

Utilising a Meta-Data Standard for Digital Credentials and Recognition of Open Learning

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1. Abstract

The MicroHE project presents a meta-data standard for digital credentials and micro-credentials. Based on the ESCO metadata schema (European Skills, Competences, Qualifications & Occupations), the MicroHE meta-data standard adds specific Higher Education and micro-credential extensions. The MicroHE team is currently developing a credentials clearinghouse and a learning passport. The aim is to showcase how a secure digital, blockchain-enabled credentialing solution could look like and function, creating a reference for further developments and standardizations. For the full meta-data standard definitions, please consult <https://github.com/MicroCredentials/MicroHE>.

In order to make an informed and consistent decision on recognizing open learning as ECTS credits towards a degree programme, Higher Education Institutions (HEIs) need sufficient information about the credential. Online education providers, either on their own systems or on portals such as iversity, edX, Coursera, Udacity, FUN, MiriadaX or XuetangX, provide in-demand skills to the labour market. To contribute their offerings in the higher education sector as equals to accredited courses or modules, they need to know which information they should provide and which formal requirements exist regarding workload, learning outcomes, assessment, ID verification, EQF level, quality of learning etc. Virtual mobility is subjected to lack of trust and transparency, making it difficult to transfer credits from online and other non-traditional short learning programmes.

A harmonised European approach to recognizing open education credentials will boost virtual student mobility, empowering students to adapt their learning portfolio to changing labour market demands and technological trends. We envisage students becoming digital pioneers and entrepreneurs of their studies, as they work on challenging projects and seek out learning resources online or from specialist sources. The World Economic Forum cites an estimate by Scott McLeod and Karl Fisch postulating that “65% of children entering primary school today will ultimately end up working in completely new job types that don’t yet exist” (World Economic Forum, 2016, p. 3). We envisage HEIs adapting their curricula and their degrees so that they can accompany and coach the students on their open learning journey.

Key Words: data standard, digital credential, ESCO, micro-credential, open learning, recognition

1. Introduction

There is no European approach to recognising open education modules. EU recognition instruments such as the European Credit Transfer and Accumulation System (ECTS), the Diploma Supplement and the European Qualifications Framework (EQF) support the award of qualifications in the areas of formal learning (Table 1). They are supported by recognition procedures for non-formal and informal learning. The recognition and transfer of individual credits through ECTS was created for an era of physical mobility, and is optimised accordingly. Little guidance exists on how to document open education experiences for the purposes of credit transfer. Open online learning (OOL) is referred to as different forms of open distance learning with access to open or distance courses (Cole, Shelley, & Swartz, 2014, pp. 111–131). In line with the terminology usage in current literature

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on the subject, we suggest to use the term 'micro-credential' for the certificate of learning and the term 'short learning programme' for the course and learning experience itself.

EU standards for qualifications	
European Qualifications Framework gives an indication as to the level of various qualifications	Not for non-formal education or open learning or micro-credentials
European Diploma Supplement provides a standardized template to give additional information about a degree	Only for degrees
European Credit Transfer System allows for individual learning units to be described in terms of knowledge, skills, responsibility and autonomy	Only for Higher Education
European Skill, Competences, Qualifications and Occupations database provides a multi-lingual standard terminology	Not used by the tools above

Table 1: EU Standards for Qualifications (MicroHE project, Ildiko Mazar)

This paper explores scenarios to make open and online learning comparable and recognisable within higher education. This is challenging (Table 2): while formal recognition according to the Lisbon Recognition Convention (LRC) is about recognising credits from accredited study programmes offered by different higher education institutions, open learning extends far beyond the realm of higher education. It includes different formats and providers in a wide range from formal to non-formal and even informal learning.

Physical Mobility: transfer credits	Virtual Mobility: transfer credits
Between higher education institutions (HEIs).	From online and other non-traditional short learning programmes. Which might be offered not only by HEIs, but also by other education and training sectors.
From accredited study programmes.	Which are typically not higher education accredited.
With credits described in ECTS.	Which are often not described in ECTS, instead use alternative systems of credentials.
With controlled assessment environments.	Where identity verification processes and assessments are more complex and challenging than in face-to-face settings.
With learning agreement from home HEI.	Without formal statement from home HEI about the perception of externally acquired learning.
With module description that provides information about workload, learning outcome and assessment conditions.	Which lack transparency regarding academic content and learning methodologies.
<input type="checkbox"/> Trust and Transparency	<input type="checkbox"/> Lack of Trust and Transparency

Table 2: Challenges of Virtual Mobility (MicroHE project, Jochen Ehrenreich)

