

Goertz, Lutz; Rashid, Sheikh Faisal; Vogel-Adham, Elke; Vogt, Andrea; Wilhelm-Weidner, Arno
Metadata standards in the German funding program "Innovationswettbewerb INVITE". Which standards are used for which purpose? A contribution by INVITE Meta and the Digitalbegleitung (technological monitoring and research) within the framework of the German funding program INVITE

Essen : mmb Institut GmbH 2023, 13 S.



Quellenangabe/ Reference:

Goertz, Lutz; Rashid, Sheikh Faisal; Vogel-Adham, Elke; Vogt, Andrea; Wilhelm-Weidner, Arno:
Metadata standards in the German funding program "Innovationswettbewerb INVITE". Which standards
are used for which purpose? A contribution by INVITE Meta and the Digitalbegleitung (technological
monitoring and research) within the framework of the German funding program INVITE. Essen : mmb
Institut GmbH 2023, 13 S. - URN: urn:nbn:de:0111-pedocs-276973 - DOI: 10.25656/01:27697

<https://nbn-resolving.org/urn:nbn:de:0111-pedocs-276973>

<https://doi.org/10.25656/01:27697>

Nutzungsbedingungen

Dieses Dokument steht unter folgender Creative Commons-Lizenz:
<http://creativecommons.org/licenses/by-nc-nd/4.0/deed.de> - Sie dürfen das
Werk bzw. den Inhalt unter folgenden Bedingungen vervielfältigen, verbreiten
und öffentlich zugänglich machen: Sie müssen den Namen des
Autors/Rechteinhabers in der von ihm festgelegten Weise nennen. Dieses
Werk bzw. dieser Inhalt darf nicht für kommerzielle Zwecke verwendet
werden und es darf nicht bearbeitet, abgewandelt oder in anderer Weise
verändert werden.

Mit der Verwendung dieses Dokuments erkennen Sie die
Nutzungsbedingungen an.

Terms of use

This document is published under following Creative Commons-License:
<http://creativecommons.org/licenses/by-nc-nd/4.0/deed.en> - You may copy,
distribute and transmit, adapt or exhibit the work in the public as long as you
attribute the work in the manner specified by the author or licensor. You are
not allowed to make commercial use of the work or its contents. You are not
allowed to alter, transform, or change this work in any other way.

By using this particular document, you accept the above-stated conditions of
use.



Kontakt / Contact:

peDOCS
DIPF | Leibniz-Institut für Bildungsforschung und Bildungsinformation
Informationszentrum (IZ) Bildung
E-Mail: pedocs@dipf.de
Internet: www.pedocs.de

Mitglied der


Leibniz-Gemeinschaft

Lutz Goertz, Sheikh Faisal Rashid, Elke Vogel-Adham, Andrea Vogt, Arno Wilhelm-Weidner

Metadata Standards in the German Funding Program “Innovationswettbewerb INVITE” Which Standards are Used for Which Purpose?

A contribution by INVITE Meta and the Digitalbegleitung (technological monitoring and research) within the framework of the German funding program INVITE

GEFÖRDERT VOM



Bundesministerium
für Bildung
und Forschung



Bundesinstitut für
Berufsbildung

Impressum

mmb Institut GmbH

Dr. Lutz Goertz
Folkwangstraße 1
45128 Essen

Dr. Sheikh Faisal Rashid

Deutsches Forschungszentrum für Künstliche Intelligenz GmbH (DFKI)
Alt-Moabit 91c
10559 Berlin

Joint contact address of the authors (mmb and DFKI): invite@mmb-institut.de

Elke Vogel-Adham, Dr. Arno Wilhelm-Weidner, Dr. Andrea Vogt

VDI/VDE Innovation + Technik GmbH
Steinplatz 1
10623 Berlin

Joint contact address of the authors: digitalbegleitung@vdivde-it.de

All authors contributed equally to this publication.

This paper was written as part of the German funding program “Innovationswettbewerb INVITE” in the “INVITE-Meta” project in cooperation with the technological monitoring and research, the “Digitalbegleitung”.

Acknowledgments

We would like to thank the participants of the INVITE projects who have participated in the three metadata workshops.

Citation:

Goertz, L., Rashid, S. F., Vogel-Adham, E., Vogt, A., Wilhelm-Weidner, A. (2023). Metadata Standards in the German Funding Program “Innovationswettbewerb INVITE”. Essen, Berlin.

