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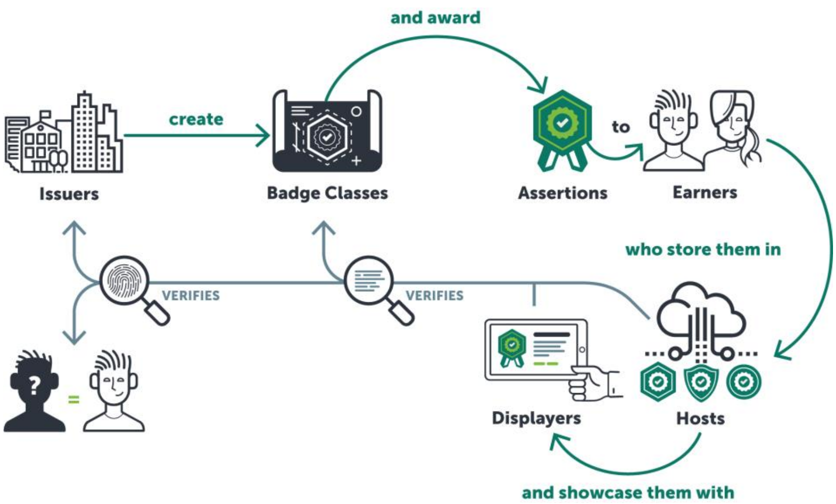
Stackability planning in informal learning and soft skill acknowledgments

Introduction

Within the framework of the DISCO VET project (DISCO VET, 2023) with the participation of the Institute of Continuing Engineering Education in Budapest (BME MTI) of the Budapest University of Technology and Economics (BME), the goal was to develop a digital badge and certificate management system based on the Open Badge standard. The capabilities of the open-source Badge program were the basics, but they could be improved. The IMS Open Badges specification describes a method for packaging information about accomplishments and recognition, embedding it into portable image files as digital badges, and establishing resources for validation and verification (Arenas, 2021).

Figure 1. **The life cycle of an Open Badge based digital credential**



Source: https://openbadges.org/build

Our DCP system, which complies with the Open Badge 2.0 standard, works well in practice. We have issued many training programs at BME that are associated with digital certificates. The system supports the collection of earned badges of our users. They have accumulated a considerable number of badges during this time. The evidence of awarding the badges is included in the metadata. According to our surveys, this data content typically provides limited information about the recipient's competencies. For this reason, the question is: would it be possible to develop a supporting competency framework that could be included as supplementary data when awarding badges? Furthermore, if such metadata-enriched certificates appeared in portfolios, could they be grouped, bundled, or stacked?

Soft skills

Soft skills (Holik and Sanda, 2021) are often defined in terms of "those skills, abilities, and personal attributes that can be used within the wide range of working environments that graduates operate in throughout their lives" (Fraser (2010).

Numerous researchers have defined soft skills (Bennett et al. (1999), Gallivan et al. (2004), Beard et al. (2007), Schulz (2008), Chamorro-Premuzic et al. (2010)); without aiming for completeness, a few recent classifications have been collected.

Council recommendation (Council, 2018) on key competencies for lifelong learning has a correst list of them.

Other list was formed by (JobTease, 2021): adaptability, information management, collaboration, communication, leadership, critical thinking, problem solving, and creativity.

Eight soft skills were noted by (Technosolis, 2024): adaptability, emotional intelligence, communication, leadership, critical thinking, continuous learning, teamwork, and time management.

Next eight items from (Ultraproductive, 2024): deep focus, self-motivation, prioritization, proactive communication, adaptability, collaboration, continuous growth, and emotional intelligence.

The ELISA (European Engineering Learning Innovation and Science Alliance) (EELISA 2019, 2023) uses a unique soft skills framework to define the digital badges issued by the alliance. The set of Sustainable Development Goals (SDGs) (United Nations, 2015) defined by the United Nations (17 items) serve as a basis; educational objectives are elaborated in another document by UNESCO (UNESCO, 2017). However, the EELISA Office also applies impact levels (*discovery*, *knowledge*, *commitment*, *action*, *transformation*) (Waite, Álvarez, Navarro, 2023)(Waite, 2023) to these soft skills. These levels indicate the depth of soft skill acquisition. The dedication of the universities participating in the EELISA alliance is reflected in how they physically display the 17 SDGs to university community members. It is illustrated in the photo below, taken in the hall of Building E at BME.