2. Basic Concepts

2.1. Meta-Data Standard

To achieve the credibility and accountability needed for formal recognition of open learning within the European higher education systems, the project MicroHE³ is creating a standard format for describing open education and virtual mobility experiences according to the standards and guidelines of the European Higher Education Area (EHEA). The proposed meta-data standard is

³ Support Future Learning Excellence through Micro-Credentialing in Higher Education, <https://microcredentials.eu/>

independent of the underlying technology. The Learning Passport based on this data standard should not only ensure accountable and verifiable documentation of open learning, but also facilitate the potentially automated translation of open learning credentials (also called micro-credentials) into ECTS credits with a formal value for higher education. The Learning Passport thus provides higher education institutions with sufficient information so that they can make an informed and consistent decision on whether to recognize such a micro-credential as ECTS credit towards a specific degree programme. The Learning Passport could also pave the way for the transition from paper-based to digital credentials in the European higher education area.

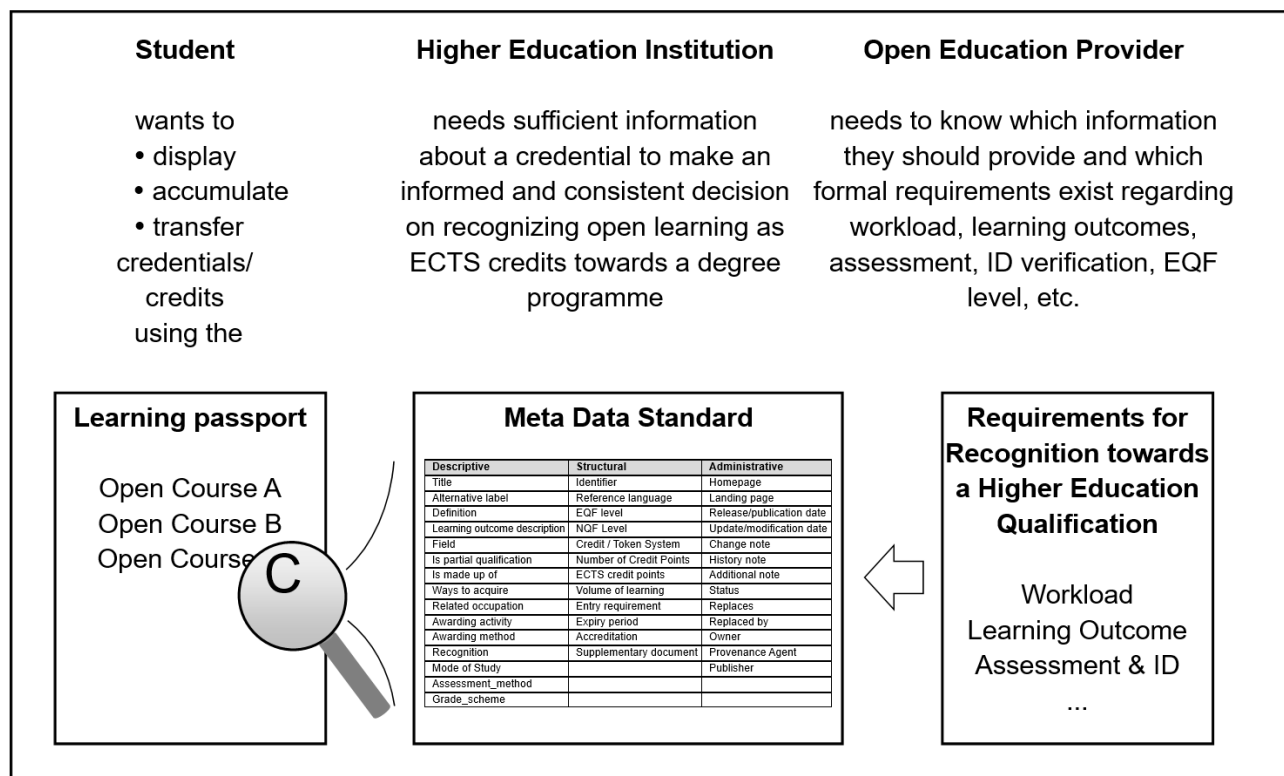


Figure 1: Basic concept of the Meta-Data Standard (MicroHE project, Jochen Ehrenreich)

2.2. ESCO Metadata Schema as the basis for the MicroHE meta-data standard

European Skills, Competences, Qualifications and Occupations or ESCO is the multilingual classification of skills, competencies, qualifications and occupations that identifies and categorizes all of those which are relevant for the EU labour market and education and training in 25 European languages. The system provides occupational profiles showing the relationships between occupations, skills, competences and qualifications. (ESCO, 2013, p. 2).

