Developing a Metadata Profile for Higher Education OER Repositories

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Abstract

To provide Open Educational Resources (OER) according to the recognised FAIR principles (improve Findability, Accessibility, Interoperability, and Reuse of digital assets), it is necessary to describe the educational material by means of meaningful metadata. There are conflicting demands to comply with. On the one hand, the educational resources should be described in as much detail as possible for accurately fitting search results. On the other hand, only strictly necessary information should be obligatory to keep the obstacles for authors as low as possible. An additional goal is to allow easy connection between repositories, thus allowing federated search and harvesting of metadata, for example, by search engines or other interested parties. Operators of OER repositories from several federal states in Germany (HOOU, OERNDS, ORCA.nrw, VCRP, VHB, ZOERR) have developed a metadata profile focussing on OER in the context of higher education. The initiators strive to reach the mentioned objectives and to establish a standard in the field. The metadata profile is based on the well-established Learning Object Metadata Standard (LOM). The chapter describes the decision process and why certain choices are made to reach the intended goals. Furthermore, the importance of editorial supervision for a sound quality of the material and metadata will be discussed. The chances and challenges are illustrated based on practical experiences with the establishment and daily operation of the *Zentrales OER Repositorium der Hochschulen in Baden- Württemberg (ZOERR)*.

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D. Otto et al. (eds.), *Distributed Learning Ecosystems*,
https://doi.org/10.1007/978-3-658-38703-7_14

1 Metadata and Why They are Needed?

An association of OER repository representatives of several federal states of Germany joined forces to promote technical infrastructure developments for OER in higher education. These are the *Hamburg Open Online University (HOOU)* for Hamburg, *Digitale Hochschule NRW* and *Hochschulbibliothekszentrum NRW* (project *ORCA.nrw*) for North Rhine-Westphalia, *Technische Informationsbibliothek Niedersachsen (twillo.de)* for Lower Saxony, *Virtueller Campus Rheinland-Pfalz (oer@rlp)* for Rhineland-Palatinate, *Virtuelle Hochschule Bayern (vhb.org)* for Bavaria, and *Universität Tübingen (zoerr.de)* for Baden-Wuerttemberg. As the author works for the latter, the operational experiences are described from the perspective of the *Zentrales OER Repositorium der Hochschulen in Baden- Württemberg (ZOERR)*.

The importance of focussing on metadata when planning OER services can be justified by three main reasons. Firstly, metadata are a cornerstone for presenting good and matching results to anyone searching for OER. Secondly, metadata are supposed to offer an overview, helping the user to easily assess if an open educational resource is suitable for the intended purpose. Thirdly, standardised metadata simplify the sharing of resources between repositories or with other interested parties such as specialised search engines. In general, it can be stated that valid metadata support quality assurance and that standards facilitate this considerably.

A comprehensive overview about metadata and their importance can be found, for example, in (Haynes, 2018). Metadata schemes are structured agreements on the syntax and semantics of descriptive data for objects. Objects in this sense are often themselves data. Therefore, the data describing them are called metadata. Every subject or discipline has varying requirements in terms of metadata. This leads to a significant number of metadata schemes. Once a scheme has been adopted by a standardisation organisation, it becomes a metadata standard. Even though most standards have been designed for certain disciplines, they still allow general use in many circumstances.

Concretisations concerning certain communities, applications, or extensions and combinations of metadata schemes are recorded in so-called metadata *profiles*. They describe and clarify the designated use of metadata schemes by providing the following information: which properties and types of the scheme are used, which restrictions will apply, and which vocabularies have to be used.

A vocabulary is a set of words, or in our context rather values, defining the permitted entries in a metadata property. In simplified terms, these entries can be just arbitrary text, numbers, or a vocabulary, depending on the semantic. Ideally,

the vocabulary is a *controlled vocabulary*, in other words, the values are defined and fixed. Controlled vocabularies allow to automatically process and agree on the meaning of metadata in data exchanges between partners.

Controlled vocabularies can be managed in different ways. For sustainability reasons, the Simple Knowledge Organisation System (SKOS) is a good choice to enable efficient maintenance, an automatic deployment via the internet, and the possibility to offer the values in different languages. SKOS is a recommendation of the World Wide Web Consortium (W3C) and allows to use the vocabulary as linked data too. For more information about SKOS, see (Miles & Bechhofer., 2009).

