certified and highly recognised.	The Carpentries have a strong brand within the community. This is also an established legal entity that can develop their brand and issue certificates.
RItrainPlus	RItrainPlus [R12] have a train the trainer model and are working to have European-wide recognition for these courses.	RItrainPlus is working to set up recognised micro-credentials. However, this work is currently in its early stages.
NI4OS-Europe	In NI4OS-Europe [R13], a combination of train-the-trainer and national end-users and capacity building trainings were delivered using a Moodle-based	NI4OS-Europe offers a user-friendly FAIR learning environment providing a mix of self-paced courses

	learning platform that has been extended to support the RDA minimal metadata schema for learning materials, enabling them to import the training information into the EOSC catalogue.	and training materials in different languages including learning paths and open badges with automated issuing.
NASA Open Science Certification under TOPS initiative (Transform to Open Science)	The NASA TOPS initiative [R14] is a community developed course offered via a MOOC.	They will issue Open Science Badges for their in-person and virtual courses. They are using Open Badges as the technical solution to issue the badges.
EC work on Micro-credentials	On 16 June 2022, the Council of the European Union (EU) adopted a Recommendation on a European approach to micro-credentials for lifelong learning and employability [R15]. Several initiatives for implementation of the recommendation have since been started.	The format of the Skills4EOSC courses seems to fit with the idea of low-volume micro-credentials. Open Badges is one of the technology stacks that is recommended for implementation of micro-credentials.
Europass/ European Digital Credentials for learning	European Digital Credentials for learning (EDC) [R16] is the main EC initiative for handling digital credentials. These are standardised tamper-proof electronic documents describing that their owner has certain skills or has achieved certain learning outcomes through formal, non-formal or informal learning context.	The Skills4EOSC Recognition Framework should fit into the Europass/EDC framework.

Open Data Institute (ODI)	ODI [R17] offers a number of paid training courses, including a programme based on the train-the-trainers model. ODI uses the term "registered trainers" to designate trainers who have obtained a certification.	As ODI's courses are not free, we don't know much about the platform's certification process or the tool it uses to certify skills.
EOSC Future	The EOSC Future project [R18] has developed training material aimed at training stakeholders to become active users and providers of EOSC and to increase uptake of EOSC resources. An important part of this is to support providers to add their resources in the EOSC Portal.	EOSC Future issues digital badges based on the Open Badges standard.
LINUX Professional Institute – LPI	The LPI [R19] offers a long range of courses for open-source developers. The certificates are valid for 5 years. Description of the technical solution for issuing the certificates not found.	The LPI offers more formal education than is planned for the Skills4EOSC Recognition Framework. Additionally, it is not clear if their work is based on open standards.
International Computer Driving Licence - Europe	The ICDL is an international organisation for basic digital skills. A special version has been developed for Europe [R20]. It is based on the educa learning platform [R21]. We were unable to find information on digital certificates.	The ICDL offers more formal than we are planning and not, as far as we can see, based on open standards.
Digital	The European Commission will	The project plans to

Credentials 4 EU – DC4EU	provide a prototype of an EU Digital Identity Wallet (EUDI) [R22] as set out in the proposed European Digital Identity Regulation. A pilot for including digital credentials in the wallet will be part of the DC4EU project [R23] under the Digital Europe programme.	implement mappings for several digital credential formats, including EDC and Open Badges.
DocTalent4EU	DocTalent4EU [R24] aims to enhance PhD employability through a strong, visible and innovative recognition-system of the most in-demand transferable skills that early-career researchers acquire or will acquire through their doctoral training and research activities.	DocTalent4EU has chosen European Digital Credentials as the technical solution for their credentials.
Digital Credentials Consortium	The Digital Credentials Consortium (DCC) [R25] was founded in 2018 by leading universities with expertise in the design of verifiable digital credentials. Their mission is to create a trusted, distributed, and shared infrastructure that will become the standard for issuing, storing, displaying, and verifying academic credentials, digitally.	The DCC maintains open-source software and code libraries to issue verifiable academic digital credentials. The work of the DCC is valuable though still in development phase. It also requires IT/infrastructure support within institutions.

2.2.1 The OBERRED project

OBERRED (Open Badge Ecosystem for the Recognition of skills in Research Data management and sharing) is a European / Erasmus+ project, funded by the European Commission for 36 months (1st September 2019 – 31st August 2022) [R10]. It aimed to define, organise, and recognise the different skills involved in Open Science, and more specifically in research data management, using digital badges in the Open Badges format [1]. Other extended goals derive from that main objective, such as the introduction of Open Badges to higher education and research institutions and a better understanding of skills associated with research data management.

With these objectives in mind, the project:

- created and animated three Massive Open Online Courses (MOOCs) developing respectively:
  - Open Badges, how they work and how to use them,
  - Research data management and sharing,
  - Becoming a facilitator of this ecosystem
- created and uploaded online a repository of skills associated with the sharing and the management of research data,
- created and uploaded online a set of Open Badges to recognize and give value to each of these skills,
- created and uploaded a practical guide describing the ecosystem, to support people willing to use and implement these Open Badges in their institutions.

The Open Badges standard was chosen very early on in the project because it is an open format that can be easily used and exchanged between different platforms. OBERRED used Badgr (now Canvas Badges) [R26], where basic use was free but more advanced functionalities, such as the possibility to collect badges for several smaller modules into one larger collection, may not be free.

OBERRED is a good example of the application of open badges to RDM. Via the MOOCs that were created, the OBERRED project produced a total of 22 badges recognising and valuing skills specifically in RDM. Two of three MOOCs were dedicated specifically to RDM: “Basics of managing and sharing research data”, and “Being an animator of the ecosystem.” They both can be

considered as training for trainers. The skills framework and the related open badges are interesting and useful: it provides a detailed description of skills, metadata, and exercises to validate them. Skills are also linked to other frameworks if available. All the materials are made available under the CC BY licence.