The introduction of standard terminology for occupations, skills, competences and qualifications can help education and training systems and the labour market to better identify and manage the availability of required skills, competences and qualifications. Jobseekers can use ESCO to describe their skills, competences and qualifications when developing their CV, which can then go through various automated or machine matching processes. Besides, they can also compare their skills, competences and qualifications against job vacancies using ESCO terminology, to identify the skills they are lacking (ESCO, 2013, p. 4).

As “ESCO has been developed in an open IT format and is available for use free of charge by everyone and can be accessed [through an online] portal”, [...] “ESCO can be used by developers as a building block for different types of applications that provide services such as auto complete, suggestion systems, job search algorithms and job matching algorithms.” (ESCO, 2017).

2.3. MicroHE meta-data standard

Figure 2 illustrates the internal logic of the MicroHE meta-data standard. It is an extension to the ESCO Metadata Schema. The MicroHE meta-data standard facilitates the automatic exchange of micro-credentials. It provides all the necessary information to make an informed recognition or validation decision. For the full MicroHE meta-data standard definitions, please consult <https://github.com/MicroCredentials/MicroHE>.

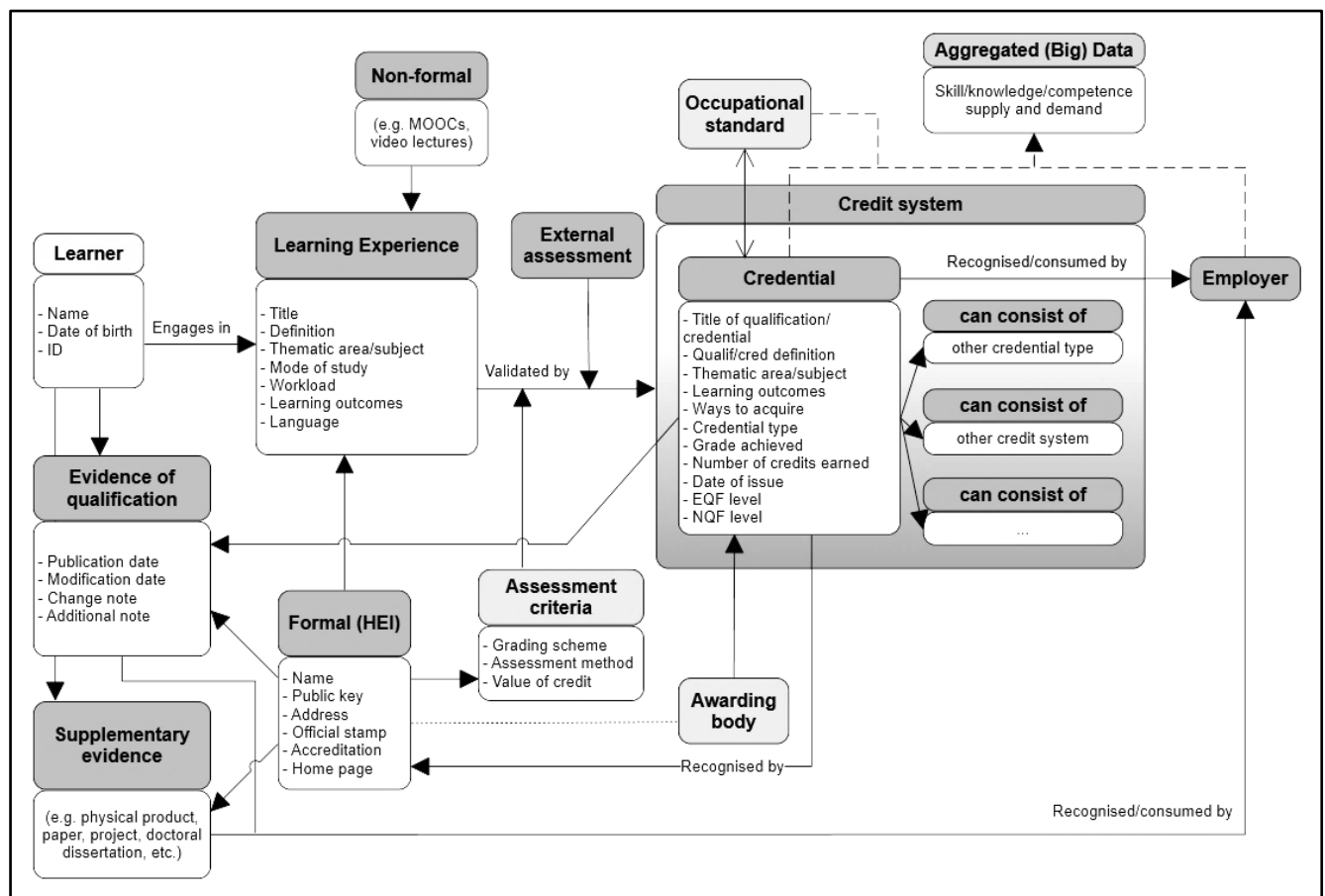


Figure 2: Simplified representation of the Ontology of the Meta-Data Standard (MicroHE project, Ildiko Mazar)

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2.4. Learning Passport

Many initiatives around the world are developing and proposing digital credentialing solutions, often using blockchain technology for verifiable transactions. Well-known examples are Open Badges⁴ and Blockcerts⁵, illustrating the wide range of possible applications from badges for participation to micro-credentials and even full academic degrees. Identifying a single best solution is not easy. Most likely, a number of open-source, interoperable technologies will emerge, and these standards and technologies will evolve through the support of a community.