Figure 2. **The physical representation of EELISA's SDGs at BME, Hungary**

Source: Own photo

From the above collection, it is clear that while there is some overlap in the content of soft skills, differences also emerge, and there is no final consensus regarding standardization.

General aspects of stackability

According to *The Britannica Dictionary* online knowledge base, stackability is "able to be arranged in a stack", referring to the ability to accumulate similar items. In the article (Reich, Ruipérez-Valiente, 2019), the authors argue – based on their surveys – that MOOC (Massive Open Online Courses) systems did not redeem the high expectations placed on them between 2012 and 2018. According to their findings, many registrants dropped out of online courses, and the completion efficiency of programs launched with the involvement of prestigious universities proved to be much higher in face-to-face formats. While it would be interesting to examine the effects of the COVID-19 pandemic in 2020, let us consider the response article listed under (DeVaney, Rascoff, 2019), written by James DeVaney and

Matthew Rascoff. They mention the concept of *stackability* as one of the significant opportunities in the MOOC world to strengthen engagement and add a sense of personalization to online education.

In contrast to the opinion expressed in the source (Reich, Ruipérez-Valiente, 2019), another researcher (Shah 2021) observes significant growth in the MOOC world, noting 220 million registered users, 950 participating universities, and 19,400 available courses as of 2021. Among major MOOC platforms, *edX* operates a stackable credential system named *MicroMasters*, while *Coursera* uses *MasterTrack*. These serve as marketing tools to strengthen learner engagement in open courses. They represent a learning strategy, as educational institutions can offer content that is better aligned in scope and format with the needs of participants.

These platforms provide shorter, smaller units of curriculum organized into a networked structure, allowing multiple entry points and pathways. The novel distribution of educational costs does not compromise the quality of education. Micro-credentials' structure is easy to follow, and learners' performance and progress can be effectively tracked. Instead of traditional entrance exams, students may be selected based on a stackable performance path.

Developing and operating a system of stackable credentials is primarily an institutional responsibility (Education Strategy Group, 2023). A shared agreement and ongoing coordinated effort among labor market actors, educational institutions, accrediting bodies, and governmental agencies responsible for quality assurance is essential.

Data Management Infrastructure and Alignment of Learning Content

The mapping and aligning learning content focuses on identifying possible learning pathways and defining connection points between them. It can be achieved through the following steps:

- Learning paths resulting from stackable certificates represent significant value from content and labor market perspectives.
- It is necessary to determine whether the specified learning paths or some combination cover the labor market's short – and long-term needs (it is worth involving the appropriate actors here).
- It is necessary to ensure the accreditation of training courses, and in some cases, professional certificates, and quality assurance based on appropriate sources.
- If student pathways consist of training offerings from multiple institutions, inter-institutional coordination, and corrections must also be carried out.
- Coordinating the conditions for completing training courses is worth it so that students can obtain the most certificates through a network of overlaps and by building on each other's strengths.

In the spirit of lifelong learning, no diploma should be considered the final. It is far more motivating for learners if they receive credentials along their educational journey acknowledging the successful completion of partial milestones – certificates recognizing each closed phase of progress. These certificates provide a solid baseline when shifting career paths or starting new learning journeys later in life - there are no more wasted efforts. It gives participants a greater sense of safety, as the time and energy invested in learning are not lost. Learners are more likely to engage in educational processes when they can see institutions' entire learning pathways.

Within the framework of valid educational policy, these groups should review curricula, map educational content, and organize the elements into coherent learning segments that can be positioned along various learning pathways. The second step is to develop a learning pathway network with the agreement and support of all relevant stakeholders, including teaching faculty, industry partners, chambers, and labor market actors. Further consultations are necessary to ensure employers recognize stackable credentials as valuable and accept them with corresponding employment opportunities and appropriate compensation.