There are key points worth noting about the project. Firstly, it is not guaranteed that the contents of the MOOCs are up to date since the conclusion of OBERRED. Additionally, the Learning Management System used to host the MOOCs, EMMA [R27], did not contain functionality that allowed skills to be tested before issuance of the open badges. Therefore, OBERRED badges do not require any assessment to be passed to be obtained.

2.2.2 NASA Open Science Certification

NASA has coined 2023 as their Year of Open Science and has developed a set of upskilling activities and actions for individuals, teams, and organisations, called NASA Transform to Open Science or TOPS [R14]. With TOPS, NASA's mission is to create an inclusive culture of Open Science. While expected to be launched in later 2023, the TOPs is working to develop Open Science Badges using the Open Badges standard [R28]. After having reviewed various badge-issuing platforms, they decided to choose Badgr as their digital badging platform. The badges are awarded in a hierarchy. For instance, each module developed will be associated with a micro-badge. Participants can gain a 'grand badge' should they complete all 5 modules.

The badging process that is planned for TOPS Open Science includes some basic minimum requirements. This includes event registration with the TOPS team, teaching a module in full, using the TOPS curriculum materials, and having a certified trainer. While all these requirements are important, the latter is of interest in the development of this Framework. The certification of TOPS instructions is derived from the Carpentries instructor base. Essentially, the certified instructors for the TOPs program are members within The Carpentries.

2.2.3 Micro-credentials

The European Pillar of Social Rights Action Plan refers to micro-credentials as an innovative instrument that "can facilitate flexible learning pathways and support workers on their job or during professional transitions" [R1].

The European Commission believes that micro-credentials can play a role to bridge the current skills gap. However, despite their increased use, the European Commission recognises that there is no common definition of, or standards for, micro-credentials in Europe.

Given this lack of a common understanding, we have sought a common understanding through the landscaping of national and local micro-credentials initiatives. Here are some definitions provided in [R29]:

- 'Micro-credential' means the record of the learning outcomes that a learner has acquired following a small volume of learning. These learning outcomes have been assessed against transparent and clearly defined standards - given by the European Commission
- Micro-credential is a record of focused learning achievement, verifying what the learner knows, understands, or can do; includes assessment based on clearly defined standards and awarded by a trusted provider; it has stand-alone value and may also contribute to or complement other micro-credentials or macro-credentials, including through recognition of prior learning; meets the standards required by relevant quality assurance - given by UNESCO
- Micro-credentials are an organized learning activity with an associated credential; the credential recognizes a skill or competency that has been acquired through an organized learning process and validated through an assessment - given by OECD
- A micro-credential is a certification of assessed learning associated with a specific and relevant skill or competency. Micro-credentials enable rapid retraining and augment traditional education through pathways into regular post-secondary programming - given by eCampusOntario
- A micro-credential is defined as digital certification of assessed knowledge, skills, and competencies in a specific area or field, which can be a component of an accredited programme or stand-alone course supporting the professional, technical, academic, and personal development of the learner - given by Malaysian Qualification Agency

- A micro-credential is a certified small volume of learning which attests to knowledge, skills, and competencies (autonomy, responsibility, and life skills) in a specific area or field. It may be acquired through assessed life and work experience or a dedicated short course. Micro-credentials support the professional and personal development of the learners. They may also be combined into larger qualifications - given by University Council of Jamaica
- A micro-credential certifies achievement of a coherent set of skills and knowledge, and is specified by a statement of purpose, learning outcomes, and strong evidence of need by industry, employers, and/or the community - given by New Zealand Qualifications Authority

Although these definitions vary, they collectively describe learning that is small in volume, assessed in some way, and associated with a digital certification. This description fits the courses provided in Skills4EOSC and the Recognition framework and digital credentials described in this report. However, for a credential to be called a micro-credential, the body issuing it needs to be accredited. As this is not the case for Skills4EOSC, our courses cannot currently be called micro-credentials and do not give formal credits (although higher education institutions may of course adopt the courses and give credits for them). Whether this is a problem for the legitimacy of the courses and the badges associated with them, is discussed further in section 4.1.

2.2.4 Europass and European Digital Credentials for learning

The Council of the EU adopted a set of Recommendations on micro-credentials, which was one of the actions under the European Skills Agenda [R30]. This is closely connected to Europass [R31] and the European Digital Credentials for learning [R16]. Europass can contain a range of different digital credentials. The main focus is on the European Learning Model (ELM), a format for storing and exchanging digital credentials. Version 3.0 of ELM was launched in March 2023 [R32] and will likely be implemented by Learning Management Systems in time.

The ongoing initiatives under the European Commission on micro-credentials were presented during the seminar “Issuing Digital Micro-Credentials By

Using European Standards and Services" (by the European Distance and e-learning Network (EDEN) and European Digital Education Hub (EDEH)) [R33]. During this seminar, the Commission confirmed that Open Badges is also one of the technology solutions they plan to support, but there is no defined timeline for when this will happen.

3 Proposed solution - Open Badges

As the technical solution for issuing credentials for the Skills4EOSC courses, we recommend using Open Badges. Open Badges are digital credentials based on an open technical specification, the Open Badge standard [R4]. They are a type of open digital credential that is designed to recognise a variety of skills, knowledge, and experiences [R3].

Originally created by the Mozilla foundation, the Open Badges standard is managed by 1EdTech (previously known as IMS Global Learning Consortium) since 2017. 1EdTech is a non-profit member-led organization "committed to advancing technology that can affordably scale and improve educational participation and attainment" [R34]. The organisation has nearly 900 member organizations from 28 countries and is considered the leading international organisation within the EdTech domain. They describe Open Badges as "the world's leading format for digital badges".

3.1 Description of Open Badges

Structurally, Open Badges are represented as images which contain embedded metadata describing the skills and achievements that the badges represent, as well as information on the issuing organization and the recipient. This provides a transparent, digital verification of what has been learned and evidence of that learning. Fig. 2 provides a visual overview of how Open Badges are situated within the wider context of credentials. The figure highlights the overlap between Open Badges and micro-credentials. Definitions presented in Section 2.2.3 suggest that a micro-credential is a short, focused credential, concentrating on a specific proficiency or skill. The Open Badge can be seen as a visual representation of that skill.