1st edition 2023
September 2023



Editor

mmb Institut – Gesellschaft für
Medien- und Kompetenzfor-
schung mbH

Folkwangstraße 1
45128 Essen

CC License

This work is licensed under a CC BY-NC-ND 4.0 license (Attribution-Noncommercial-No Derivative Works-4.0 International). For more information, see the Creative Commons website: <https://creativecommons.org/licenses/>

Table of Contents

- 1 Abstract4**
- 2 Metadata – A Journey of a Thousand Miles Begins With the First Step4**
- 3 Points of Contact - INVITE Projects Jointly Find Standards for Different Fields of Application5**
- 4 Inspiration – Metadata Standards from an International Perspective7**
- 5 Outlook – Ways to Bring Metadata Standards into the Mainstream.....12**
- List of Figures.....13**
- Bibliography13**

1 Abstract

This paper is about the definition and recommendation of metadata standards for the field of continuing vocational education and training. The standards were discussed in a bottom-up approach and selected in several workshops attended by projects from the German funding program “INVITE” on behalf of the BMBF (German Federal Ministry of Education and Research).

2 Metadata – A Journey of a Thousand Miles Begins With the First Step

Digital learning opportunities in Germany are very diverse. It is foreseeable that there will be no agreement on a completely uniform use of standards in the near future. Therefore, it is important to exchange views on this topic and to find a common ground in the area of vocational education and training concerning the use of standards to further improve interoperability between educational platforms and learning opportunities in the coming years.

The German Federal Ministry of Education and Research (BMBF) has been funding 35 projects with a total of EUR 88 million between 2021 and 2025 with the program “Innovationsswettbewerb INVITE”. The aim is to connect and further develop platforms for vocational education and continuing training and the common use of standards. The German Federal Institute for Vocational Education and Training (BIBB) has been commissioned to provide technical and administrative support for the program, supported by the technological monitoring and research, the “Digitalbegleitung” (VDI/VDE-IT) and scientific support “INVITE-Meta” (mmb Institute and DFKI) (BIBB, 2023).

Metadata for learning purposes plays an important role in the consistent organization and description of educational resources for effective management, discoverability, and interoperability of learning content. This metadata goes beyond the basic file attributes and addresses the specific characteristics as well as the context of educational content including learning objectives, educational levels, prerequisites, audiences, competencies, and technical requirements.

By capturing such information in a standardized way, learning metadata improves the description and discoverability of resources. It also enables the seamless integration and exchange of information between different educational systems. To identify commonalities, differences, and challenges of current metadata standards, INVITE-Meta and the “Digitalbegleitung” have conducted three workshops with INVITE funded projects from April to May 2023. In this paper, we summarize the key findings and favored standards discussed in the workshops.

On the one hand, the paper is aimed at INVITE funded projects and intends to stimulate further exchange and common use of standards within the INVITE program. On the other hand, it intends to stir public discussion and suggests the use of metadata for all those who work with metadata in the learning context.

The article first presents the course of the workshops and a model of the various phases of the learning process. Based on the findings of the workshops, the metadata standards are added to the model and will be described in more detail. Finally, we take a look at the international perspective and further steps regarding metadata in education are outlined.

3 Points of Contact - INVITE Projects Jointly Find Standards for Different Fields of Application

The workshops took place virtually via Microsoft Teams (workshop 1) and Zoom (workshops 2&3) with a duration of two hours each. In advance, the INVITE projects received together with the invitation some guiding questions about their use of metadata in preparation for the event. The three workshop topics were:

1. Metadata of learning opportunities
2. Metadata of learners
3. Metadata of digital credentials

In each case, an INVITE project gave a brief input first, followed by an open discussion guided by the moderator. In the second half, individual topics were then dealt with in a targeted manner, which the moderator had prepared or which arose spontaneously from the discussion. This exchange took place either in plenary sessions or in small groups. Participation in the workshops and the exchange between the projects were lively. The description of the results for this paper is based on the protocols of the workshops.

Metadata standards are integrated into a phase model of the learning process

In the fall of 2021, the INVITE Meta phase model of the learning process was developed for the INVITE funded projects, (white boxes in Figure 1) (Reichow et al., 2021). To this model, the central topics of the projects were assigned (light brown boxes). According to the results of the three workshops the most frequently used metadata standards were integrated into the process model (green boxes). These are further explained below.