2 Why Do We Not Employ an Existing Standard Directly?

Enquiries have shown that many standards are either not established, not suitable for learning objects, or simply not sufficiently disseminated (Ziedorn et al., 2013). A decent overview of metadata in the context of OER can be found, for example, in (Steiner, 2017). The widely used Dublin Core schema is too general and not able to meet the specific needs of OER. The ELAN Application Profile (ELAN is an acronym for *eLearning Academic Network Niedersachsen*) defines a minimal set of metadata for learning objects and appears to be a promising approach for our goal (DINI AG Metadaten et al., 2005). Yet it distinguishes very strictly between courses and content, for example, everything needs to be part of a course, which is not flexible enough. Furthermore, the profile has not found widespread distribution. In the educational context in Germany, the so-called *Erweitertes Austauschformat* (EAF) had been used by the *Medieninstitut der Länder* for many years. The format has been frozen since 2012, and it was announced any further development would be transferred into a new LOM-EAF scheme (AG Mediendistribution & Dokumentation, 2012). Unfortunately, there is no published specification or documentation on this. Under the umbrella of the *Deutscher Bildungsserver,* the institute made efforts to specify a LOM-DE metadata profile (Schumacher et al., 2010). However, this specification never reached an official and recognised state. Apart from that, it has mainly the same extent as the original LOM and focusses on school education.

Therefore, we decided to adhere to the original LOM (IEEE, 2002). A compact overview of LOM and Dublin Core can be found, for example, in (Barker & Campbell, 2010). Despite its age and complexity, the Learning Objects Metadata Standard (LOM) is still the most used international standard in the field,

focussing especially on objects suitable for e-learning (Haynes, 2018, p.73f.). Comments on the role of LOM in the repositories Merlot and Ariadne can be found in (Wiesner, 2010, p.34f.). Moreover, LOM is also used as a basis in the renowned OER Commons repository (OER Commons, 2014). Additionally, LOM has recognised mappings to the widely used Dublin Core metadata standard (IEEE, 2002, Annex B). LOM consists of nine categories covering a wide variety of fields to characterise learning objects in various respects. Even though this is favourable from an informational perspective, it is not that user-friendly as lecturers who author OER are often not willing to put in the effort to fill in long forms with metadata when uploading their OER. Therefore, given the manageability and the main goal of collecting a large variety of OER content, a sophisticated reduction of the standard was needed. The means and results in the form of a metadata profile for OER in the context of higher education called HS-OER-LOM are described from chapter 3 onwards. Yet before, some thoughts on LRMI are given.

2.1 Learning Resource Metadata Initiative (LRMI)

The option to deploy the LRMI metadata scheme is a special case and deserves some remarks. The Learning Resource Metadata Initiative (LRMI) started a project with the same name in 2011 to establish a vocabulary for describing learning resources (see https://dublincore.org/about/lrmi/). For several years, the advantages of providing metadata as LRMI have been discussed in the community, for example, in (Haneefa & Chembrakuzhi, 2014). LRMI was not designed to describe objects with a monolithic set of metadata but rather for the use of so-called microdata. Microdata allow to tag content of websites in line with structured metadata. LRMI integrates parts from the schema.org standard (Ziedorn et al., 2013, p.6f.). LRMI development was led by the Association of Educational Publishers and Creative Commons. Meanwhile, it is curated by the Dublin Core Metadata Initiative. A feasibility study of the *Deutscher Bildungsserver* recommends the implementation of LRMI to serve search engines properly (Deutscher Bildungsserver, 2016, p.48). Another study on ten OER platforms was conducted by Campbell and Barker (2014). They state that a survey of LRMI implementations on these repositories found that "several projects noted that they had not observed any measurable impact as a result of implementing LRMI" (Campbell et al., 2014, p.11). Nevertheless, the parties also said "they also felt it had been beneficial to be involved in the LRMI Implementation Projects and to be at the 'cutting edge' of metadata technology" (Campbell et al., 2014, p.11). It remains

unclear how the large search engines exploit the metadata from the websites as the algorithms are secret.