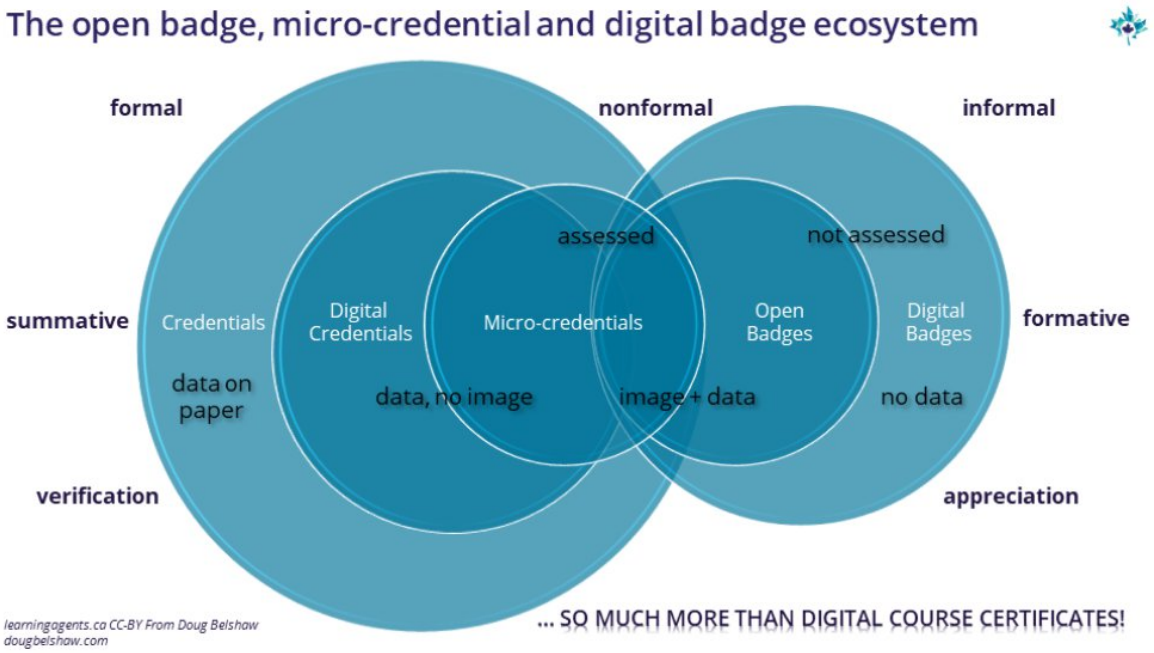

Fig. 2 - Description of open badge ecosystem

Open Badges are not tied to a particular platform or service and can be reused freely across the web. Subsequently, many leading learning management systems (LMS) have built-in support for Open Badges today [R35], including some of the most popular ones such as Moodle [R36], Blackboard [R37], Canvas [R38] and Open edX [R39]. This feature allows badge earners to collect many badges from different issuers. These can easily be promoted and displayed on websites, networks, blogs and other channels to facilitate job opportunities and career development.

Earners can combine and display their various badges via 'backpacks', which are supported by the Open Badges specification[1]. Backpacks are digital repositories where open badge earners can collect, categorise, and share their open badges [R3]. There are a number of online backpack services available today such as Badgr, Edubadges and The Open Badge Passport [R40], [R41] and [R42], allowing users to register for a free account, import all their badges, and have them available for showcasing from a single central location acting as a personal portfolio. Certain learning management systems

[1] Note that the Open Badge Backpack originally developed by Mozilla is now a part of Badgr.

that support the Open Badges specification also allow for a direct integration with third-party backpack services, permitting their users to effortlessly include obtained badges to their personal backpacks.

Open Badges can be defined either on a platform level or on a course level. The latter allows the course managers themselves to set custom criteria for when a badge should be awarded [R43]. Multiple criteria can also be defined for a given badge. For instance, when integrating Open Badges with an existing learning platform, the criteria can be:

- Successful completion of a given activity (i.e., a quiz) with a passing grade
- Successful completion of a given course
- Successful completion of a set of previously defined competencies [R44]
- Possession of another badge as a prerequisite
- Manual issuing by a user with a certain role (e.g., trainer, course manager, platform administrator)

Regarding the criteria, there are key features of note. Firstly, the course manager can choose whether all or only a subset of the conditions needs to be satisfied before the badge can be awarded. Secondly, using the "possession of another prerequisite badge" as a criterion, it is possible to model hierarchical badge relationships, as is done on the NASA TOPs program. It is also possible to represent various proficiency levels on a given subject matter. In such scenarios, the learner can progressively obtain additional badges validating their expertise in a given subject area, as their knowledge increases. In this way, open badges can be used to build pathways to support individuals to work toward learning or teaching goals.

One of the most important aspects of using any certification framework is the ability to establish the validity of the presented credentials. Since Open Badges is an open standard with a well-defined schema, badges can be validated using publicly available validators [R45], [R46]. The validation process relies on the continued availability of the issuing platform, since ultimately the issuing platform is the one that should certify whether such a badge has been issued or not.

Open Badges contain metadata (rich information) in an openly available format, which has many advantages, such as

- **Verifiability and transparency**: badges are verifiable, i.e. the source can be traced. The veracity of the information contained is transparent and verifiable.
- **Portability**: can be adapted to different contexts - can be collected in a portfolio or backpack.
- **Alignment**: badge can refer to a URL specifying a system or standard to which the badge is aligned.

Utilising and implementing Open Badges for the purposes of recognition in Skills4EOSC is advantageous. Moodle, the underlying platform for the Skills4EOSC learning platform [R47], on which all the training materials and workshops for the project will be held, supports Open Badges. Additionally, due to project collaborations and connections to the OBERRED project, we are able to utilise previously developed materials to assist with implementing Open Badges. For instance, OBERRED created a practical guide that includes the technical specificities and issues of Open Badges, roles and skills related to RDM, and principles for the application of Open Badges to research data management. Therefore, Skills4EOSC already has a starting point for a framework to support the implementation of Open Badges.