It is already apparent that there is no "one-size-fits-all" standard for all learning situations. For each sub-process, metadata standards have proven themselves in the INVITE projects. These standards have emerged in very different contexts. Only ESCO's competency standards appear in different phases.

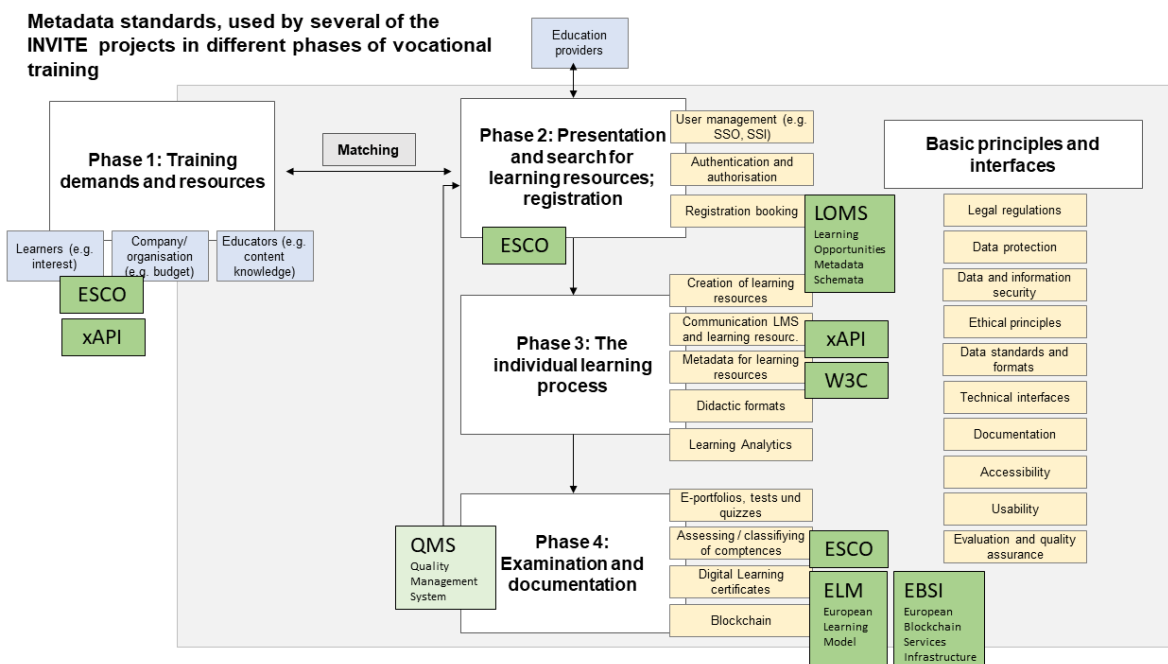


Figure 1: Integration of metadata standards in a phase model of the learning process

Which standards fit which phases of the learning process?

At this point, the abbreviations in the green boxes will be explained in more detail. Which standards are hidden behind them?

ESCO (European Skills, Competences, Qualifications and Occupations): If we look at the metadata standards of learning opportunities, learners, and educational certificates, ESCO is the overarching standard used in three phases of the learning process model. That shows that the ESCO standard can be used to describe competencies that learners already possess, that are taught in learning opportunities, and that are ultimately stated in certificates of completion.

ESCO is a European classification system that links skills, competencies, qualifications, and occupations. It is intended to improve the transparency and comparability of educational and professional qualifications in Europe and thereby enhance occupational mobility in Europe. Standardization is carried out in a multilingual online database (27 languages), which is continuously updated to meet the changing needs of the labor market. (Europäische Kommission, 2023)

One challenge ESCO is facing, and which was frequently discussed in the workshops, is the adequate mapping of the diversity of professional competencies and qualifications in different countries and sectors. Definitions of skills and competencies can vary by context, leading to ambiguities, inconsistencies, and gaps. To address this challenge, INVITE projects, for example, take the approach of classifying job offers and complementing ESCO in a context-specific way. Modern AI techniques can be used for automated tagging of courses and matching of ESCO competencies to eliminate gaps.