The Learning Passport will allow students to store credentials from different education providers all in one place and selectively share them with educational institutions and employers. It could pave the way for the transition from paper-based to digital credentials in the European Higher Education Area. We envisage that a digital credentialing solution would include the following components:

- a secure digital Learning Passport where students and lifelong learners can collect credentials from various formal and non-formal (possibly also informal) learning experiences,
- a way for students to share such credentials, for example in CVs, online portfolios etc.,

⁴ <https://openbadges.org/>

⁵ <https://www.blockcerts.org/about.html>

- an international consortium of educational institutions jointly operating the digital credentialing solution and taking responsibility for governance and evolution of the Learning Passport, as well as for admission of new full and associate members,
- digital certificates/credentials issued to a student by members of the consortium,
- a way to ensure that only consortium members, i.e., accredited institutions, can issue such digital credentials,
- a way to authenticate the certificate and ensure its validity,
- a way to verify the learning outcomes (described in ECTS) documented by the credential, as well as its link to the EQF, automatically.

2.5. Credentials Clearinghouse

We at the MicroHE project aim to create a system for issuing, verifying and sharing micro-credentials in terms of ECTS, which we call Credentials Clearinghouse. Digital credentials must have a secure mechanism for verification, therefore a publicly accessible record is indispensable. We propose for this purpose to employ a distributed ledger based on blockchain technology, as outlined in Figure 3.