3.2 PDF certificate

One might consider a traditional paper or PDF certificate to be an alternative to a digital badge. It is technically easy and inexpensive to implement and issue. However, it does come with substantial disadvantages, which primarily relate to its verifiability and credibility and machine-readability. The contents of such a certificate are not standardised. Additionally, it can be easily forged or duplicated. Finally, you can only have limited information (metadata) on the certificate itself. It is recognised that this can be partially mitigated by including a QR code that links to the learning platform that issued the certificate.

3.3 Open digital badges pilot implementation

The use of open digital badges has been piloted within the Skills4EOSC project via its learning platform. This has been done in coordination with the Skills4EOSC FAIR-by-design Methodology for learning materials. As the FAIR-by-design train of trainers [R48] workshop aims to showcase the common methodology that should be used for the development of all training materials within Skills4EOSC, it has been identified as the most suitable pilot wherein the participants can be introduced to the concept of open digital badges and its role within the wider project.

Based on the recommendations developed within Task 2.5, the project-wide training has been extended so that the training participants have the possibility to obtain Badges that can be used to provide verifiable digital credentials certifying that the participant has successfully completed part(s) of or the whole training.

For these purposes, in coordination with GARR, the organisation managing the Skills4EOSC learning platform, the necessary extension of the Moodle system for support of open digital badges has been added. As Moodle (from v3.8 and above) is certified as an Open Badges v2.0 issuer by 1EdTech [R49], the open badges defined on the Skills4EOSC learning platform are packaged following the latest Open Badges standards. This confirms that these badges can be read and seamlessly imported into badge backpacks. To support the easy collection of different open badges and their sharing outside the Skills4EOSC project, the learning platform has been connected with one of the most popular solutions for storing badges, the Badgr backpack [R26]. This enables all users of the Skills4EOSC learning platform to easily organize, manage, and publicly display their badges as digital credentials obtained during different training activities.

Following the particular structure of the pilot training, a hierarchical group of open badges has been defined as depicted in Fig. 3 wherein the lower-level open badges can be obtained by successfully completing a given stage of the FAIR-by-design methodology, while the overarching higher-level badge

can be obtained only if the participant has successfully completed the whole training.

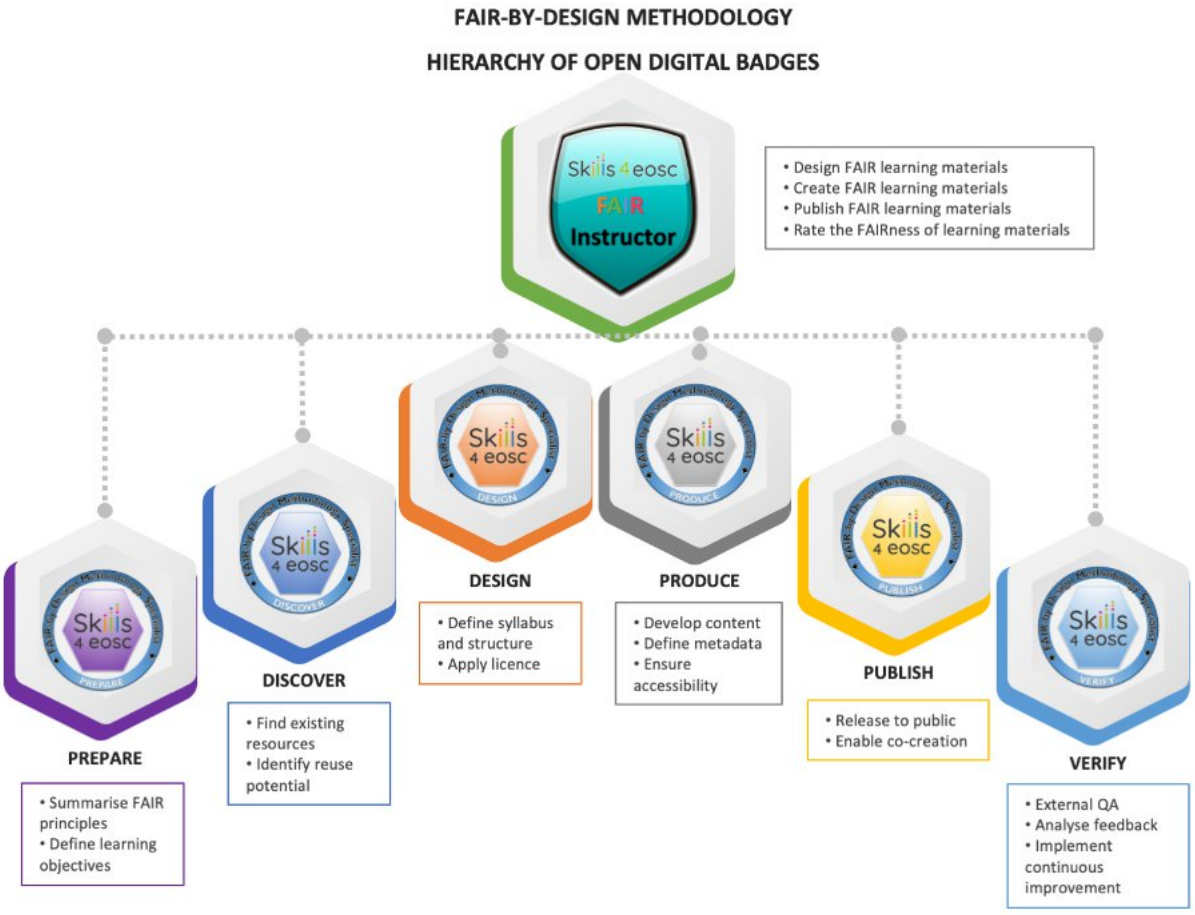

Fig. 3 - Hierarchical definition of open digital badges for the FAIR-by-Design Methodology for Learning Materials Development training, each badge is related with a group of specific learning outcomes, materials, and assessment

