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BRIDGING YESTERDAY TO TOMORROW: CREATING A KNOWLEDGE RESOURCE INFORMING DIGITAL CREDENTIALS POLICY

Authors:
Knoth, Alexander, German Academic Exchange Service
Clancy, Kathleen, German Academic Exchange Service
Peters, Leo, German Academic Exchange Service
De Leeuw, Herman, Groningen Declaration Network
Chakroun, Borhene, UNESCO
Pieume, Calice Olivier, UNESCO
Ananiadou, Katerina, UNESCO
Teter, Wesley, UNESCO
Duklas, Joanne, Duklas Cornerstone Consulting
Hart, John, Independent Consultant

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Abstract

Against the background of sustainable development goals, lifelong learning, changing learner mobility patterns and global learner rights, DAAD, GDN and UNESCO are seeking to provide a knowledge resource informing policy on the regulation of Digital Credentials. Following the learner journey, challenging components for the implementation of a globally interoperable DC infrastructure are identified (digital identity & authentication, technical standards, qualification frameworks & world reference levels, political & legislative frameworks). Drawing on the historical development of DCs the conceptual framework and schemes for use case descriptions as well as data collection will be outlined. This will provide the knowledge for a collaborative visual tool which will allow stakeholders to gain new insights into the DC landscape and improve decision-making.

German Academic Exchange Service (DAAD), Germany
Groningen Declaration Network
UNESCO

Content

Acronyms

DAAD German Academic Exchange Service

DCs   Digital Credentials

EiF   Entered into Force

GDN   Groningen Declaration Network

LLL   Lifelong Learning

MOOC Massive Open Online Course

NQF   National Qualification Framework

RLP   Recognition of Prior Learning

UNESCO United Nations Educational, Scientific and Cultural Organization

[**Note: The following narrative, including footnotes, should not exceed 4,000 words – this does not include references and any annexes**]

Introduction

Digital technologies have opened new, individual learning paths in (higher) education as well as new possibilities for identification and documentation of acquired qualifications and skills.

The Digital Credentials (DCs) landscape is highly diverse and poorly defined, with many competing initiatives. So far, the resulting solutions for issuing and verifying DCs (mainly through centralised credential depositories) are either disconnected or hardly compatible with one another and cannot be used in an interoperable way between different platforms and across borders of states or of education and training systems. An interoperable infrastructure for DCs has the potential to "ensure inclusive and equitable quality education and promote lifelong learning opportunities for all" (2030 Agenda for Sustainable Development, Goal 4[1]). Yet such a global infrastructure does not exist, due to differing technical, regulatory, and political conditions.

The question of how globally interoperable DCs in education can be achieved and which actions are necessary to achieve international standards on both technical and policy levels is central to improving the possibilities of progression for individuals.

According to Brown et al. (2021, p. 228) 'more clarity and coherence will emerge as governments around the world increasingly align new credentialing developments with existing national qualification frameworks', not only due to versatile stakeholders responding to the changing nature of education and work by providing opportunities for lifelong learning, but also due to an increasing need for efficiency, integrity, and fraud protection. Education providers can no longer rely on storing predominantly paper-based learning achievements in data silos but must adapt to new mobility patterns by expanding the learner's control over their data and enabling a verifiable history of individual academic outcomes. The creation of a globally interoperable infrastructure for educational credentials must be bolstered by collaboration on technology developments, but also relies on compatible legal regulations within different regions. A historical view of the formation of credentialing initiatives and projects alongside the corresponding legal and political frameworks offers the opportunity to advance knowledge of the history of digitisation and data exchange whilst making future policy and technology recommendations.

The following is a starting point for the creation of a basic knowledge resource outlining the alliances' varying objectives to be achieved by means of digital credentialing, the components involved for the implementation of a global, interoperable infrastructure and their historical development, culminating in a visual concept to facilitate future policy recommendations. This knowledge resource will then be used to design a collaborative visual tool with the aid of data collected on case studies.

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[1] https://unstats.un.org/sdgs/report/2017/Goal-04/

1 Objectives

The German Academic Exchange Service, the Groningen Declaration Network and UNESCO are three diverse partners with very different core missions. Despite their varied mission statements, they have formed an alliance to resolve the issue of globally interoperable DCs in education, as this goal directly affects the operating fields of all three organisations.