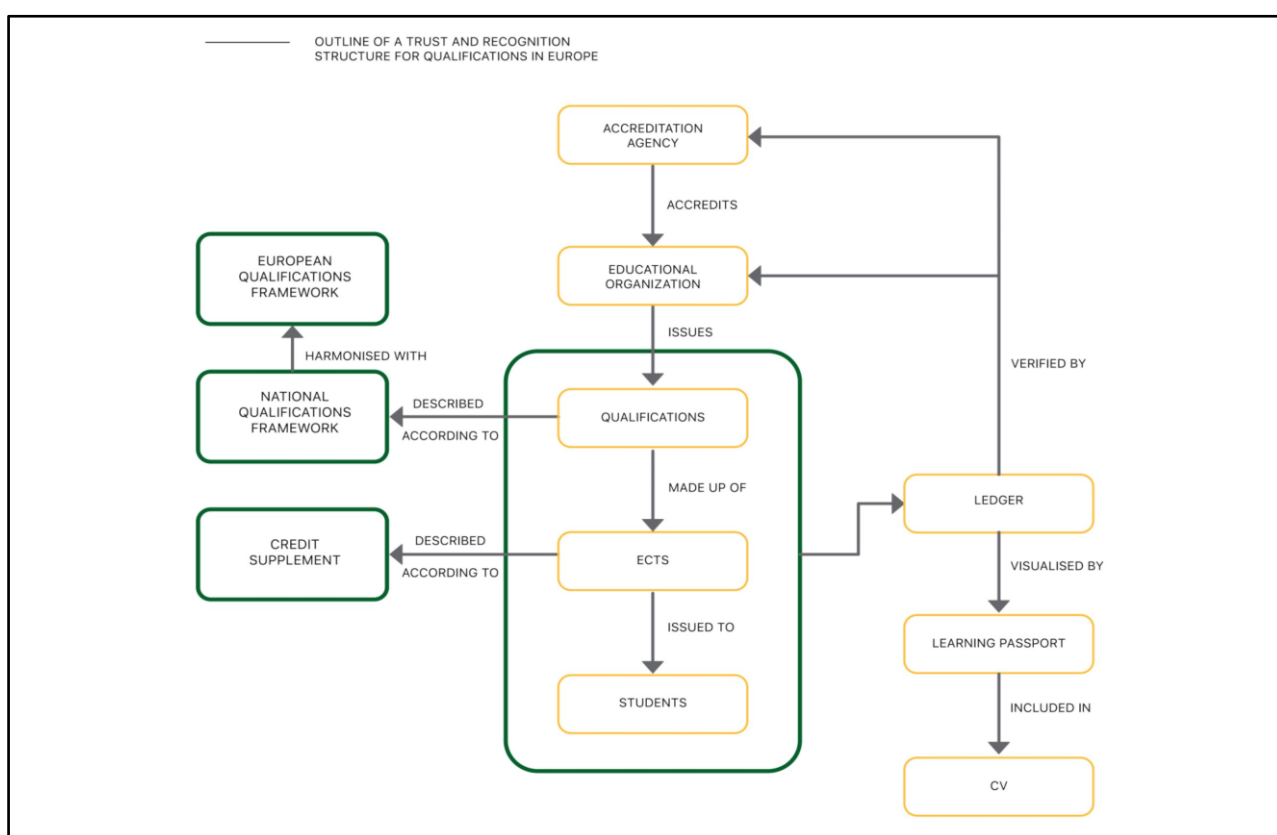


Figure 3: Blockchain in Education (Grech & Camilleri, 2017)

The Learning Passport is aligned with a solution that utilizes a combination of a public blockchain and a private blockchain run by a consortium of participating educational institutions. There are different consortium blockchains, one for each specific token type. So there is one for ECTS qualifications, one for ECVET qualifications, and there are other blockchains for other different qualification types. These blockchains are collectively maintained by the consortium of educational institutions that issue credentials on them. To ensure integrity, hashes of each block on these consortium chains are in turn stored on a public blockchain involving proof-of-work. Credentials will be stored on the consortium blockchain in anonymous form using a Universal Unique Identifier.

Qualification data (like for example versioned and time-stamped module descriptions) are stored off-chain in a qualification database. Evidence linked to a credential is stored off-chain in an evidence database. This could be project work a student has created as part of an assessment in open learning, like a video, a website or a computer program. To prevent tampering and falsification,

hashes of the off-chain data are stored on the consortium blockchain (Figure 4).

The Learning Passport can be interpreted as the view of an individual on all the qualifications and credentials associated with that specific person, i.e., the individual's wallet. Likewise, the database that an institution maintains about all the credentials it has issued is that institution's wallet.

In this Learning Passport community, each educational institution who is a consortium member “maintains his or her own copy of the information and all members must validate any updates collectively. The information could represent transactions, contracts, assets, identities, or practically anything else that can be described in digital form. Entries are permanent, transparent, and searchable, which makes it possible for community members to view transaction histories in their entirety. Each update is a new “block” added to the end of a “chain.” A protocol manages how new edits or entries are initiated, validated, recorded, and distributed. With blockchain, cryptography replaces third-party intermediaries as the keeper of trust, with all blockchain participants running complex algorithms to certify the integrity of the whole.” (Grech & Camilleri, 2017, p. 16).

Education providers will issue digital credentials using their institutional wallet. There will also be a paper representation of the digital credential containing a link to the digital form.