LRMI may have its advantages but because of the concept of microdata integrated in the content, it is not suitable for the exchange of structured metadata between connected repositories.

3 Which Roads Lead to a Good Metadata Profile?

As discussed in the previous chapter, the developed metadata profile for higher education OER (HS-OER-LOM) builds upon and is compatible with the internationally established LOM standard. While LOM supports a comprehensive description of OER, we were confronted with the task to reduce the coverage in a way that it can be conveniently managed. This resulted in the following leading question: How can a good balance between sufficient and user-friendly (for submitters) metadata be reached? Potential users need sufficient information to find suitable material, while creators of material should not be discouraged by overly demanding metadata requirements. To find an answer, the following questions were considered.

How much and which metadata can be requested from authors? Basic information about the OER such as title and license would be essential, as well as some information regarding the subject. It is needed for the correct usage (license information) of the OER, see, for example, the TULLU rule (Borski & Muuß-Merholz, 2016). Yet, more information takes more effort that submitters are often unwilling to invest (Hielscher et al., 2015). Also, various pedagogical data can often only be supplied by someone who is trained in didactics, which does not apply to all OER authors.

Which metadata can be automatically produced, and which need to be entered individually? Automatically generated metadata such as the publishing date or technical format of the OER takes no human effort and should be included if it is of actual use.

What can be done by editorial staff who has no specialised knowledge in the respective fields? Higher education covers a wide range of subjects and editors cannot have expert insights in them. This contrasts with journal editors who only cover a certain scientific field. Common bibliographic data and keywords can certainly be checked or provided by editors. However, content description is limited to a general level.

Which metadata is actually given by authors in practice, and which fields are ignored? Without question, data such as title and author are always

supplied, and the need for a license can easily be motivated. Anything else has to be argued. A meaningful description going beyond the title is certainly a valuable piece of information for people searching for OER. Real-life experience has revealed that this often has to be requested from the authors or done by the editors themselves. Another aspect is the unsurprising finding by (Hielscher et al., 2015, p.151f.) that fields with a given vocabulary to choose from are more frequently filled in than those asking for free text. The rather difficult issue of pedagogical metadata is addressed in the next question.

Furthermore, we considered whether the management of metadata is still worth the effort if metadata are not or only rarely supplied. Then the alleged benefit turns into a disadvantage—a matching OER is not found just because the data are missing. In this case, the alleged availability of certain metadata gives rise to false expectations. For example, let us take a look at fields regarding accessibility. Without question, accessibility information is desirable, and more effort should be invested to make OER also usable for functionally impaired students (Zhang et al., 2020). With a great deal of work focussing on this audience, substantial improvements in providing OER can be reached (Navarrete & Luján-Mora, 2018). There are repositories offering the possibility to enter metadata for accessibility along the way but without accompanying measures in this matter. The people running them report that those fields are ignored by the authors and the effort to supply information here is avoided. Consequently, a search mask promising to find OER fulfilling certain accessibility criteria gives rise to expectations which cannot be met. Thus, it is better to relinquish such data if the information cannot be ensured at least for a certain part of the OER provided.

What metadata are important especially for OER or learning objects? This issue deals mainly with pedagogical metadata. This covers various aspects like preconditional knowledge, curricular attribution, suitable age, time involved to work through the OER, etc.—they are helpful categories. Learning objects are distinct from material usually catalogued by libraries particularly concerning the pedagogic aspect. Yet there are several issues when considering the possibilities to make such attributions. The kind of the OER can have different forms. Pedagogical metadata in learning courses with several modules, maybe even developed on demand for specific lectures, can be provided more easily. This is due to the fact that a course already belongs to a certain didactic setting and has been developed with a pedagogical intent. In contrast, the labelling can be quite difficult for a small piece like an image, a video clip, or a contribution illustrating a topic in a concise way. The purpose of OER like these is that they are embedded and reused in other contexts. This and the possibility to modify the material

are the main advantages of OER and they are made possible by open licensing. This flexibility, however, often hinders the supply of pedagogical metadata as, for example, a curricular attribution, a note on time needed, sometimes even the specification of a subject group. The educational openness of universities in contrast to schools also impedes such categorisation.