1.1 Sustainable Development Goals and Lifelong Learning

In recognition of the crucial role of learning for sustainable development, lifelong learning has been included as a guiding principle of the Education 2030 Agenda. The discussion around DCs in education needs to be anchored in the context of sustainability. In a highly inequitable world, the technology of interoperable credentials is making new educational pathways accessible to all. The concept of lifelong learning (LLL) is 'rooted in the integration of learning and living, covering learning activities for people of all ages [...], in all life-wide contexts (family, school, community, workplace and so on) and through formal, non-formal and informal modalities which together meet a wide range of learning needs and demands.' (UNESCO, 2014).

However, there is no single concept of LLL and therefore, it is possible to distinguish among others the following definitions of LLL:

- 'all learning activities undertaken throughout life for the development of competencies and qualifications' (ILO, 2004);
- 'all general education, vocational education and training, non-formal education and informal learning undertaken throughout life, resulting in an improvement in knowledge, skills and competences within a personal, civic, social and/or employment-related perspective. It includes the provision of counselling and guidance services' (Cedefop, 2014, p. 171)

In this global context, characterised by a very young population lacking adequate skills to the changes in the labour market, the objective of lifelong learning must be ensured that all (youth and adults in school, out of school, informal sector etc.) participate effectively in society and the world of work through learning, training, and employment opportunities. It is therefore up to governments to promote all modalities of learning, as outlined above.

In addition, the rapidly changing job market has created an urgent need for re-skilling as well as a possibility for DCs to permeate the labour market (Gottlieb and Pongratz, 2021) thanks to a newfound understanding of the opportunities presented.

1.2 Access and Mobility

As the world's largest funding organisation for academic mobility, the DAAD considers new technologies and proposes strategies to enable student and researcher mobility and improve access to educational services regardless of one's local country or region.

Interoperable DCs will facilitate increasing international mobility on both the degree and credit level. Degree mobility covers all study-related mobility during which a degree is acquired abroad. Credit mobility, on the other hand, refers to study-related visits abroad as part of a degree programme in the learner's home country. In addition to temporary study visits abroad, this also includes visits abroad that are completed as placements, language courses, study trips, project work or summer schools (DAAD and DZHW, 2021). Credentialing could also positively affect transnational education or double-degree programmes and researcher mobility. The proportional number of internationally mobile academics and researchers has remained stagnant since 2004 (DAAD and DZHW, 2021).

This does not reflect the general mobility trends: Since 2008, the number of internationally mobile students has increased by around 2.2 million, or 68% according to UNESCO. In 2018