Learner-Centered Support

The main objectives include the following:

- Provide a tool for monitoring student progress, which can help predict potential dropouts and prevent premature withdrawal from studies.
- Train and sensitize instructors to recognize, understand, and respond to students' emerging needs. In many cases – especially for students balancing work and study – faculty members may be the only accessible point of contact within the institution.

These objectives can be achieved through the institution's provision of adequate human and financial resources. The learner-centered support team develops and implements the necessary academic, advisory, and financial assistance services.

EU related stackability

The cited sources have primarily reflected the Anglo-American perspective on stackability. However, in its summary briefing (COUNCIL, 2021), the European Commission presents a highly structured and well-regulated approach to handling micro-credentials.

Among the mandatory metadata for each micro-credential, the following items are listed (highlighting elements that are essential for stackability):

- Identification of the learner
- Title of the micro-credential
- Country/Region of the issuer
- Awarding body
- Date of issuing
- *Learning outcomes*
- Notional workload needed to achieve the learning outcomes (in ECTS credits, wherever possible)
- *Level (and cycle, if applicable) of the learning experience leading to the micro-credential (EQF, QF-EHEA), if applicable*
- *Type of assessment*
- Form of participation in the learning activity
- Type of quality assurance used to underpin the micro-credential

Among the optional elements, we find the designation of the stackability item requirement (integration/stackability options: standalone, independent micro-credential / integrated, stackable towards another credential).

Key design considerations include Pathways, Recognition Learning, and Portability. Overall, the EU framework clearly understands the fundamental concepts and components of stackable credential systems.

The EU has issued a *recommendation* (Council Recommendation, 2018) in which the *definition* of micro-credentials explicitly allows for stackability. A highlighted excerpt reads:

"'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. Courses leading to micro-credentials are designed to provide the learner with specific knowledge, skills and competences that respond to societal, personal, cultural or labour market needs. *Micro-credentials are owned by the learner, can be shared and are portable.* They may be standalone or combined into larger credentials. They are underpinned by quality assurance following agreed standards in the relevant sector or area of activity."

Following this theoretical and legal foundation, we can now turn to an overview of technical implementation considerations.

How do you plan a stackable function based on soft skills into an Open Badge host?

Placing extra contents into an Open Badge certificate

In an Open Badge 2.0-compliant certificate, there are several locations where content can be embedded to support *stackability.*

The standard (1EdTech, 2018) distinguishes between two main components: *badge class* and *assertion*. The *badge class* can be seen as a master template describing the certification event's purpose and the conditions required to earn it. The *assertion*, in contrast, is a specific instance issued to an individual, documenting the actual completion process. A single *badge class* can serve as the basis for many *assertions*.

For the *badge class*, the standard defines the following text fields:

- name (required): The title of the achievement
- description (required): A summary of the achievement
- alignment (optional): A textual object that provides reference points to help contextualize the class about specific goals or other standards.

The *name* and *description* fields are primarily designed for human readability. The *alignment* field, however, offers more flexibility. It can include multiple entries that more precisely define the scope and context of the badge. These may include target name, URL, targetDescription, targetFramework, and targetCode.

For the *assertion*, the following fields are available:

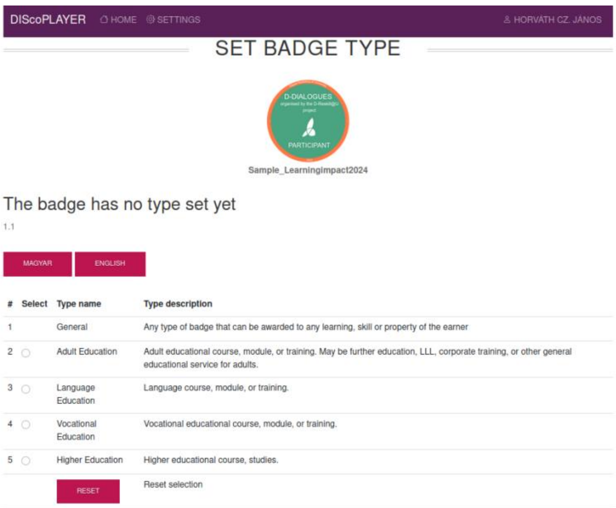
- evidence (optional)
- narrative (optional)

The *evidence* field, which may contain multiple entries, allows documentation of the circumstances surrounding an individual's achievement. Subfields include id, name, narrative, description, genre, and audience. The narrative field exists independently and as a subfield within evidence, which introduces some redundancy by design.