As highlighted in Fig. 3, in order to provide a detailed list of the skills obtained with the gained badge, it has been decided that each badge description will contain the list of the learning outcomes that need to be achieved for the particular badge. To assess whether the training participant has managed to reach the learning objectives, each learning unit in the training is accompanied with a quiz-like assessment. The learning unit is considered complete only when all learning materials associated with that learning unit have been consumed by the training participant and the related quiz is

passed with a minimum 80% grade. Each stage of the FAIR-by-design methodology is divided into a number of units, and in order to obtain a stage-specific open badge (one of the lower-level badges in Fig. 3), all learning units associated with that stage need to be successfully completed. By obtaining a stage-specific open badge, the participant becomes a FAIR-by-design methodology Specialist in the given stage (e.g. FAIR-by-Design Methodology Specialist: Design) signifying that the training participant is able to practically implement the activities of the given stage of the methodology. The higher-level open badge named "FAIR Instructor" is issued to training participants that have successfully completed the whole training, or, in other words, have obtained all the stage-specific open badges. By obtaining the FAIR Instructor open digital badge, the participant is certified as able to put the FAIR-by-design methodology into practice, thus becoming a FAIR instructional designer.

The hierarchical relationship between the badges is graphically depicted by using different shapes for the different level badges, thus enabling fast recognition of the skill level in question. All issued badges are also branded with the Skills4EOSC project logo so that their origin is quickly identified without the need to access the badge metadata. These pilot badges have also been used as examples for the development of project-wide badge templates in coordination with the Skills4EOSC communications team.

In line with the co-creation and monitoring processes designed by Task 2.6, the feedback gathering after the training has also been extended with additional questions regarding open digital badges aiming to perform an initial investigation on the level of familiarity with the concept of open digital badges among the training participants, who are to be future trainers for the project. Of the total of 49 participants on the training course, 21 (~43%) have completed the feedback form, providing an initial view on the familiarity with and importance of open badges.

The results from the two questions related to open badges are provided in Fig. 4 and Fig. 5. Based on the gathered feedback, it is evident that the current level of familiarity with open digital badges among the training participants is not very high. However, the results did indicate that most are familiar with

the concept and its benefits. The very strong initial feedback on the plan to obtain the offered badges clearly shows interest among the trainers which will help them improve their knowledge about open badges and positively reinforce their future use in the project.

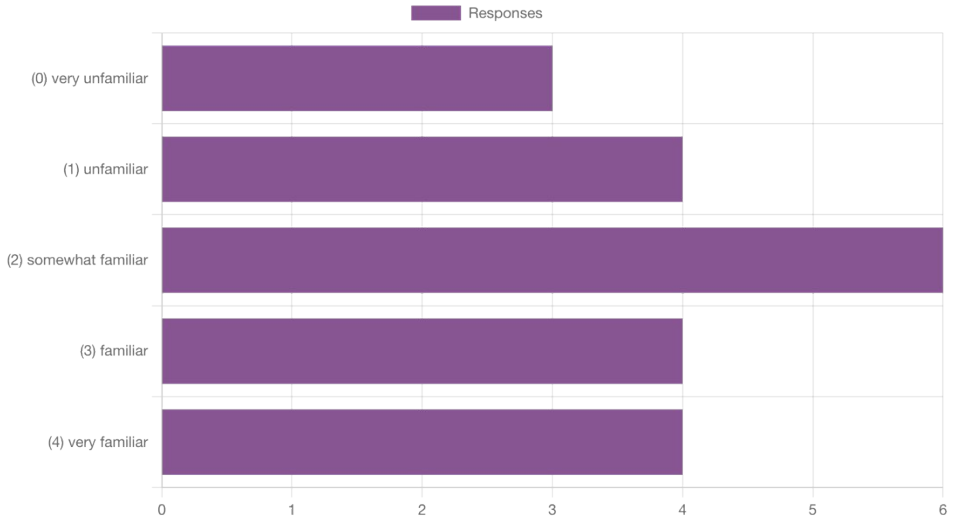

Fig. 3 - Familiarity with open digital badges among training participants (question: Are you acquainted with Open Digital badges as a verifiable representation of skill acquisition that you can share with anyone?)

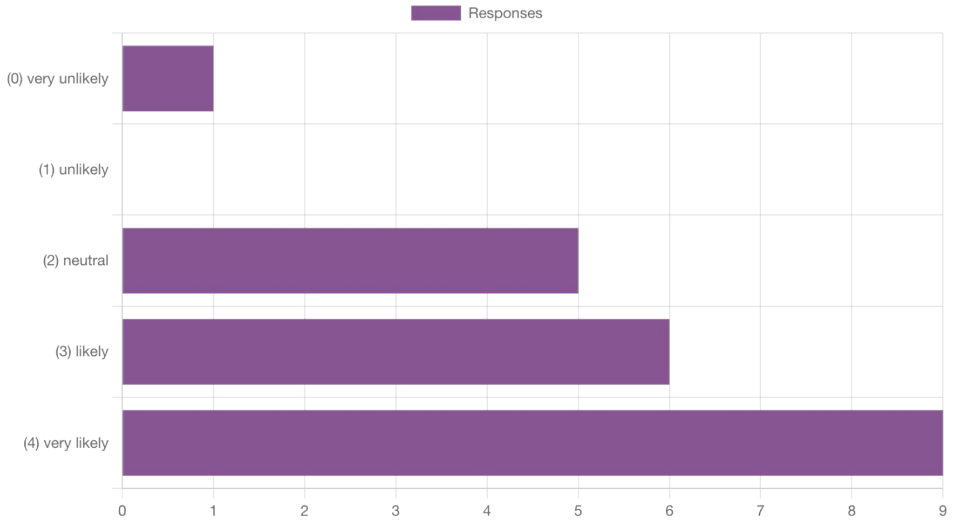

Fig. 4 - Interest in obtaining open badges (question: Do you plan to try to obtain the Open Badges available for this training?)