alone around 5.6 million students were enrolled outside their home country. (DAAD and DZHW, 2021) And yet, the obstacles on a simply organisational level can be detrimental. Domestic students in Germany list 'difficulties aligning my visit with the standards and requirements of my study programme' as one of the major reasons for declining a planned study visit abroad (cf. Figure 1). In 2019, major topics of advice for prospective students from refugee backgrounds in Germany were the 'recognition of qualifications' and 'missing documents' (cf. Figure 2), while one of the main reasons for the rejection of international applicants from Bangladesh, Ghana, Nigeria, South Korea and Tunisia to a German university in 2020 were 'incomplete documents' (cf. Figure 3). These findings suggest that DCs could be an important instrument in overcoming formal hurdles for international exchange.
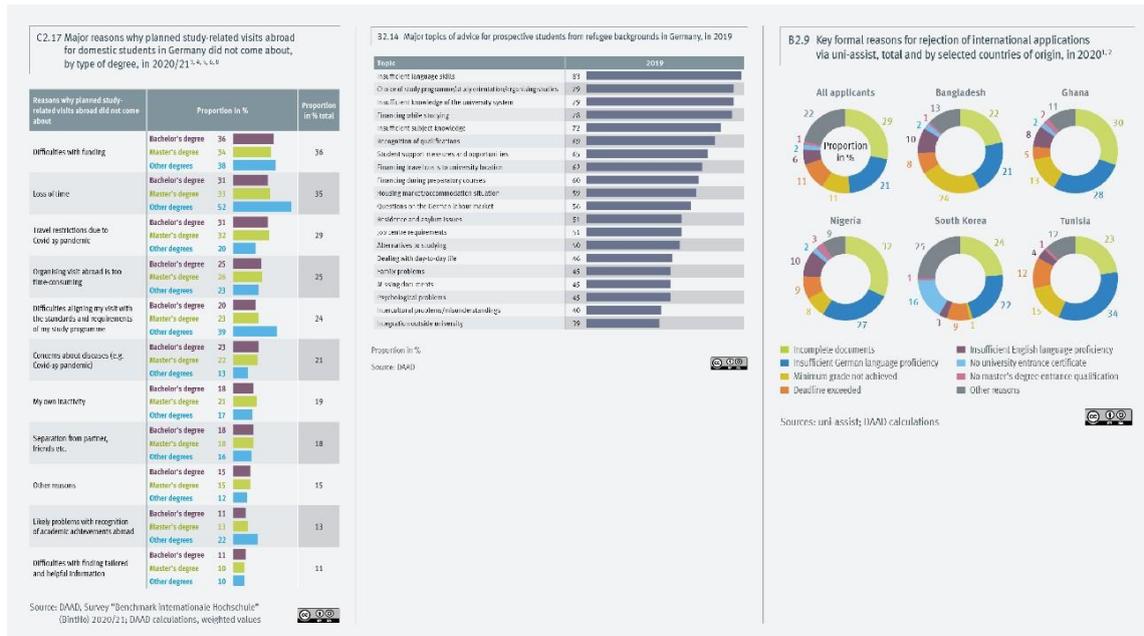
Figure 1 – *"Major reasons why planned study-related visits abroad for domestic students in Germany did not come about, by type of degree, in 2020/21 [C2.17]" ([Wissenschaft Weltoffen 2021](#))*

Figure 2 – *"Major topics of advice for prospective students from refugee backgrounds in Germany, in 2019 [B2.14]" ([Wissenschaft Weltoffen 2021](#))*

Figure 3 – *"Key formal reasons for rejection of international applications via uni-assist, total and by selected countries of origin, in 2020 [B2.9]" ([Wissenschaft Weltoffen 2021](#))*

1.3 Global Learner Rights

The Groningen Declaration Network has and continues to engage the global DC community in a discussion regarding the rights of the learner and the potential for expanding accessible digital options and technology. The network advocates for 'citizens worldwide [to] be able to consult and share their authentic credentials and data with whomever they want, whenever they want, wherever they are.'[2]. This is the apotheosis of learner autonomy, agency, and self-sovereignty, which are best enabled by establishing a trusted, coherent, and comprehensive credential comparability ecosystem. Making the management of individual achievements simpler through wallets is a first step, however for a successful wide adoption and strengthening of learners' privacy and control, it is essential that interoperable standards for data exchange are implemented while 'respecting regional diversity, authority, and autonomy' (Duklas et al., 2021, p. 4).

2 Implementation

The DC ecosystem is 'made up of a combination of traditional (better established) systems and flexible and dynamic (much less regulated and new) systems. This is a […] common

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[2] https://www.groningendeclaration.org/ (Accessed 15 March 2022)

characteristic of most complex systems' (Chakroun et al., 2018, p. 30). The intricate interrelations within such complex systems are difficult to comprehend. To perform an analysis of the current situation, we have outlined the elementary building blocks to attempt systematisation and eventual visualisation.

2.1 Building Blocks along the Learner Journey

DCs become most apparent at transition points during the learner's journey, when a diploma is obtained and used to apply for jobs, subsequent degrees, or scholarships. However, these credentials are an integral part of learner agency throughout a person's academic and professional life, as they are a prerequisite for flexible learning paths, documentation of individual achievements and they provide the infrastructure for international exchange. The rise of international, collaborative, and digital learning scenarios, such as the European University Alliances alongside new teaching and learning formats (e.g. MOOCs, virtual exchange and blended mobility) bring about the need for credentials.