In addition, AI can be used to add learning outcomes to course descriptions based on ESCO. ESCO is also used for examinations and documentation. EUROPASS, a European Union tool that enables individuals to present their qualifications, skills, and competencies in a transparent and comparable way, uses the ESCO standard for this purpose. (Europass European Union, 2023a) INVITE projects store digital certificates related to ESCO skills in so-called “digital wallets”, or personal digital repositories.

xAPI (Experience API) is a technical standard for capturing and tracking learners’ experiences and activities in digital learning environments. It enables the collection of comprehensive data on the learners’ behavior and performance, regardless of the learning platform or application used. (Rustici Software, 2023) xAPI is used to communicate between learning content and the learning management system (LMS). Through the information contained in xAPI statements about learners, activities performed, and learning content, the LMS obtains detailed data about the learners’ learning behavior and progress. The information stored in a Learning Record Store (LRS) can be used by the LMS for a comprehensive analysis and adaptation of the learning environment. (Reichow et al., 2021) In INVITE, xAPI is used for learning analytics, data tracking, learning process data, and more.

The **Learning Opportunities Metadata Schemata (LOMS)** standard describes the metadata of learning opportunities. (Europass European Union, 2023b) In INVITE, the LOMS standard of the European Learning Model is used in combination with ESCO for the representation of skills/competencies, but also for adaptive learning within courses. The standard should not be confused with the IEEE Learning Objects Metadata (LOM) standard (IEEE Xplore, 2023). This standard has been deemed no longer relevant by the INVITE projects.

W3C standards form the basis for the exchange of metadata in INVITE. The W3C standards are technical specifications developed by the World Wide Web Consortium to ensure the interoperability, security, and accessibility of the World Wide Web. Examples include **Verifiable Credentials** (data model for digital education credentials), **WCAG** (web accessibility), and **WAI-ARIA** (accessibility for dynamic web content). (Reichow et al., 2021)

The **European Learning Model (ELM)** aims to establish a unified semantic vocabulary for learning in Europe. By standardizing technical terms, it enables seamless data exchange across borders for different scenarios, including the listing of information about learning opportunities and qualifications, as well as the issuance of accreditation certificates and the recognition of diplomas and other educational documents. The new open standards-based **ELM v.3** is an aligned and interoperable data model that ensures compatibility with ELMO and the EBSI Diploma Use Case and is linked to existing frameworks and classifications (e.g., EQF, ESCO, ISCED-f), in particular the W3C Verifiable Credential data model. It is also available in all 31 languages of Europass. (Europass European Union, 2023c) INVITE projects use ELM, among other things, for Verifiable Credentials.

The **European Blockchain Services Infrastructure (EBSI)** was created within the framework of the European Blockchain Partnership (EPB) and aims to provide a trusted and secure infrastructure for the use of blockchain technology in the EU. Currently, several use cases are being pursued: ESSIF – a Self-Sovereign Identity model in Europe, digital education credentials, traceable documents, or trusted data exchange between tax and customs authorities in the EU. (Reichow et al., 2021) INVITE projects participate in EBSI in the early adopters program and thereby contribute in a non-academic context. At EBSI meetings use cases across countries are discussed and then integrated into the appropriate data format or schema.

A central challenge remains the complete and uniform filling of metadata fields. **Quality management systems (QMS)** can play a decisive role. For example, a QMS could ensure that metadata for learning content and certificates are filled in in a standardized and correct manner. In INVITE, for example, QMS is used for learning outcomes. In the workshops, it was also discussed that AI could be used to validate the quality of the machine-filled metadata fields.

4 Inspiration – Metadata Standards from an International Perspective

Although the metadata standards discussed by the INVITE projects provide a good overview of the standards used in education at the German and European level, it is worth taking a look at the use of standards from an international perspective, as many approaches are currently being newly or further developed.

To date, there are several international standards for learning metadata that facilitate various aspects of the digital learning process. Standards development organizations such as IEEE, ISO, IMS Global Consortium, DCMI, Advanced Distributed Learning Initiative (ADL), the World Wide Web Consortium (W3C), and many more continue to develop and maintain standards for learning metadata to meet the diverse needs of the education sector from school education to vocational and higher education.

The EdMatrix (see Figure 2) provides a good overview of existing international metadata standards. The matrix was developed by Brandt Redd based on his proposed taxonomy of educational metadata standards and includes four layers of data standards.