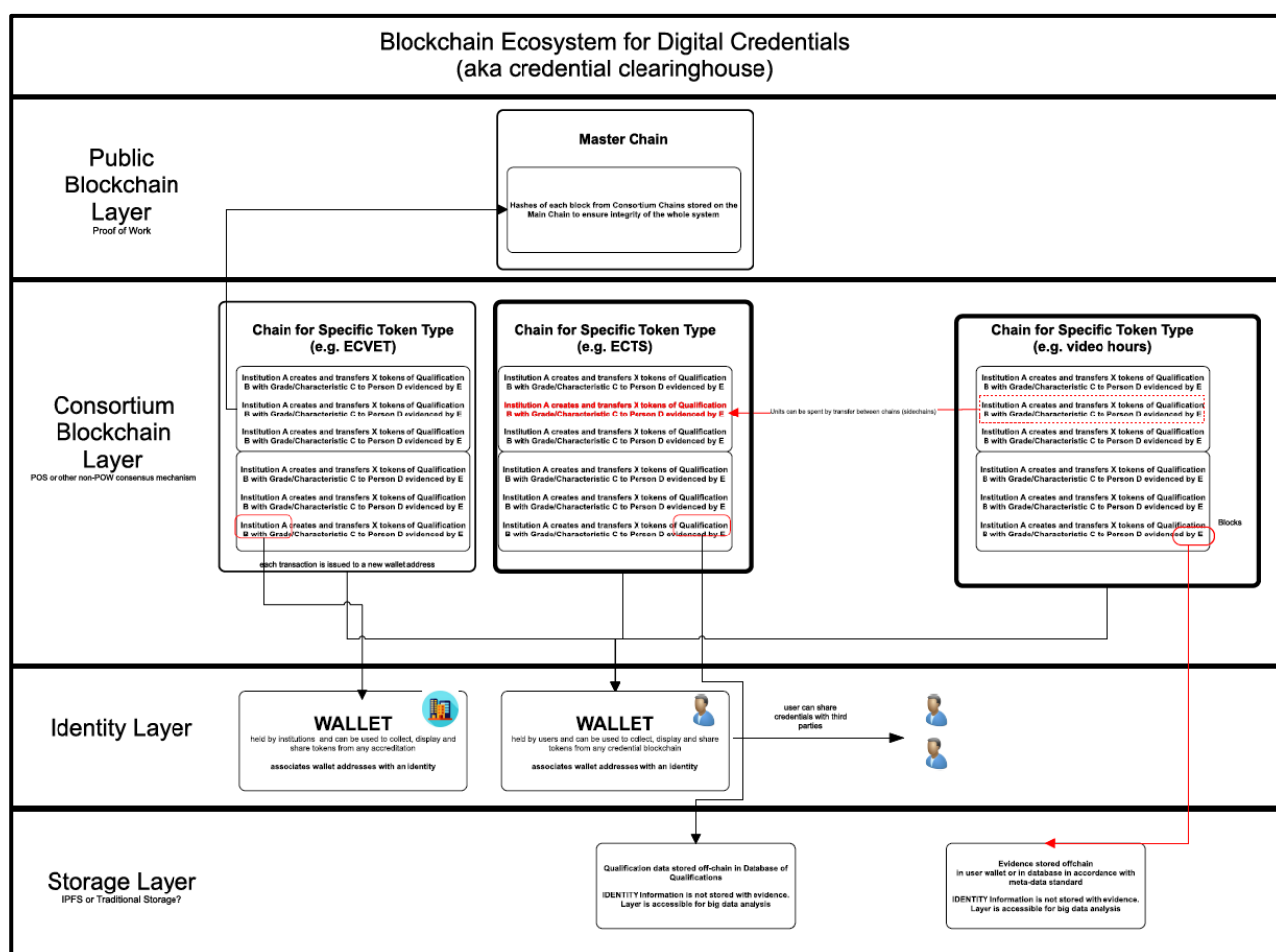


Figure 4: Blockchain Ecosystem for Digital Credentials (Source: MicroHE project, Anthony Camilleri)

Developing and maintaining applications is not within the scope of the MicroHE project. Therefore, we welcome outside collaboration. To provide front-end and back-end integration and applications, we collaborate with the Blockchain experts from 0xcert⁶. 0xcert uses non-fungible tokens on the Ethereum blockchain according to the ERC721 standard. For a start, we envisage the following applications and functionalities:

⁶ <https://0xcert.org>

- Learning Passport as a web service and as an application
- Social Media and Career Network integration
- New Europass integration
- Verification services

2.6. Digital Credentials

In the context of education and training, a credential is a certificate issued by a responsible institution that attests and verifies that a person has achieved specific learning outcomes and acquired specific skills and competences. The learning experience can involve online- or face-to-face-learning, or both. Credentials can be paper-based or digital, and they can be degrees, certificates, badges, diplomas, licenses, and industry certifications, among others, testifying attained skills and competences (Connecting Credentials [Lumina Foundation], 2016; Ganzglass, 2014; SUNY, 2018).

The switch from paper-based to digital credentials offers advantages to learners and employees, to educational institutions and to potential employers. Open education demands digital credentials (ICDE, 2019). A system of universally recognized and stackable micro-credentials for smaller units of learning below degree level (both online and offline) enhances student mobility and employability and enables truly flexible learning paths. It has the potential to take life-long learning to a new level. Stackable credentials are referred to as a “‘transferable currency’ that can help people progress in our multi-layered education, training, and credentialing system” without having to duplicate certain courses as their needs and learning pathways change (Ganzglass, 2014).