The task will continue to monitor the feedback gathered from the pilot training together with the process of issuing the badges which has already started. Within the first week after the training, there are already issued badges for the FAIR-by-design methodology specialist in Prepare (8), Discover (5), Design (4), Produce (4), Publish (4), Verify+CI (3) and 3 issued badges from the higher-level FAIR instructor category.

4 Risks and opportunities

The proposed Recognition Framework is based on courses and learning materials developed within the Skills4EOSC project. Based on the review of various options, Open Badges was chosen as the technical solution for digital credentials.

In this chapter, we highlight risks that need to be addressed before the final version of the framework is delivered. Identifying mitigation measures to reduce the probability or the consequences of these risks will be one of our main tasks in the time to come. In the following sections, we explore these risks, possible mitigation measures and some opportunities that we need to decide whether or not to go for.

4.1 Conditions for Receiving Credentials

It is essential for the legitimacy of the courses and credentials from Skills4EOSC that the criteria for issuing badges ensure the quality of the skills acquired. In other words, we need to set clear and sensible conditions that have to be met before the learner receives a badge.

Not having a formal credential for the Skills4EOSC courses may result in a reduced legitimacy for the framework. However, having formal credentials for the courses would require the involvement of an accredited body. One possibility might be to have an existing education institution take responsibility for the courses. Another thought is to establish some sort of school connected to the EOSC Association. Different alternatives for turning the Skills4EOSC courses into formal education (micro-credentials) will be examined in the next year.

During the lifetime of the Skills4EOSC project, this task together with task 2.4, which has developed the Skills4EOSC quality assurance framework for learning materials, can make high-level recommendations on what criteria or conditions should be met before a badge is issued. There have also been recommendations made on the branding and metadata that should be included on the badge to make them standardised and recognisable credentials. It is outside the scope of this task to monitor whether the

recommendations are followed. For the duration of the project, we could consider putting in place a system of peer review in which every task that will be offering training should reach out to another partner to ensure the required conditions are being met. This is the approach that Task 2.6 lays forth, and it is essential to make sure that it actually happens.

4.2 Registry of certified trainers

As more people go through the Skills4EOSC trainer education, there is a risk that their skills will not be effectively used. This could be alleviated by having a registry of certified trainers. For the project duration it is advised to create a trainer registry on the Skills4EOSC website. This would include the names of all trainers who have successfully completed and been awarded training badges to have their name and training profile added to registry. In order for such a registry to be put in place, GDPR issues must be handled and consent from the trainers must be acquired.

Beyond the project duration, we recommend transferring the responsibility for sustaining such a registry to the Competence Centre network that will be established as part of the project (see section 4.4).

4.3 Lack of uptake of the chosen solution

In order to achieve uptake of the Recognition framework among the competence centres and research institutions, it is important to create a framework that has legitimacy and to choose solutions that will gain acceptance in the research community. The solutions that we have chosen, have been tried and tested, are broadly available and easy to use both for the training organisations and for the trainees, and we believe this is the best choice possible.

Another reason for possible lack of uptake might be that the framework and the solutions are not well enough known. It will be important to work on spreading information for the rest of the project duration.

The feedback from the EU Survey accompanying this deliverable will be a vital component to ensure legitimacy.

4.4 Responsibility beyond the project timespan

Sustainability beyond the lifetime of the Skills4EOSC project, which ends in 2025, is seen as the most significant risk. Maintenance of the framework and issuance of any certification is best done by a single and recognised authority, within the EOSC governance framework. However, once the project ends, the centralised umbrella of the Skills4EOSC project will cease to exist.

We suggest that the responsibility for maintenance of the framework after the project ends, lies with the Competence Centre network that Skills4EOSC will create. WP7 will create a lightweight mechanism to ensure effective coordination between the Skills4EOSC Competence Centres. We recommend exploring the possibility of attaching the network to the EOSC Association in some way.

Utilising the Skills4EOSC Competence Centre Network to maintain the Recognition Framework, the following areas would be addressed:

- **Quality Assurance and recognition**: It is advisable that recommended quality and certification parameters are adopted by the issuing institution beyond the Skills4EOSC project. However, this is impossible to monitor without having a central authority in place. During the lifetime of Skills4EOSC, the project will be responsible for updating the Recognition Framework.

  After the project ends, the Competence Centre Network or EOSC Association could undertake quality assurance activities and take responsibility for continued effort to ensure that guidelines for certification are kept updated and to keep the certification criteria harmonized.
- **Trainer registry**: Ensure there is a centralised registry of trainers that is maintained and kept up to date. This would make it easier for institutions to contact these trainers for design and/or delivery of trainings to further Open Science skills training in their local context.
- **Renewal of badges**: With no responsible authority, it is not possible to mandate a renewal of a badge, e.g. after 5 years. This may not be desirable, but without a responsible body, it is not possible.

4.5 Funding

As the world of Open Science develops, it will be necessary for the learning materials and Recognition Framework to develop along with it. This will require resources that must come from either the institutions involved or from some other source. At this point in time, we have no clear picture of the amount of resources required or how to fund it. This must be clarified before we publish the final version of the Framework.

4.6 Choice of technical solution

We have recommended the use of Open Badges as the technical solution and format for providing the digital badges for Skills4EOSC. This choice was made early in the project because Open Badges is a well-established de facto standard and has been chosen by closely related projects such as OBERRED and EOSC Future. Additionally, the issuing of Open Badges is supported by a wide range of learning platforms.

During the last few weeks before finishing the deliverable, we became aware that the work on European Digital Credentials using the standard European Learning Model (ELM v3.0) [R32] has come much further than we thought. The European Commission has established services for the issuance of credentials and support for those who want to start using either these services or to implement such services locally. There is also work ongoing to implement mappings between the most commonly used formats, such as Open Badges, ELM and ELMO. With such mappings in place, the choice of Open Badges could work well alongside credentials from institutions choosing to use the ELM format.