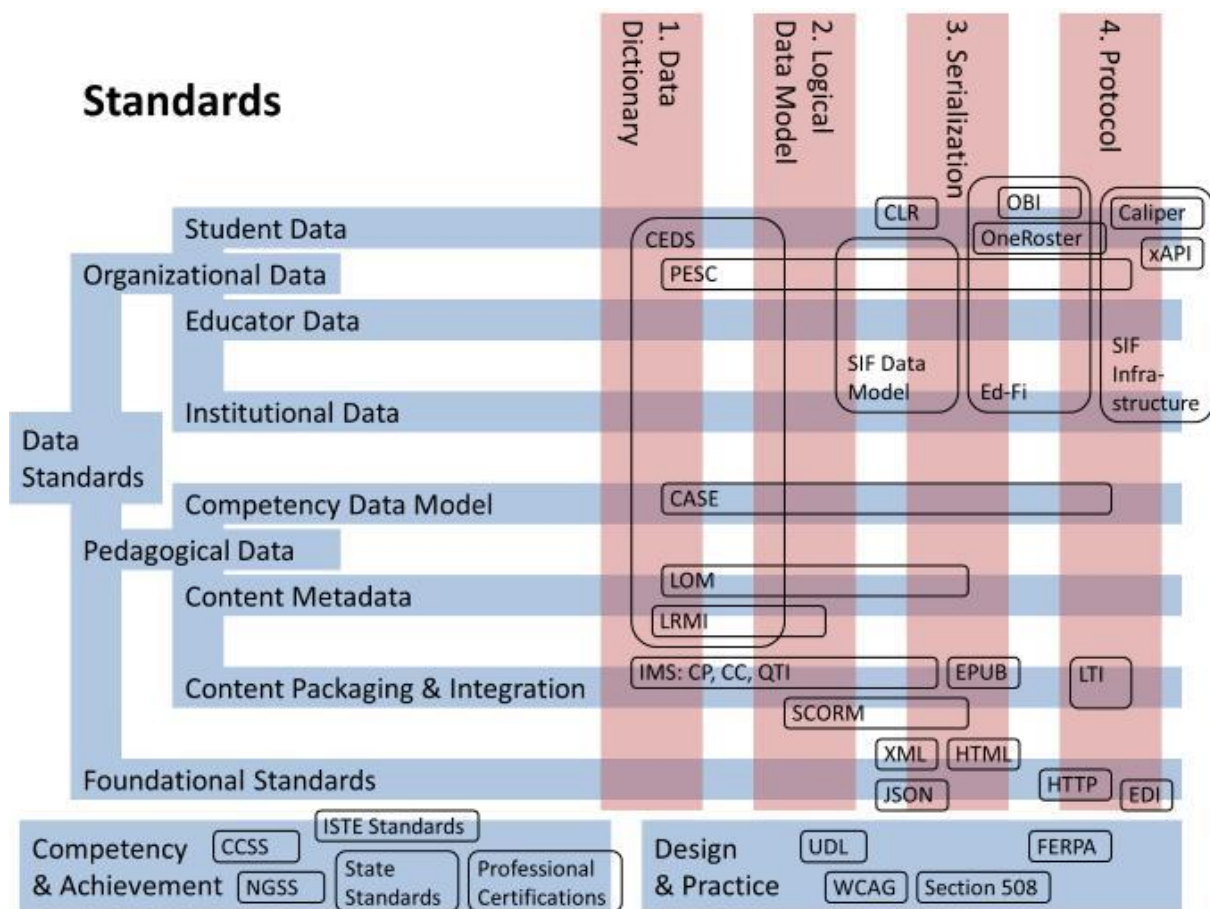


Figure 2: EdMatrix. A four-layered framework for data standards and taxonomy of educational standards. Source: <https://www.edmatrix.org/Dimensions#taxonomy>

The following table provides a brief overview of some international learning metadata standards.