While the evidence field could technically store metadata, it is rarely utilized this way, especially considering how badge-displaying applications render content.

We have implemented metadata extensions in our digital badge management system (DisCoPlayer, DCP Host) (DISCO VET, 2023). We can attach supplementary data to badges issued via DCP using specially prepared forms. When recipients upload these badges back into the DCP system, this additional information becomes accessible – although it is not directly available on other badge displayer platforms.

Figure 3. **The control panel of extra metadata fields**



Source: Own screenshot from DCP portal

Figure 3 shows the current supplementary metadata form, which displays the available data fields. Specific information can already be recorded during the badge class's creation, while *personal data* is meaningful only within the assertion's context. Integrating soft skills is relatively straightforward when dealing with supplementary metadata.

Finding badges in patterns

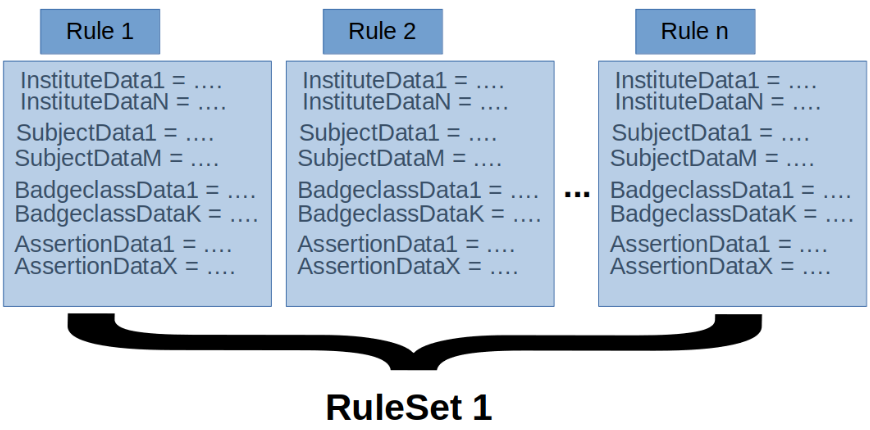
Enriching digital badges with additional metadata is only the first step. The system must identify badges uploaded by users and, upon meeting predefined conditions, trigger some follow-up events. For example, if a user collects badges that certify the skills defined in the source (Summa, 2022), the DCP system issues a summary meta-badge. In another case, if a user has earned badges covering at least half of the skills within three different soft skill categories, the DCP may offer a learning path to obtain the missing credentials. A pattern recognition engine, part of the digital badge host application, identifies combinations that match the defined rules. The most straightforward approach is to search for exact word matches in text fields intended for human readability. The match is considered valid if a given word or phrase appears with the correct spelling in selected fields. However, this method performs poorly when working with multilingual content or when badge creators use ambiguous terms.

Greater efficiency can be achieved if the pattern recognition engine works with predefined lists. In such cases, it searches for elements from those lists within the extra metadata fields of the class or the assertion.

The situation becomes more complex in the case of the stackable learning pathways discussed earlier. While it remains necessary to embed extra metadata in badges, additional layers of information must be created to support further operations. Defining learning pathways may rely on intra- and inter-institutional training programs. Therefore, the badge-hosting application must be capable of interpreting rules that include institution-related data among the conditions.

Likewise, educational program descriptions must be based on standardized rules, such as those in the course description files available on the BME TAD portal (BME GTK, 2025).