Figure 4 illustrates at which points within this journey DCs play a role. From orientation and language tests, admissions, applications for scholarships and study abroad programmes to credit recognition for intra-institutional and external achievements and, of course, the final diploma. Policy recommendations on digital credentialing must take the local, national, European and international frameworks into account and consider potential applications for lifelong learning.
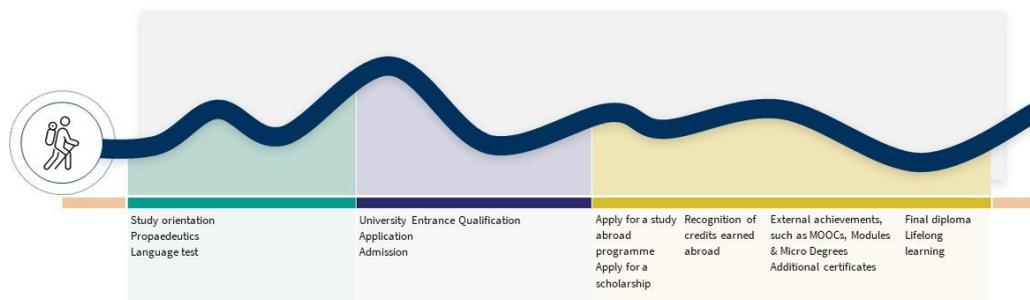

Figure 4 – Digital Credentials along the student journey (source: DAAD)

Digital Identity and Authentication

Secure and trustworthy digital identities/identifiers and authentication mechanisms are necessary preconditions for the exchange of DCs, whether in education or in other areas. They are needed to digitally represent the trust relationship between the acting entities. In education, credentials, such as diplomas, are usually linked to the natural person of the learner, which is why state identities are of particular importance in this context. Although digital state identities (eIDs) are already widely used in various countries worldwide, there is little or no interoperability between the systems. Within the EU, the further development of the eIDAS regulation (regulation on electronic IDentification, Authentication and trust Services) shall provide a uniform system of digital identities (eID) and authentication mechanisms for the EU member states. This is intended to create a uniform European trust area for the digital domain. In the international context, standards are needed on how digital identities will be technically represented and authenticated in the future. However, the key question of mutual trust between states and organisations in the validity and legitimacy of digital identities cannot be answered by technology alone but is primarily a political question that must be dealt with in the political and diplomatic sphere.

Technical standards

When thinking about the necessary technical building blocks for an interoperable DC infrastructure, it makes sense to distinguish between the level of the credential in its external

form and the level of the content contained in the credential, as different issues need to be resolved at both levels. To describe this, the metaphor of the envelope and the data object it contains has become established, following the familiar processes of the physical world (Chartrand et al., 2020).
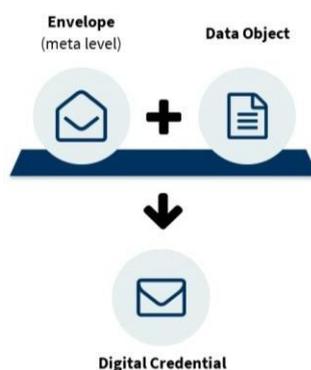
Figure 5 – Envelope and data object metaphor (source: DAAD)

The envelope describes a meta-level on which the exchange of data between the entities involved (issuer, learner, relying party and others) takes place. At the envelope level, it must be technically ensured that the certificate gets from a to b securely, that the identity of the issuer and the subject (learner) are valid, that the content contained in the envelope cannot be manipulated in transit and that the authenticity of the data can be verified by a third party. To achieve international interoperability, there needs to be a standardised process and specifications for the corresponding open technical infrastructure that dictates how credential data can be exchanged and verified between entities worldwide (and cross-border) in a secure and unforgeable manner. This process does not have to be specific to educational certificates, as the content of the exchanged data object is not initially relevant at this (payload-agnostic) meta level.

In addition, it must be ensured that the content of the credential can also be (automatically) processed and correctly interpreted by all parties involved. At the content/data object level, the challenge is to agree on a standardised data model for credentials which specifies what data must or can be included in a credential, what types of credentials are distinguished, in which format the data should be and how the data should be structured. Along with an advancing digitalisation of student data processing at universities, there have been significant developments in this field and some proposed data standards for student data mobility, which have intensified significantly over recent years (for an overview of the most important approaches, see Nuffic, 2020).