Standard	Short Description	Application Area
DCMI – Learning resource metadata initiative (LRMI)	The LRMI specification is a collection of classes, properties, and concept schemes for markup and description of educational resources. The specification builds on the extensive vocabulary provided by Schema.org and other standards like Dublin Core.	Phase 2 and Phase 3
IEEE – Learning object metadata (IEEE – LOM)	This standard specifies a conceptual data schema that defines the structure of a metadata instance for a learning object. For this standard, a learning object is defined as any entity, digital or non-digital, that is used for learning, education, or training. The purpose of this standard is to facilitate the search, evaluation, acquisition, and use of	Phase 2 and Phase 3

	learning objects, for instance, by learners, instructors, or automated software processes.	
ISO - Metadata for learning resources (MLR)	ISO/IEC 19788 – Metadata for learning resources is a multi-part standard that is used to describe a learning resource by providing metadata elements and their attributes with the objective to support search, discovery, acquisition, evaluation, and use of learning resources by learners, instructors, or automated software processes.	Phase 2 and Phase 3
EOC - Educational or Occupational Credential	A diploma, academic degree, certification, qualification, badge, etc., that may be awarded to a person or other entity that meets the requirements defined by the credentialer.	Phase 4
1EdTech/IMS Global Consortium Standards	1EdTech standards focus on educational content, assessments, accessibility, and student data such as: <ul style="list-style-type: none"> • CASE - Competencies & Academic Standards Exchange • CC - Common Cartridge: A content packaging standard for course materials. • CP - Content Packaging: A format for packaging content and associated metadata for exchange between educational systems. • Caliper - Caliper Analytics: A protocol for transmitting and collecting learning events for later analysis. • LTI - Learning Tools Interoperability: A protocol that enables a learning management system to incorporate custom learning tools or experiences offered by another system. • OBI - Open Badge Infrastructure: A format for communicating skills and achievements. • OneRoster: A protocol and format for a secure exchange of class roster information between applications. • QTI - Question and Test Interoperability: A content packaging format for questions (assessment items) and tests. QTI 3.0 incorporates the accessibility features formerly defined in IMS APIP. 	Phases 2, 3, and 4
Advanced Distributed Learning (ADL) Standards	ADL initiative (sponsored by the U.S. Government) seeks to facilitate interoperability and promote best practices for using distributed learning. Many specifications developed by ADL are standardized by the IEEE LTSC. Standards: <ul style="list-style-type: none"> • SCORM - Sharable Content Object Reference Model is a format for developing and publishing reusable digital learning resources for use in learning management systems and other learning environments. 	Phase 3

	<ul style="list-style-type: none"> • xAPI - Experience API is a protocol for reporting and tracking learning activities and student experiences. 	
Common Education Data Standards (CEDS)	<p>CEDS provides data dictionaries and logical data models representing all types of educational data.</p> <p>https://ceds.ed.gov/dataModel.aspx</p>	Phase 2
Postsecondary Electronic Standards Council (PESC)	<p>An open standards-development and standards-setting body, PESC develops and advocates for data standards and protocols with a particular focus on the transfer of student records to and between colleges and universities.</p> <ul style="list-style-type: none"> • Admissions Application - The admissions application standard is for various types of educational service providers to support applicants looking to be admitted into the postsecondary environment. • College Transcript - This was developed for use by postsecondary educational institutions to send current and historical records of educational accomplishments and other significant information for students who are or have been enrolled at the sending institutions. • Credential – This standard is to be used by any organization, college, university, school, district, state, province, and/or service provider to fully communicate degrees, certifications, and other similar credentials obtained by the student. • ePortfolio - The Academic ePortfolio schema facilitates the transmission of ePortfolio data from one ePortfolio system to another. 	Phase 1 and Phase 4
MedBiquitous	<p>MedBiquitous is a program of the Association of American Medical Colleges (AAMC) that develops and promotes technical standards for all health professions. These data standards support technologies for higher education/continuing education administration, health professions teaching and learning, and workforce training. A list of standards is found here:</p> <p>https://www.medbiq.org/standards</p>	Phases 2,3 and 4
Blockcerts	<p>Blockcerts is an open standard for creating, issuing, viewing, and verifying blockchain-based certificates.</p>	Phase 4
Ed-Fi Alliance - Data Standard and APIs	<p>Assessment API: describes a REST API surface to enable an exchange of assessment metadata and student assessment results between disparate and geographically separated systems operated by different organizations.</p>	Phases 2, 3 and 4