Figure 4. **Rules work as filtering by metadata of badges**

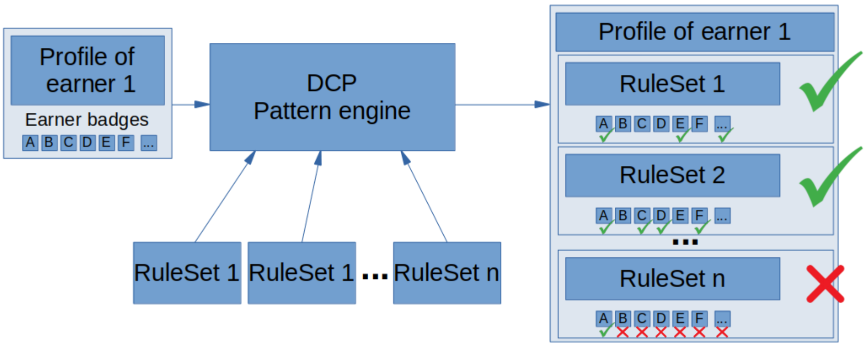


Source: Own edited figure

Figure 4 illustrates the details of a *Rule Set. A Rule Set* comprises multiple *Rules*, each scanning the textual content and metadata in digital badges. If a badge meets the condition of a rule – such as having a specific value in a particular data field (e.g., the *badgeclassID* matches a predefined value) – that badge is considered *selected* for that rule. Suppose at least one badge is found that matches each rule within the RuleSet (i.e., all individual rules are satisfied based on data pattern matches). In that case, the entire RuleSet is considered fulfilled.

In contrast, as shown in Figure 5, *RuleSet n* appears unfulfilled because at least one rule within the set did not find a matching badge. Using logical operators (such as AND, OR, etc.) between rules and within individual rules allows for further refinement in matching conditions and enhances the precision of pattern recognition.

Figure 5. ***RuleSets win or fail a set of badges from a portfolio of an earner***



Source: Own edited figure

The group responsible for aligning the curriculum content must define the exact data types in consultation with all relevant stakeholders, including labor market actors and chambers of commerce. A coordination platform is necessary to facilitate structured dialogue among educational institutions, labor market participants, chambers, and other organizations.

As a result of this collaborative and coordinated effort, clearly defined learning pathways, the names of intermediate stackable credentials, the associated metadata, and the possible value sets for each element form a complex information package. Ensuring the availability of this package to all stakeholders – especially newcomers – represents a separate logistical challenge. Such an information package must be maintained and accessible despite individual changes across institutions, faculty, employers, chambers, and other actors. Blockchain-based technology can guarantee the permanence and universal accessibility of stackability-related rules and data structures.

Blockchain

The global recognition of blockchain technology began in 2008, amid the financial crisis, with the emergence of the cryptocurrency Bitcoin (Bashir, 2023). While Bitcoin is the most well-known blockchain use case, it is only one among many possible applications. With the launch of Ethereum in 2015, the concept of smart contracts entered the public consciousness. In 2018, multichain architectures emerged, followed by the rise of decentralized finance (DeFi) and non-fungible tokens (NFTs) in 2023.

A blockchain is a decentralized network where common data knowledge is maintained despite communication errors or intentional data falsification. The successful combination of several previous technical processes is the basis for reliable operation. These include public key cryptography, hash functions, peer-to-peer networks, and secure time stamping.

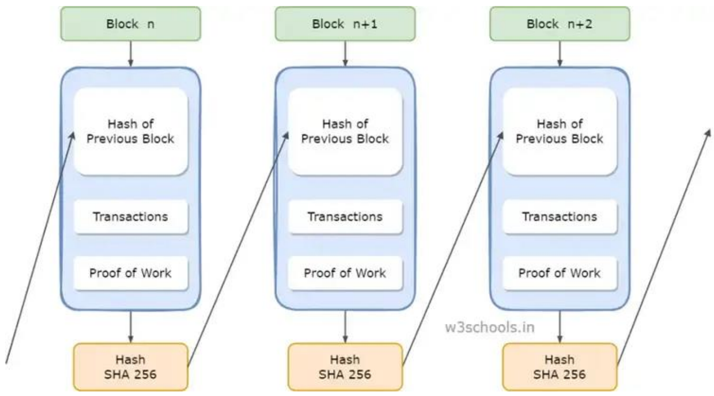
How does blockchain work

At its core, a blockchain is a chain of data blocks linked together in sequence. For the reliable infrastructure, fundamental principles must be upheld. These include:

- *Peer-to-peer architecture* (P2P): The network has no central communication hub – each participant (node) can directly communicate with any other, eliminating the need for intermediaries.
- *Distributed ledger*: A shared ledger (used for financial transactions or other types of records) that is fully accessible to all network participants, with continuous synchronization and distribution among them.