Therefore, it was decided to have only very few obligatory pedagogical metadata. In the end, only the *learning resource type* and *description* made it into the profile. The former has advantages for both sides—authors can choose easily from the controlled vocabulary and searchers find it useful to roughly filter the available OER for their intended use according to the type. *Description* in the context of LOM refers to comments on how this learning object can be used. This may be necessary for some kinds of OER. Additionally, it has the benefit that related but rarely used specifications, which would go into more specific pedagogical data fields in the original LOM, can be recorded here as well. Because of the mentioned considerations, any other pedagogical metadata has not been adopted into the profile. This decision was encouraged by the results of a survey among faculty staff conducted by the ZOERR at the beginning of the project. The results show that faculty staff search for content suitable for their lectures. During that process, they are not interested in pedagogical filters. The material is checked with personal expertise and the main criterion is the fit into their own teaching material, that is, the pedagogical suitability is a by-product of the personal review.

4 How Was the Metadata Profile Implemented?

The metadata profile has been formalised and is available as XSD schema, which can be used for validation of individual metadata. Furthermore, there are examples and an extensive description (Menzel, 2020a). The latest version can be found here: https://w3id.org/dini-ag-kim/hs-oer-lom-profil/latest/

As the description mentioned above, an overview article (Menzel, 2020b), and a specification (Menzel et al., 2021c), which extensively decribe the details of the HS-OER-LOM metadata profile, already exist, the focus here will only be on a classification regarding the necessity of the individual attributes, resulting from the considerations in the previous chapter. A detailed consideration of the vocabularies used is also made.

The profile requires obligatory metadata in a few places only. Our considerations for the implementation lead to four categories of metadata:

1. Obligatory metadata: *title, originator/author, license*. This information is strictly necessary to offer OER at all (rules for citation [Borski & Muuß-Merholz, 2016]).
2. Highly recommended metadata: *description, origin, language, learning resource type, persistent identifier, creation date, publishing date*. Most of these data can be provided easily or generated automatically. Only the description needs an effort by the submitter, yet is helpful from a user's viewpoint for a quick overview of the content of the OER. The persistent identifier, provided by the repository, is not obligatory. For OER which are linked and not uploaded onto the repository, a persistent identifier might already have been provided by the original source, or there may sometimes be doubts about the permanent availability of the offered OER.
3. Useful metadata: *keywords* and *scientific subject*. This information considerably facilitates the search for accurately fitting OER and is, therefore, desirable.
4. Optional metadata: *technical requirements* and *further persons involved*. For some OER, special applications are necessary to use them. These applications may not be well-known but can be common practice in a scientific field, for example, certain tools for data visualisation or statistics. Furthermore, hints on a correct import, for example, into a learning management system, might be very helpful. For this purpose, notes on the technical requirements should be included. When further persons or organisations were involved in the production of the OER, it is good practice to name them too.

The investigations in (Hielscher et al., 2015, p.151f.) clearly indicate that vocabularies offered to submitters of OER can significantly lower the inhibition threshold to fill in metadata. In two places of the developed metadata profile, a fixed vocabulary is used that is not taken from the LOM standard. Firstly, there are the learning resource types. Originally, LOM had defined this kind of metadata in a rather basic manner. Our investigations have revealed that many parties apparently consider this specification as inadequate. Therefore, they developed variants and extensions on their own. To the best of our knowledge, none of these could be established as a standard. Among the parties we looked at were EAF/LOM- DE (ELIXIR) (DIPF, 2021), LOM-CH, OER Commons (OER Commons, 2014), DuEPublico (Universität Duisburg-Essen, 2021), ILIAS, and Moodle. Eventually, we decided to develop our own vocabulary for the purpose, that is, with a focus on OER and higher education.

Secondly, a vocabulary for scientific subjects had to be defined. After some debate, the classification of university subjects by the German Federal Statistical Office (DESTATIS) was chosen (Statistisches Bundesamt, 2020). In the discussion about the new profile, involving various partners from all over Germany, the

mentioned classification emerged as the best common ground. The classification depicts a multilevel hierarchy of the university subjects in Germany. By using this scheme, the granularity can be chosen by anyone in a compatible way. At the same time, when searching for OER, the subject filter can be narrower or wider.