Qualification frameworks and (world) reference levels

Starting as early as the 1950s a range of measures have been taken to create systems and structures to help navigate a growing range of qualifications and find ways to compare these. National Qualifications Frameworks (NQF) are the most widely used and established at least half of the 193 states of the United Nations member states to structure the levels, types of qualification and main awarding bodies in the country concerned. There is also a growing number of Regional Qualifications Frameworks, one of the most influential is the European Qualifications Framework (EQF) which is used as a reference point by a variety of countries looking for a recognised currency. In addition, many local, national, and international as well as sectoral frameworks for specific occupations are also emerging.

Creating a common understanding of what these frameworks mean for credentials is a massive challenge. Often the number of levels used vary considerably, making comparisons difficult.

Titles like *certificate* and *diploma* can have different connotations and the norms for stages of education or training will vary from system to system.

The International Labour Organisation offers a range of agreed concepts in the International Standard Classifications of Education (ISCED) and occupations (ISCO) which could contribute to meta data. UNESCO has developed a prototype system of World Reference Levels which can act as a lingua franca when used alongside National or Regional systems.

At the most fundamental level, what is needed is secure agreement on terms and definitions and on what constitutes evidence of achievement and quality. Given the range of possibilities, this might take the form of a gradation, indicating different levels or strengths of evidence from highly formal assessment and quality assurance systems, to forms of 'open recognition' (as in Rentzsch, 2021).

Political and Legislative frameworks

Political and legislative frameworks relevant to DCs can be structured as follows:

- Recognition and access to (higher) education:
  UNESCO has established six regional conventions since 1974[3] and awaits the ratification of the Global Convention on the Recognition of Higher Education Qualifications.[4] These conventions are essential for the future creation of interoperable networks. One of the most tangible effects of the conventions is the creation of several regional networks[5] that bring together national authorities and other stakeholders dealing with the evaluation and recognition of higher education credentials.
- Privacy and Data Protection:
  The plethora of privacy and data protection laws alongside consumer and competition law, which apply to the governance of personal data online, pose a challenge for global data exchange.
- National identification programmes:
  By 2018, 161 countries alone had embarked on national identification programmes reliant on digital technologies.[6] Technological solutions are numerous and identity-based infrastructures are expanding in the private sector, however 'policies and laws to govern their usage' (Anand et al., 2021, p. 35) are not yet deployed.
- Academic autonomy:
  In the educational domain one must consider academic autonomy and differing educational systems around the world, which rely on often starkly contrasting education legislation depending on country, jurisdiction or even institution.

In order to map the complex relevant political and legislative frameworks according to region, we will require the case studies to specify, which frameworks directly affect individual initiatives.

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[3] Higher education regional conventions | UNESCO https://www.unesco.org/en/education/higher-education/conventions
[4] Global Convention on Higher Education | UNESCO https://www.unesco.org/en/education/higher-education/global-convention
[5] Asia and the Pacific: https://apnnic.net/ Europe and North America: https://www.enic-naric.net/ Mediterranean Region: http://www.meric-net.eu
[6] World Bank (2018) ID4D. https://id4d.worldbank.org/global-dataset/visualization

2.2 Learning from the Past

Historical Approach as a Method

A historical approach is always aiming at reconstructing the past. With the development of an interactive visualisation as a historically informed knowledge resource we are pursuing two goals:

1. Making the historical developments of concepts visible
2. Identification and Description of (country-specific) case studies

Therefore, we want to help information-seekers to explore the history of ideas allowing for reconstruction of the shifting meaning of DCs. A historical approach is particularly valuable, as one of the 'major obstacles to interoperability arises from legacy systems. Historically, applications and information systems in public administrations were developed in a bottom-up fashion, trying to solve domain-specific and local problems' (European Commission, 2017, p. 30), thus resulting in fragmented islands rather than connected information and communication tools. Additionally, we want to help users to make comparisons to identify similarities and differences of DC initiatives around the globe.