The choice of technical solution will be a focal point in the months to come.

4.7 Sustainability of technical solutions

The use of Open Badges requires a learning infrastructure that supports this standard. During the Skills4EOSC project (until August 2025), this is in place via the project's learning platform, based on the open-source Moodle learning management system.

Beyond this project, any organisation wanting to pilot or use the Skills4EOSC Recognition Framework would have to either use the same platform or use another learning platform that has enabled the use of Open Badges. That system will need to run for as long as possible enabling learners to be able to verify their badges, so a long-term operation and support plan needs to be considered.

This might create a barrier for some organisations to use this solution. However, this is a risk we face no matter our proposed solution. The choice to use Open Badges seems to be the solution which currently is least likely to create problems. It has become the de facto standard for open digital badges, and a long list of learning platforms are already compatible with this standard [R35].

One possible solution to the validation challenge may be to implement national registries for certificates. So far, The Netherlands and Norway have done so, and Sweden is considering a similar solution.

Choosing to move to EDC/ELM or to provide a choice between the two will also reduce the risk. It should be saft to assume the EC will ensure the long-term possibility for validation of credentials using these solutions.

4.8 Lack of formal identification of the badge holders

Ideally, it would be desirable to have learners formally and digitally identify themselves when taking the tests at the end of a course. However, this has been found to be too complex to implement during the project lifetime. We will, however, investigate the issue further. There are currently discussions at a European level on establishing a digital identity. We will follow these discussions and include any conclusions that might be available before the project end-date. It may also be possible to implement such identification at a later stage as part of the maintenance process.

4.9 Challenges of Open Badges

In the process up to the final version of this deliverable, we will also consider how we can reduce some additional risks connected to Open Badges:

- The quality of different badges issued by various organisation may vary as there is no common quality indicator that must be followed. We have indicated ways to handle this within the lifetime of the project, but we need to keep working on how to uphold such mechanisms after the project ends.
- A badge may be seen as less valuable than a traditional certificate or other type of credential that gives formal credits.
- Learners may become focused on attaining the badge instead of obtaining the knowledge.

5 Recommendations and further work

The following are the recommendations we give for the contents of the Skills4EOSC Recognition Framework both during and after the project:

- The Open Badges standard is chosen as the technical implementation of digital credentials (section 3).
- We recommend letting the Skills4EOSC Competence Centre Network be responsible for managing and maintaining the Skills4EOSC Recognition Framework after the end of the project (section 4.4).
- We recommend establishing an organisational link between the Skills4EOSC Competence Centre Network and the EOSC Association (section 4).
- We recommend creating a registry of accredited Skills4EOSC trainers, subject to limitations of GDPR (section 4.4).

Below, we give some recommendations to other work packages in Skills4EOSC tasked with developing training materials:

- Consider splitting train-the trainer courses into low-volume modules and issue Open Badges for all trainings. All trainings offered in the Skills4EOSC project should issue at least one Open Badge on a course or course module level. If badges are offered on a module level, consider issuing a higher-level badge for the total course (section 3.3).
- Follow recommended criteria before issuing Badges. Each badge can only be issued after certain conditions are met. Each task organising and delivering the training should set the conditions for when a Badge can be awarded, and this should be clearly stated in the information of the training (section 3.3).
- Follow Skills4EOSC badge branding and metadata guidelines. The recommended logos and required information for the metadata are addressed in section 3.3.
- Have a system of peer review in place. For all trainings, as per the FAIR-by-design-methodology, request a partner to check if your training meets the recommended criteria for certification (section 4.1).

- Include trainers on the Skills4EOSC trainer registry. The task that has organised the training should send the Skills4EOSC admin an e-mail to have all trainers who have received a badge and who consent to being listed, to be added to the trainer registry (section 4.2).

Until the delivery of the final version of this deliverable in February 2025, we will focus on the following:

- Gathering feedback from external stakeholders by inviting input and presenting the draft recommendations to a broad set of audiences. It is vital to have input from various stakeholders to test our assumptions and choices.
- Following the development on European Digital Credentials and the ongoing initiatives to establish openly available mappings between EDC and other formats. We will explore the possibility of moving to use of EDC/ELM as a technical solution for providing credentials, either by switching to using this or by providing a choice between Open Badges and EDC.
- Investigating the possibility of a sustainable structure for maintaining the Skills4EOSC Recognition framework through the Competence Centre Network or another structure associated with the EOSC Association.
- Identifying any remaining gaps between the work of task 2.4 on certification of training materials and that of 2.5 on accreditation of trainers.
- Identifying ways to support the uptake of the Recognition framework by research institutions.

6 Guidelines for the use of the Framework

To help institutions adopt the Recognition framework, the final version will provide a set of guidelines for the use of Open Badges. Currently, this chapter only contains a suggested list of issues to be covered. These will be further explored and expanded upon before the final publication and different possibilities for publication will be discussed to ensure a user-friendly design.

- From a course manager perspective:
    - Developing a strategy for badge issuing. What modules require badges, and would there be dependencies between different badges? Would there be multiple badges covering the same area designating different levels of understanding (e.g., basic, intermediate, advanced)? Would there be a final badge which would be issued once all modules of a given course are successfully completed and the associated badges obtained?
    - Designing the badges, using a badge template, taking into account the necessary image format and dimensions (at least 300x300 pixels). Make sure that the badge is accessible in terms of colour, font, text size.
    - Adding necessary metadata to the badge. Provide a name, version, description, and attribution to the image being used for the badge. The badge description should include the learning outcomes related to the badge. Recommendation to not set an expiry date for the badge.
    - Ensuring access to the badges once they have been finalized (if not enabled, they will not be issued, even if course participants meet the criteria). Encourage users to upload their badges to their own backpack, leveraging the backpack integration at the learning management system level (as enabled by the administrator), or by simply downloading the badge from the platform, and uploading it to their backpack of choice.
- From the learners' perspective:

- Browse the available content on the learning platform and acquire additional skills in areas of interest. Obtain a badge certifying the newly acquired skills once the set-out criteria have been met.
- Download the obtained badge and upload it to a backpack of choice or make use of the backpack integration available on the learning platform to share the badge using the predefined backpack service.
- Share the badge with additional third-party services, such as LinkedIn.