Furthermore, the subject classification by DESTATIS is maintained and updated on a regular basis. In recent talks with members from the project Open Education Austria Advanced (which is a follow-up of a project described here [Lingo et al., 2019]), who are about to run OER repositories as well, it was found that they have their own, slightly different classification of subjects. However, they are interested in the metadata profile presented here and plan to adopt it as well. For more information on their repository called *OERhub,* visit https://www.openeducation.at/suchen/. Regarding the subject, switching to an internationally recognised classification scheme used by libraries, such as the Dewey Decimal Classification (DDC), is not feasible because many scientific subjects are not represented on a comparable level, especially new ones that have emerged in the last decades. For example, computer science is just a sub-item in the main class called "Computer science, information & general works", which also accommodates all kinds of topics that do not fit to another subject. On the other hand, "Philosophy and psychology" is a main class with several sub-items of fine granularity and does not even include religion, which forms a main class by itself.

Both vocabularies are implemented using the Simple Knowledge Organization System (SKOS). For the learning resource types see https://w3id.org/kim/hcrt/scheme and for the subjects see https://w3id.org/kim/hochschulfaechersystematik/scheme. Therefore, they are machine-readable. Every single value has a permanent identifier. The vocabularies themselves are not fixed permanently, though. Proposals for extensions and modifications can be put forward and discussed via projects in GitHub (Menzel et al., 2021a) and (Menzel et al., 2021b). Adopted changes can be automatically deployed by applications.

Let us now say a few words about keywords, which are simple terms in the specification of the metadata profile. The Baden-Wuerttemberg OER repository ZOERR distinguishes between free and fixed keywords. The former are entered freely by the author, while the latter are fed by a catalogue of common terms, which is a part of the Integrated Authority File (GND) of the Deutsche Nationalbibliothek (DNB) (Deutsche Nationalbibliothek, 2021). The facilitation through the fixed keywords yields several advantages. Spelling mistakes are avoided, and equal terms are named equally. Additionally, synonyms are covered by the vocabulary, that is, when synonymous terms are entered, they are automatically rooted back to the main term which makes matching requests more likely. For these

reasons, the fixed keywords should be preferred whenever possible. Keywords that cannot be found in the catalogue can still be declared free keywords.

As it was pointed out in the beginning, LRMI is a schema recommended by various parties and can be regarded as an add-on because of its different lightweight nature (microdata). The findings by (Campbell et al., 2014), that the practical outcome cannot really be measured, are in line with the experiences of the ZOERR repository, which has implemented and exposed a very basic LRMI scheme in the HTML pages as well. Also, another profile using schema.org/LRMI is in development using the HS-OER-LOM metadata profile as one of the building blocks. It is about to be released and will be published in the format JSON/LD (Pohl et al., 2021). Its goal is better usability in the context of HTML and by Internet search engines. The *OER Search Index (OERSI)*, see https://oersi.de/resources/, utilises this profile.

Striving for standardisation both with the profile itself and the used vocabularies, the clarity in classification and description of OER is promoted. This leads to better search results when looking for OER and enables the automated exchange between repositories.

5 What is the Operating Experience with ZOERR like?

An overview of the beginnings and background of the *Zentrales OER Repositorium der Hochschulen in Baden-Württemberg (ZOERR)* can be found in (Rempis, 2017). The FAIR principles (GO FAIR Initiative, 2021) are an important guideline for repositories, too. Therefore, the following paragraph describes how the ZOERR considers these principles and which role the metadata profile plays in this.

Findability: Users can employ the unspecific search in an one-line search slot, like they are used to with other search engines. All metadata and content, that can be automatically parsed, is indexed. Users are so accustomed to this kind of search that it is standard and should be offered for usability reasons. Nonetheless, an optimal hit accuracy will not be reached this way in most cases. However, the extended search allows filtering with high accuracy by its defined metadata fields, even if it is sometimes considered an outdated approach. The controlled vocabularies for learning resource types and scientific subjects are very helpful in the selection. Likewise, the keywords based on the Integrated Authority File are helpful for finding similar OER. All OER hosted (not linked) by the repository obtain a handle, which is a globally unique and persistent identifier; every entry in the

repository has a unique identifier. Identifiers are published on the top-level in the metadata of each record.