The tool should help to ask the right questions. For instance, what exemplars exist in history that can help inform a better future?

A Brief History of Digital Credentialing

Paper based documents were the norm when asked to submit proof of educational attainments and skills well into the 1990s, while digital services such as bank transfers and flight reservations had already started to be transacted digitally. The education sector continued to use print-outs of data born in digital systems from the mid-1980s. One of the drivers towards the digital transition may well have been the increasing quality and affordability of modern printing and photocopying technology since the 1990s, leading to noticeable levels of diploma forgeries. Notwithstanding those advances in printing and photocopying technology and the resulting rise of document forgeries, it took time before the scales started to tilt towards adoption of digital data and the digital transition. That moment came when document forgery had grown into a sizable issue worldwide and government bodies realised that their policy needs were essentially in step with technological (infrastructural) advances that could be used to combat document fraud.

The past decade has shown five significant areas of development:

- The establishment of the term 'lifelong learning' and, with it, a move away from a norm of formal, didactic, restricted learning and an acceptance of the need for more situated, constructivist and diverse approaches.
- The general adoption of outcomes and competences as the bases for structuring curricula and qualifications and for measuring achievement in a quality assured way, regardless of where, how and how quickly learning took place.
- A growth in the uses of and demand for new qualifications – e.g. to meet a demonstrable or policy-driven need for specific skills; to provide progression into or through an (inter-)national, or local field of practice; to motivate learners of different kinds and levels; to encourage providers to offer training; to participate in a qualifications market.
- The emergence of sectoral, national and regional frameworks, which placed standard, outcomes and qualifications in hierarchical relationships and advisory, regulatory or legislative structures.

- The emergence of digital platforms which provide secure storage and exchange of information about learning opportunities and may also offer online learning, assessment, and certification.

The tracks of these developments are coming together in the current debates on (micro-) credentials and influencing views on what these should be representing specific perspectives which need to be blended into a universal understanding. Such patterns can best be identified and analysed if the data sources are viewed historically and evaluated by means of visualisations.

3 Policy meets Practice: A Knowledge Resource for Digital Credentials Visualisations

We have identified the interlocking of policy and (technological) practice as an area of required action to reach a globally, interoperable DC infrastructure. The creation of a common typology of both macro- and micro-credentials and governance practices are prerequisites to building interoperable networks.

3.1 Establishing a common understanding of credentials

A common view of credentials and how these are derived and accredited is required for a comprehensive credential comparability ecosystem. We suggest the following taxonomy, which captures and classifies existent credentials in a standard format of characteristics:

- Credentials which offer evidence of experience or abilities which is not quality assured – e.g. references or endorsements, records of membership, attendance or participation, badges for unassessed outcomes. These are already common in some systems of continuing professional development, or where experience in a field is seen as valuable in judging an individual's potential for employment or learning. They would be likely to have no/limited value outside these specific situations.
- Credentials which offer indirect, but reliable evidence of experience or abilities – e.g. RPL profiles based on outcome or outcome-like statements which capture the main general or occupationally specific features of an individual's background.
- Credentials awarded for single short courses leading to a set of related outcomes and evidenced by some coherent and quality assured assessment regime – e.g. a module/unit/part qualification. These would be one form of micro-credential.
- Credentials awarded for courses based on a collection/series/cluster of short courses (modules/units) each validly and reliably assessed and quality assured. These would be another form of micro-credential.
- Credentials which could be called 'full qualifications' - i.e. awards which are made on the basis of quality assured assessment and have legal, formally-agreed, or demonstrable "wont and use" recognition as guarantees of capability or competence and give entry to, or the right to practice in, some academic or occupational field or role. These are macro-credentials.

3.2 Policy-making for Interoperability

The recognition of qualifications between regions is crucial for learner exchange and global understanding. DCs are the technological tool, but frameworks are the priority. The European interoperability framework, for instance, defines four layers of interoperability challenges: legal, organisational, semantic, and technical. (European Commission, 2017) whilst highlighting the coordinative role of governance. Rentzsch (2021, p. 18) also points to the threat of 'semantic confusion', which refers to an 'increasing vagueness and obscurity in the use of certain terms, which is often exacerbated in the internal and public discourse among decision-makers.' For this reason, cooperation in the form of shared vision and objectives between stakeholders is key. The envisioned cross-border interoperability requires political support and governmental resources, which involve all stakeholder communities and include the individual

learner in the decision-making process on development. Currently identity management governance practices are often siloed and rarely consider the 'networked nature of digital ecosystems.' (Anand et al., 2021).