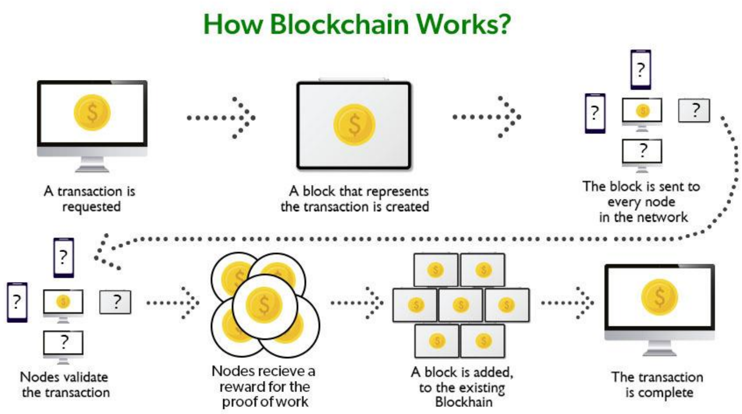
- *Cryptographically secure*: The integrity of ledger data is protected through cryptographic techniques that ensure data authenticity (proof of origin), integrity (no tampering), and non-repudiation (actions cannot be denied after the fact).
- *Append-only*: New data can only be added to the blockchain; previously added blocks are immutable and cannot be altered.
- *Updatable via consensus*: Any operation on the blockchain requires agreement among the majority of nodes based on strict consensus rules. This process guarantees decentralization and removes the need for any central authority.

Figure 6. **Blocks are linked to the chain by the hash code of the previous block**



Source: https://www.w3schools.in/blockchain/chaining-blocks

Figure 7. **A transaction (new information) is integrated into the blockchain via consensus**



Source: https://www.geeksforgeeks.org/how-does-the-blockchain-work

There are numerous advantages to using blockchain technology. Communication or transactions between the network nodes occur directly, without intermediaries, making the process faster and cheaper. So-called innovative properties can be linked to a blockchain transaction, meaning that once ownership is transferred, the asset cannot be resold without the new owner's consent.

The ledger provides transparency for all stakeholders – every action is traceable in terms of timestamp, participants, subject of the event, and other descriptive data, thereby increasing trust. The ledger's immutability further reinforces this trust. If an earlier data entry requires correction, the original data is not altered; a new, corrective block is added. It makes every change request traceable over time.

Blockchain becomes especially powerful when many participants collaborate within the system. The failure of a few nodes does not disrupt operations, as redundancy ensures high availability.

The strong cryptographic foundation of blockchain is key to enabling smart contracts. These contracts use advanced mathematical algorithms to allow parties to enter into agreements – potentially even anonymously – where the cryptographic protocols automatically verify whether each party has fulfilled its obligations, often using techniques such as zero-knowledge proofs.

Examples of blockchain applications

The initial use cases of European Blockchain Services Infrastructure (EBSI) include the following:

- *Notarization*: Leveraging the power of blockchain to create trustworthy digital audit trails, automate compliance checks in time-sensitive processes, and ensure data integrity.
- *Diplomas and Educational Credentials*: Returning control to citizens over managing their educational credentials, significantly reducing verification costs, and enhancing trust in authenticity.
- *European Digital Identity*: Implementing a universal digital identity capability allows users to create and verify their identities across borders without relying on central authorities while ensuring compliance with the eIDAS regulatory framework.
- *Trusted Data Sharing*: Applying blockchain technology for secure data sharing between EU authorities – starting with IOSS identifier numbers and supporting single-window systems for customs and tax authorities.