Accessibility: According to the principles of OER, the repository and its content can be used completely freely. Registration is only necessary for authors providing OER to organise the submission process sensibly. Metadata are harvestable using the OAI-PMH protocol. There is also a public REST-API. Both are open and universal protocols for information retrieval.

Interoperability: This can be viewed from two different angles. Firstly, there is a structural aspect. More precisely, a coordinated exchange of metadata with other repositories and interested parties can be achieved by utilising the jointly created metadata profile. Thus, the OER can be offered to a wider audience. The metadata specification and used vocabularies are openly available and the representation uses state-of-the-art formats. There are mechanisms for further development when needed. Secondly, interoperability can be seen regarding the OER themselves. As operators of the ZOERR, we try to foster open formats. Yet in the end, we are only intermediaries between providers and users. In this context, we have to come to terms with commonly accepted formats like Microsoft Office. Furthermore, authors are encouraged to also provide the editable sources of their materials, in other words, not only the final presentation in PDF, for example.

Reuse: All material that is hosted by the repository itself can be downloaded and used subsequently in the context of the user. This is fostered by the open licenses, and OER can be modified and enhanced by users. Each metadata record contains a minimum of mandatory terms, the supply of an (open) license and an authorship for all OER is obligatory, and all uploaded material and metadata is traceable to a registered user of ZOERR.

5.1 Editors—Who Needs Them?

Right from the start, the ZOERR repository was devised with an accompanying editorial supervision in mind. Consequently, it is not a self-publishing system. In running operations, this decision was confirmed as crucial and correct.

A workflow was established for publishing OER via the ZOERR. When the submitter uploads an object into the repository, a dialogue pops up asking for descriptive metadata. The submitter can but does not have to be the author. In the latter case, he might only upload the information he obtained from the author. The metadata can be entered immediately or whenever convenient. The object including the metadata can be shared among colleagues within the system for

collaboration. New versions can be uploaded as well. When the OER is ready to be published, the submitter passes the material on to the editorial staff.

In our view, editorial supervision is necessary for the appropriate (formal) quality of the OER and metadata. Editorial staff cannot conduct an examination of the content itself because general OER repositories cover almost all areas of science, and a classic peer-review of all OER requires far too many resources, especially for many small pieces. However, in the daily work, the editors of the ZOERR make a valuable contribution by revealing private notes, unintended gaps, formatting errors, and such like in the OER submitted for publication. In such cases, they contact the submitters, ask for their intention, and offer support. The editors can also encourage the submitters to provide valuable metadata, for example, a concise description and reasonable keywords. Moreover, they lend active support with the metadata. Experience shows that this help is generally gladly accepted. An editorial process can also inhibit an arbitrariness in the metadata. As an example, note the *communities* in Zenodo, which are intended to cluster all the contributions in a reasonable way, see https://www.zenodo.org/communities/. Apparently, anyone can create a new community in Zenodo. Even though this idea sounds good, during an investigation by the author in the year 2020, the number of communities increased by about 300 each day, and about 15,000 communities existed in total. Obviously, this concept cannot be used in a practical way. Admittedly, there are (meanwhile) mechanisms to correct that (not investigated further) because another check in July 2021 showed a number of communities half as high and falling. The point is that curating metadata may help a lot when it comes to classification and findability.

When the editorial process is finished to the satisfaction of all sides, the new OER is then published together with a persistent identifier. For some OER that are significant and above a certain level of creation, the editors will also record the new work in the library catalogue. This is a step towards raising labour-intensive OER of high quality to a similar level as other publications of scientific papers.

5.2 Can we share?

The operators of ZOERR see it as an important and beneficial task to publish the OER in the ZOERR and to give access to suitable OER of other sources to a wide range of users. To this end, the exchange of metadata is necessary. A metadata profile like the one jointly developed by the operators of OER repositories for higher education renders this exchange possible. The ZOERR offers the metadata

of its content via an OAI-PMH interface to the public. Arrangements were made with the *Hamburg Open Online University* and the OER repository of the *Virtueller Campus Rheinland-Pfalz (oer@rlp)*. Thus, a technical implementation could be realised to include the OER from these repositories when querying the ZOERR in such a way that search hits are presented in a transparent manner. To access the actual OER, the user is then forwarded to the corresponding repository. There are plans for cooperations with more partners.