3.3 Visualisation as a Method

The goal of visualisation is not only to 'aid our understanding of data by leveraging the human visual system's highly tuned ability to see patterns, spot trends and identify outliers' (Heer et al., 2010, p. 1), but also to improve decision-making by stakeholders. Visualisations can make data more accessible and thus engage more diverse audiences in exploration and analysis. Three design principles for effective and engaging visualisations are guiding our planned visualization (Dörk, Carpendale, Williamson, 2011, p. 4 ff.):

1. Orientation: The notion of orientation combines a sense of overview (having an idea of the lay of the information landscape, in a map-like fashion) and direction (having an idea of where one has been, how to move forward, and how to return). In an information space, this notion of map and directionality typically refers to an information need or interest.
2. Serendipity: This term refers to finding interesting and inspiring information by accident. The information systems should help the information seeker develop a mind that is open towards new information, encouraging people to "step back and take a broader view".
3. Exploratory Search: The issue is how to create interfaces that help the searcher freely engage in information exploration. Exploratory search is a stimulating invitation to explore an information space in order to overcome uncertainty.

Designing powerful visualisations representing the historical evolution of DC initiatives, related discourse on different levels (connected standards and projects, regulations, geographic proximity) and changing networks is very ambitious. We are aiming at creating collaborative resource tool that can be used to share and advance knowledge of the histories within regions and the implications for future policy and technology directions.
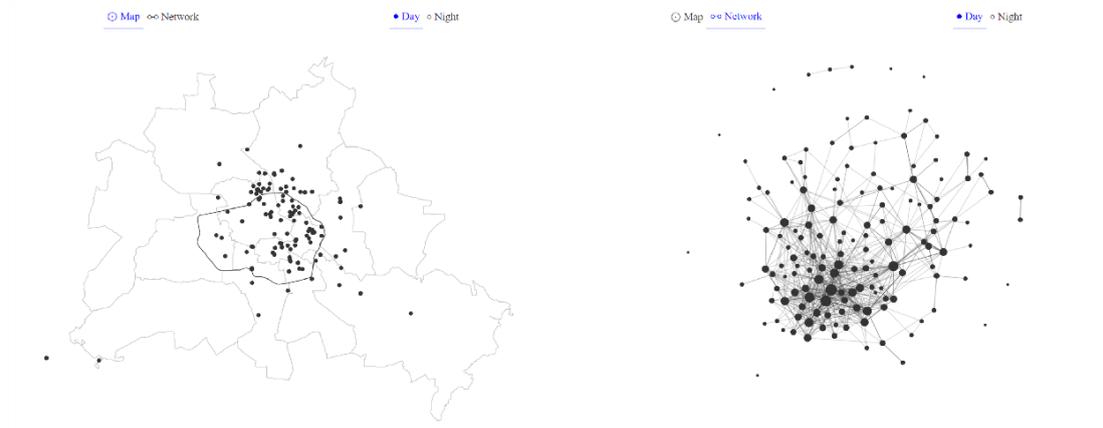

Figure 6 – Screenshots of the Visualisation of Artists' Networks in Berlin by S. Neumann and A. Skowronnek ('Visit my Orbit: Exploring Artists' Networks' (2021), https://visitmyorbit.vercel.app/)

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Annexes

Preliminary Guiding Questions for Data Collection

- Country, region of operation
- Objective (150 words)
- Which data standards do you use?
- Which of the following regulations are relevant to your initiative, please specify: eID, qualification frameworks/quality assurance, accreditation of education institutions, data protection,
- What has triggered or accelerated the emergence /growth in the development and use of credentials and qualifications in your country?
- Is your initiative connected/interoperable with systems in other countries? How does it support interoperability?
- How does your initiative support learners and the mobility & access agenda?