The advantages of digital credentials and the Learning Passport for learners are:

- all credentials are conveniently stored online in one place
- the credentials are securely stored for a long time
- the learner “owns” his or her credentials
- the credential incorporates the verification of the identity of both earner and issuer
- the credential is verifiable
- there is a permanent link to the credential and the supporting evidence, even after the program or course has been completed, changed or discontinued
- the credentials may contain links to evidence of tasks performed or of assessment results
- a digital credential can document achievements from formal education, non-formal learning, lifelong learning, apprenticeships and short programs
- even small or diverse bits of learning may get visible and documented (and possibly credited)
- the credential’s content (meta-data) is searchable
- a credential may be linked to an online identity
- digital credentials can be made available to employers and HEIs when applying for work or for a study programme, in full or selectively
- possibility to create multiple flexible collections of credentials to (a) communicate distinct sets of skills and competences and/or to (b) identify skill/knowledge gaps when pursuing degrees or specific employment
- potential to utilise the digital certification ecosystem to present existing evidence of prior learning to earn corresponding credential
- increased possibilities for physical and virtual student mobility

The advantages of digital credentials and the Learning Passport for educational institutions are:

- option to access additional information about the credential and the acquired knowledge, skills and competences
- easier admission processes
- easier recognition processes
- consistent recognition decisions due to transparent documentation
- potential to consult data on skill/knowledge/competence demand by labour market
- the credential’s content (meta-data) is searchable
- version control: time-stamped history of module descriptions and their evolution over time

- quick issuing of credentials (once the protocol is in place and administrators are trained)
- inexpensive issuing of credentials
- quick and inexpensive replacement of lost credential
- safe and secure credentials that are harder to temper with than traditional credentials
- option to withdraw credentials in case of errors or misuse
- option to track how and to which extent the digital credentials are being consulted
- most of the data is already available in the IT system
- can be linked to the IT system and to administrative processes
- standardized data format
- verified transactions via blockchain are a logical next step
- enables unbundling of credentials (e.g., for modules instead of degrees)
- enables stackability
- new forms of study and new business models are possible
- new potential students or customer groups can be reached

The advantages of digital credentials and the Learning Passport for employers are:

- simple and quick verification of digital credentials
- link to evidences of tasks performed and/or the results of assessments
- potential to consult data on HE skill/knowledge/competence supply and trends
- option to access additional information about the credential and the acquired knowledge, skills and competences
- encourages lifelong learning
- opportunity to document in-service / continuing professional development training in compatible credential format
- transparent solution
- the credential's content (meta-data) is searchable

Adapted from (Riksen & Kerver, 2016).

2.7. Unbundling

Unbundling means that products and services that were being offered or sold together are now being offered in parts. In Higher Education, all modules of a study programme leading to a degree were traditionally organized and offered by the same institution. Upon successful completion that institution awarded the degree. Open learning recognition could potentially lead to unbundling in higher education. As an example of how higher education institutions can embrace the trend towards unbundling in higher education, consider the “curiosity-driven education” approach of the Code University in Berlin, Germany. Students work on challenging projects, seek out learning resources online, define the competencies and skills to be acquired through a learning agreement with their professors, and are accompanied by university lecturers in their personal development and learning processes. They become digital pioneers and entrepreneurs of their studies. They develop the self-confidence to accept unknown challenges and develop new competencies (Code University of Applied Sciences, 2019).

3. Recognition

3.1. Standards and Guidelines for Recognition

We envisage an automated system of credential recognition as a long-term goal. In order to ensure such recognition, it is not only necessary to provide suitable (innovative) procedures but also to fulfil the standards that are required for formal recognition by the relevant authorities, mainly HEIs. The Learning Passport will thus be designed in alignment with the standards and guidelines of the European Higher Education Area. The major reference for the project thus are the European Standards and Guidelines (ESG, 2015), the European Area of Recognition Manual (Nuffic, 2012; The EAR HEI and STREAM projects, 2016) and the ECTS Users' Guide of the European Commission (European Union, 2015). Additionally, the national and European qualification frameworks (NQF and EQF) play a major role for the taxonomies behind the credential, linked to

other initiatives such as ESCO. As part of the PARADIGMS project the Dutch NARIC Nuffic recently published a policy paper called *Oops a MOOC* focussing on the evaluation of MOOCs that suggests several criteria for the assessment of a MOOC certificate which could be applied to the context of micro-credentials in general (PARADIGMS, 2018).