6 What are the Results? How to Carry On?

Since there was no standard metadata scheme for OER in higher education, the need arose to reach an agreement on this. The main arguments here are findability of OER for users on the one hand and dissemination or harvest of openly licensed learning objects on the other hand.

We aimed to deploy an existing metadata standard scheme. As we pointed out, there were serious reasons to develop a scheme. To stay compatible with others, we specified a suitable metadata profile based on the internationally known LOM scheme, which focusses on learning objects. We investigated what information is useful for potential users and what can be supplied efficiently in daily business. The results were recorded as a XSD schema that can also be used for validation purposes of self-produced metadata. The schema is accompanied by an extensive documentation including examples.

We are convinced that a slim metadata profile like the HS-OER-LOM presented here is a vital basis for a continuous operation of a repository with consistently high quality. As operators of ZOERR, we have had positive experiences working on the basis of this profile but think that editorial support is vital in order to maintain the quality standard. However, this certainly depends on many more conditions, such as the precise kind of content, intended audience, providers, granularity of OER, etc. Quality assurance is a large topic to be discussed elsewhere and metadata is only one significant part of it. We argue that HS-OER-LOM is a reasonable compromise between preferable extent and practicable brevity. There is always a certain level of maintenance expenditure, but this remains manageable when limited to what is necessary. The linking-up with other providers is only possible in an economic way when agreeing on a clear and manageable scheme.

Furthermore, the profile is designed in a way that extensions can be carried out in a defined process in the future if the demand arises. To that end, there are GitHub projects for the metadata profile itself (Menzel et al., 2021c) as well as

for the used vocabularies (Menzel et al., 2021a, 2021b). The specifications are made in a format with long-term availability in mind. The KIM metadata group for OER in the context of the DNB forms a framework for interested parties to discuss further developments (Kompetenzzentrum Interoperable Metadaten, 2021).

We are pleased that HS-OER-LOM is attracting attention from other players in the field like Open Education Austria Advanced. We hope that the metadata profile will convince others and find a wide distribution among the parties managing OER in the context of higher education.

References

AG Mediendistribution und Dokumentation. (2012). *EAF—Erweitertes Austauschformat*. http://agmud.de/eaf-erweitertes-austauschformat/.

Barker, P., & Campbell, L. M. (2010). Metadata for learning materials: An overview of existing standards and current developments. *Technology, Instruction, Cognition and Learning, 7*(3/4), 225–243.

Borski, S., & Muuß-Merholz, J. (2016). *OER leichtgemacht mit der TULLU-Regel*. OER-info—Informationsstelle OER. Retrieved August 13, 2021, from https://open-educational-resources.de/oer-tullu-regel/.

Campbell, L. M., & Barker P. (2014). *LRMI implementation: Overview, issues and experiences*. Centre For Educational Technology Interoperability Stan- dards (CETIS). http://publications.cetis.org.uk/wp-content/uploads/2014/12/lrmiImplementationSynthesis.pdf.

Deutscher Bildungsserver. (2016). *Machbarkeitsstudie zum Aufbau und Betrieb von OER-Infrastrukturen in der Bildung (Stand: Februar 2016)*. urn:nbn:de:0111-pedocs-117154.

Deutsche Nationalbibliothek. (2021). *Gemeinsame Norm- datei (GND)*. https://www.dnb.de/DE/Professionell/Standardisierung/GND/gnd_node.html.

DINI AG Metadaten für Multimedia-Objekte, & ELAN Arbeitsgruppe Metadaten. (2005). *ELAN Application Profile: Metadaten für elektronische Lehr- und Lernmaterialien*. Deutsche Initiative für Netzwerkinformation (DINI). https://doi.org/10.18452/1481.

GO FAIR. (2021). *FAIR Principles*. https://www.go-fair.org/fair-principles/.

Haneefa, K. M., & Chembrakuzhi, M. (2014). *Metadata standards for open educational resources*. 59th ILA International Conference on Managing Libraries in the Changing Information World: From Surviving to Thriving, Indian Institute of Technology, Roorke. https://www.researchgate.net/publication/305298208_Metadata_Standards_for_Open_Educational_Resources.