- From the platform administrator perspective:
  - Verifying whether Open Badges are natively supported on the learning management system of choice.
  - Deciding whether to use the learning management system itself as an issuer (if supported) or a third-party service acting as an external issuer. Caution needs to be exercised during this decision, weighing the pros/cons of each approach. A third-party service acting as an issuer might require complex integrations with the learning platform and might incur additional cost. On the other hand, it might provide a more reliable infrastructure, allowing the badges to be verifiable even in the case if the original learning platform is no longer available.
  - Enabling integration with a third-party service offering the backpack functionality, allowing users to collect the obtained badges in a central location. Backpack services are usually free.

7 References

No	Description/Link
R1	European Commission, Directorate-General for Education, Youth, Sport and Culture, Proposal for a Council Recommendation on a European approach to micro-credentials for lifelong learning and employability, December 2021
R2	Shields, Rebecca, and Ritesh Chugh. "Digital badges–rewards for learning?." *Education and Information Technologies* 22 (2017): 1817-1824.
R3	Clements, Kyle, Richard Edward West, and Enoch Hunsaker. "Getting started with open badges and open microcredentials." *The International Review of Research in Open and Distributed Learning* 21.1 (2020): 154-172.
R4	1EdTech, IMS Global Learning Consortium, Open Badges Specifications (accessed December 9 2023)
R5	EOSC-A, The EOSC Partnership Monitoring Framework, V6.6, March 2022
R6	Whyte, A. et al. (2023). D2.1 Catalogue of Open Science Career Profiles - Minimum Viable Skillsets (v1.2). Zenodo.
R7	Filiposka, S., at al. (2023). D2.2 Methodology for FAIR-by-Design Training Materials (1.4). Zenodo.
R8	Sánchez, M., at al. (2023). D2.3 Community-endorsed quality assurance and certification framework for professional training and qualifications (1.3). Zenodo.
R9	Hoebelheinrich, N. J., et al. (2022). *Recommendations for a minimal metadata set to aid harmonised discovery of learning resources* (Version 1.0). Research Data Alliance.
R10	Open Badge Ecosystem for the Recognition of Skills in Research Data Management & Sharing - OBERRED European Erasmus+ project
R11	The Carpentries, fiscally sponsored project of Community Initiatives
R12	RItrainPlus project, funded by the European Union's H2020 programme under grant agreement no.101008503
R13	The **N**ational **I**nitiatives for **O**pen **S**cience in Europe (NI4OS-Europe) project, funded by the European Commission under the Horizon 2020 European research infrastructures grant agreement no. 857645
R14	NASA's Transform to Open Science (TOPS) initiative
R15	General Secretariat of the EC Council, Adoption of the Proposal for a

	Council Recommendation on a European approach to micro-credentials for lifelong learning and employability, May 2022
R16	Europass, European Digital Credentials for learning, Europass digital tools (accessed on December 9 2023)
R17	The Open Data Institute (accessed on December 9, 2023)
R18	The EOSC Future project, co-funded by the European Union Horizon Programme call INFRAEOSC-03-2020 - Grant Agreement Number 101017536
R19	Linux Professional Institute (LPI), non-profit, global certification standard and career support organization for open source professionals
R20	ICDL Europe (accessed on December 9, 2023)
R21	Educa learning platform(accessed on December 9, 2023)
R22	EU Digital Identity Wallet Pilot implementation, July 2023
R23	Digital Credentials for Europe - DC4E project, co-funded by the European Union's Digital Europe Programme under Grant Agreement no. 101102611
R24	European university foundation, DocTalent4EU project, co-funded by the Horizon EUROPE programme
R25	MIT Open Learning, Digital Credentials Consortium (accessed December 9, 2023)
R26	Canvas Badges, Badgr, all-in-one digital badging
R27	EMMA, European Multiple MOOC Aggregator (accessed on December 9, 2023)
R28	NASA Transform to Open Science GitHub repository
R29	Martin, M., Van der Hijden, P., Short courses, micro-credentials, and flexible learning pathways: a blueprint for policy development and action: policy paper, UNESCO IIEP, 2023
R30	European Commission, European Skills Agenda - Employment, Social Affairs & Inclusion, 2023
R31	European Union, Europass, free, personal tool for learning and working in Europe
R32	European Commission EMPL, European Learning Model, GitHub repo
R33	EDEN & EDEH, "Issuing Digital Micro-Credentials By Using European Standards and Services"Webinar, September 2023
R34	About 1EdTech Consortium (accessed on December 9, 2023)
R35	List of platforms supporting Open Badges and accredited by1EdTech (accessed on December 9, 2023)
R36	The Moodle Learning Management System

R37	The Blackboard Online Learning & Teaching Platform
R38	The Canvas Learning Management System
R39	The Open edX Learning Platform
R40	The Badgr Backpack - European region (accessed December 9, 2023)
R41	Edubadges (accessed December 9, 2023)
R42	The Open Badge Passport (accessed December 9, 2023)
R43	Moodle Documentation, Using badges, v. 4.2 (accessed December 9, 2023)
R44	Moodle Documentation, Competencies, v. 4.2 (accessed December 9, 2023)
R45	Badgr Open Badges 2.0 Validator (accessed December 9, 2023)
R46	IMS Global Open Badges 2.0 Validator (accessed December 9, 2023)
R47	Skills4EOSC Learning Platform (accessed December 9, 2023)
R48	Skills4EOSC Learning Platform, FAIR-by-Design Learning Materials Methodology Training, 17-19 October 2023
R49	Moodle, Certify your learners' skills and competences with Open Badges v2.0 on Moodle 3.9, 31 July 2020