Quality Criteria of Credentials	OpenCred	Oops a MOOC	EAR Manual	
<i>The credential should provide information on...</i>				
C1 Identification of Credential & Institution	Informative certificates / badges acknowledging learning	2. Verification of the certificate [Authenticity]		Transparency
C2 Identification of the Learner	Identity Verification of the Learner	7. Identification of the participant [Identification]		
C3 Learning Outcomes		4. Learning outcomes	5. Learning Outcomes	
C4 Workload of Learning		5. Workload (volume)	2. Workload	
C5 Level of Learning		3. Level of the study programme [Level]	1. Level of a Qualification	
C6 Quality of Learning	Quality Assurance	1. Quality of the study programme [Quality]	3. Quality	
C7 Assessment of LOs / Rules to earn	Supervised assessment Award of Credits	6. The way study results are tested [Testing]		
	Partnership & Collaboration		4. Profile	
<i>The medium should be ...</i>				
M1 Distinct			(Substantial and non-substantial differences)	Trust
M2 Authentic	(Informative certificates / badges acknowledging learning)	(2. Verification of the certificate [Authenticity])	(Authenticity)	
M3 Accessible				
M4 Exchangeable			(Credits, grades, credit accumulation and credit transfer)	
M5 Portable			(Purpose of Recognition)	

Table 3: *Quality Criteria of Credentials* (Source: *MicroHE project*, citing (PARADIGMS, 2018; The EAR HEI and STREAM projects, 2016; Witthaus et al., 2016))

There are several possible use cases for credential recognition, among them:

- Learning agreement
- Stackability
- Curricula that integrate prior or open learning
- Recognizing (micro-) credentials towards a Higher Education degree

3.2. Learning Agreement

Ideally, the decision about recognizing an open learning credential will be made before the student takes that course, and the student and the institution sign a corresponding learning agreement.

3.3. Stackability

Institutions may choose to define learning pathways (or curriculums) through which they define beforehand that some specific courses combined will be awarded with a summative credential or degree. . Stackable credentials may be accumulated over time to build individual's qualifications allowing him to move along career pathway allowing to optimize credential attainment (Ganzglass, 2014).

3.4. Curricula that integrate prior or open learning

Higher education institutions might also decide to accept certain pre-qualifications as equivalent to some (usually entry-level) modules of their curriculum. The Massachusetts Institute of Technology

(MIT) has signed agreements with over a dozen universities from around the world. They recognize MIT's edX online credential "MicroMasters in Supply Chain Management" as equivalent to between 20 and 42 ECTS credits of their own curriculum. Some Bachelor's curricula in midwifery or physiotherapy in Germany recognize a vocational education in that field as equivalent to the first two or three semesters of the curriculum.

3.5. Recognizing (micro-) credentials towards a Higher Education degree

For a higher education institution to recognize open learning credentials as credit towards an HE degree, a responsible person has to make an informed decision by evaluating the information and evidence about the learning that the credential attests and comparing it to the learning outcomes of the module that it will be credited to (graded or non-graded). The initial decision about recognizing a certain credential as ECTS credit towards a specific module must always be done by a responsible person or committee. It cannot be automated.

Automation can only kick in for all subsequent recognition requests about that course, i.e., to ensure consistency once a recognition decision has been taken about a specific credential. Recent studies have tried to provide guidance on the recognition of online learning (Kiron Open Higher Education, 2017; Rampelt, Niedermeier, R wert, Wallor, & Berthold, 2018; Witthaus et al., 2016) and of foreign degrees (The EAR HEI and STREAM projects, 2016).

4. Conclusion

A meta-data standard is an important element in the emerging ecosystem for digital credentials and recognition of open learning. Following the start of the MicroHE project, the European Commission announced the preparation of an update of the Europass, which will include a framework for digitally signed credentials. The MicroHE project has engaged closely with the DG Employment on this matter. This has resulted in Europass adopting a number of key decisions based on research done by MicroHE.

The MicroHE project is developing and field-testing the Credentials Clearinghouse using innovative technology on the blockchain. The aim is not to have a perfect solution by the end the project, but to showcase how a digital blockchain-enabled credentialing solution could look like in the future and to discover the potential pitfalls of such a system. In particular, the project is launching a set of APIs which allow for credentials to be created as non-fungible tokens using the Ethereum network. This is the first application of this technology globally for credentials. By creating APIs, other institutions are then free to use this technology platform to develop other solutions.

5. Acknowledgements

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⁷ Knowledge Innovation Centre, Swieqi, Malta

⁸ Stifterverband f r die Deutsche Wissenschaft e.V., Essen, Germany

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