IPFS-based storage of stackable pathways

Information placed on the web is not eternal. According to some studies (Trivette, 2021), the average lifespan of a website page is estimated to be around three years. Furthermore, websites today are often hosted using cloud services, resulting in strong centralization of data storage. A technical failure in such services can lead to the inaccessibility of significant portions of web content. It is also important to note that verifying the authenticity of data sources on the web is often tricky, which may lead to data loss, corruption, or unauthorized access.

Given the extensive collaboration involved in creating the previously discussed stackable learning pathways and other related content, it is essential to adopt at least one technical solution that ensures:

- Shared accessibility of the content
- Controlled mutability, allowing modifications only through mutual agreement among stakeholders

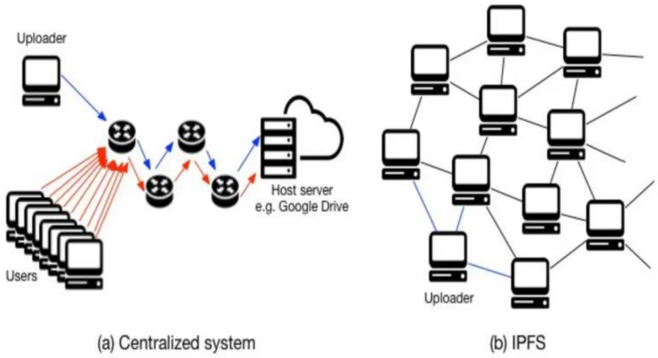
Source (Lemoie, 2024) examined several blockchain-based technologies for storing Open Badge-compliant credentials. Here, we propose using IPFS (InterPlanetary File System) as a solution.

IPFS is a peer-to-peer (P2P) file storage network based on a distributed network of computers. Files are accessible via unique identifiers (CIDs – Content Identifiers) and stored across IPFS nodes (Figure 8). A single file can exist on multiple machines across the network, making it more resilient to node failures than centralized systems.

When a file is uploaded, it is assigned a unique digital fingerprint (CID). The file can be downloaded using this CID. Due to the peer-to-peer architecture, files are transmitted through multiple machines, and intermediate nodes may temporarily cache copies of the file. As a result, subsequent download requests can be served by geographically closer nodes, thereby accelerating access.

When a new version of a file is uploaded, the old version is not deleted – a new CID is generated.

Figure 8. **Difference in data movement in a centralized system (a) and on an IPFS network (b)**



Source: *https://symphony.is/about-us/blog/introduction-to-ipfs*

The design and maintenance of stackable learning pathways is a large-scale task that can easily exceed the scope of a single institution. An IPFS-based, blockchain-powered peer-to-peer (P2P) file-sharing system is a suitable solution to enhance the efficiency of multi-stakeholder coordination and disseminate the results as widely as possible. Moreover, setting up a private IPFS network is relatively straightforward, making it a practical and scalable choice for such collaborative initiatives.

Conclusion and further steps

We have examined the stackability options based on soft skills within the DCP application, which complies with the Open Badge 2.0 standard. Associating soft skills with various certificates enhances the description of certified competencies, thereby improving employability in the labor market.

The capability and success of stackability depend on the coordinated efforts of multiple stakeholders. On the one hand, the shared agreement between institutions and labor market actors forms the framework within which stackable learning pathways - and the accompanying credentials - become interpretable, assessable, and collectible for learners. At the same time, it is necessary to establish a technical infrastructure that enables a digital badge management system to recognize stackable credentials and organize them according to defined rules by embedding metadata in the proper fields and enriching the content. These stackability rules must be reviewed, refined, and updated regularly. The system only works effectively and satisfies participants when these rules are updated. A blockchain-based P2P file-sharing network, such as IPFS, can facilitate the easy and fast accessibility of the required general and technical documentation. The DCP implements version 2.0 of the Open Badge standard. However, the upcoming *version 3.0* (1EdTech, 2024) significantly extends the scope of badges. The new version introduces a distributed performance definition database, which provides a shared foundation for recognizing a certified individual's competencies and skills across multiple certifying organizations.

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