	<p>Core Student API: describes a REST API surface that covers the core data domains typically managed by student information systems in K–12 education.</p> <p>Ed-Fi Data Standard: is a common model providing the data elements and serialization formats on which all other Ed-Fi data systems are based.</p> <p>Enrollment API: describes a set of read-only REST APIs for transfer of basic student and teacher demographic data and enrollment data for K–12 education.</p>	
<p>Access 4 Learning Community (A4L)</p>	<p>Defines the SIF family of standards for educational and student data with a focus on K-12 operations.</p> <ul style="list-style-type: none"> • SIF Data Model: Data model for representing and transmitting educational information. • SIF Infrastructure: Protocol for transmitting educational information. 	<p>Phase 2</p>

5 Outlook – Ways to Bring Metadata Standards into the Mainstream

The example of the projects in the German funding program INVITE shows that different organizations and companies can indeed agree on common metadata for educational purposes. In order to exchange their data and learning content with each other and thus expand their offerings, they implement standards that fit their purposes in a grassroots approach.

However, this is still a use of metadata standards in a very manageable environment, e.g., only for a specific industry or a specific type of certificate. A larger consensus exists merely in the context of the European classification for skills/competences, qualifications and occupations (ESCO), which is used in different phases of learning.

To achieve further scaling of metadata standards, e.g., by extending them to other sectors or learning concepts, there is certainly still a very long way to go. An impetus for this can also be provided by higher-level projects that aim to bundle and mediate many educational offerings in a decentralized networking infrastructure, such as the German project “National Education Platform” (NBP, Digital Networking Infrastructure for Education) or the portal “my NOW” (National Continuing Education Portal for Vocational Education). If the educational offerings are described here in a standardized form using standardized metadata, their nationwide presentation will be significantly facilitated.

Where this is not achieved, a so-called “middleware” helps, which enables automatic conversion of data from one standard to another. In INVITE, for example, a project developed a SCORM-to-xAPI wrapper, which is also publicly available on Gitlab.

A look at the international status of metadata development reveals further possibilities. Insofar as the aforementioned global consortia ensure that the standards also increasingly correspond with each other, this could solve problems in the scaling of metadata standards and educational offerings in the future. A higher degree of compatibility is guaranteed.

Conclusion: It is a great step forward if education providers can agree on common metadata standards in Germany – as it is the case in INVITE. However, it is also worth keeping an eye on the current progress in the development of standards at the international level in order to cooperate more closely in the exchange of data and in making educational offerings visible.

List of Figures

<i>Figure 1: Integration of metadata standards in a phase model of the learning process</i>	5
<i>Figure 2: EdMatrix. A four-layered framework for data standards and a taxonomy of educational standards. Source: https://www.edmatrix.org/Dimensions#taxonomy</i>	8

Bibliography

(BIBB, 2023) BIBB, Bundesinstitut für Berufsbildung, Innovationswettbewerb INVITE, <https://www.bibb.de/de/120851.php>, last access: 24/07/2023.

(Europäische Kommission, 2023) Europäische Kommission, Was ist ESCO?, <https://esco.ec.europa.eu/de>, last access: 01/08/2023.

(Europass European Union, 2023a) Europass European Union, What is ESCO and how is it used in Europass?, <https://europa.eu/europass/en/what-esco-and-how-it-used-europass>, last access: 01/08/2023.

(Europass European Union, 2023b) Europass European Union, Publication of Qualification and Learning Opportunity Data, https://europa.eu/europass/system/files/2020-07/Documentation_publishing%20of%20Q%20and%20LO%20Data_v2.0.pdf

(Europass European Union, 2023c) Europass European Union, Upcoming launch of the European Learning Model v3, [https:// europa.eu/europass/en/news/upcoming-launch-european-learning-model-v3](https://europa.eu/europass/en/news/upcoming-launch-european-learning-model-v3), last access: 01/08/2023.

(IEEE Xplore, 2023) IEEE Xplore, 1484.12.1-2020 - IEEE Standard for Learning Object Metadata, <https://ieeexplore.ieee.org/document/9262118>, last access: 11/08/2023.

(Reichow et al., 2021) Reichow, I., Hochbauer, M. & Goertz, L. (2021). Standards und Empfehlungen zur Umsetzung digitaler Weiterbildungsplattformen in der beruflichen Bildung: ein Dossier im Rahmen des INVITE-Wettbewerbs.

(Rustici Software, 2023) Rustici Software, xAPI Overview, <https://experienceapi.com/overview/>, last access: 01/08/2023.