Haynes, D. (2018). *Metadata for information management and retrieval—Understanding metadata and its use* (2nd ed.). Facet Publishing. https://doi.org/10.29085/9781783302161.

Hielscher, M., Cantieni, A., & Hartmann, W. (2015). To share or not to share: ist die nutzung von OER-austauschplattformen eine frage der kultur? In H. Pongratz & R. Keil (Eds.), *DeLFI 2015—Die 13. E-Learning Fachtagung Informatik* (pp. 145–156). Gesellschaft für Informatik e. V.

IEEE. (2002). *IEEE standard for learning object metadata* (1484.12.1-2002). https://doi.org/10.1109/IEEESTD.2002.94128.

Kompetenzzentrum Interoperable Metadaten (KIM). (2021). *OER–Metadatengruppe*. Deutsche Initiative für Netzwerkinformation (DINI). https://wiki.dnb.de/display/DINIAGKIM/OER-Metadatengruppe.

Leibniz-Institut für Bildungsforschung und Bildungsinformation (DIPF). (2021). *ELIXIER Die Suchmaschine für Bildungsmedien*. bildungsserver.de. https://www.bildungsserver.de/elixier/.

Lingo, S., Budroni, P., Ganguly, R., & Zwiauer, C. (2019). Open Education Austria—ein Modell für die Integration von OERs in die österreichischen Hochschulen. *Zeitschrift Für Hochschulentwicklung, 14*(2), 43–58. https://doi.org/10.3217/zfhe-14-02/03

Menzel, M. (2020a). *LOM for Higher Education OER Repositories—Ein Metadatenprofil für Open Educational Resources im Hochschulbereich* (2nd ed.). Universitätsbibliothek Tübingen. doi: https://doi.org/10.15496/publikation-39713.

Menzel, M. (2020b). LOM for Higher Education OER Repositories—Ein Metadatenprofil für Open Educational Resources im Hochschulbereich zur Förderung der Interoperabilität von OER-Länderrepositorien. *O-Bib. Das Offene Bibliotheksjournal, 7*(1), 1–10. https://doi.org/10.5282/o-bib/5579

Menzel, M., & Pohl, A. (Maintainer). (2021a). *HCRT—Hochschulcampus Ressourcentypen*. https://github.com/dini-ag-kim/hcrt.

Menzel, M., & Pohl, A. (Maintainer). (2021b). *Hochschulfächersystematik*. https://github.com/dini-ag-kim/hochschulfaechersystematik.

Menzel, M., & Pohl, A. (Maintainer). (2021b). *LOM for Higher Education OER Repositories (HS-OER-LOM)*. https://w3id.org/kim/hs-oer-lom-profil/latest/, GitHub: https://github.com/dini-ag-kim/hs-oer-lom-profil.

Miles, A., & Bechhofer, S. (Eds.) (2009). *SKOS Simple Knowledge Organiza- tion System Reference*. W3C. http://www.w3.org/TR/2009/REC-skos-reference-20090818/.

Navarrete, R., & Luján-Mora, S. (2018). Bridging the accessibility gap in open educational resources. *Universal Access in the Information Society, 17*, 755–774. https://doi.org/10.1007/s10209-017-0529-9

OER Commons. (2014). *OER commons learning object metadata Element Set v4*. ISKME. Retrieved August 09, 2021, from https://www.micollegesonline.net/uploads/ckeditor/files/OERCv4-MetadataApplicationProfile.pdf.

Pohl, A., et al. (2021). *A schema.org/LRMI-based profile for describing educational resources*. https://github.com/dini-ag-kim/amb.

Rempis, P. (2017). ZOERR—Zentrales OER-Repositorium der Hochschulen in Baden-Württemberg. *Synergie—Fachmagazin für Digitalisierung in der Lehre*, 4, 68–71. urn:nbn:de:101:1-2017120619896.

Schumacher, F., et al. (Ed.) (2010). *LOM-DE Specification of a LOM Profile for German metadata exchange*. Retrieved August 09, 2021, from http://sodis.de/lom-de/LOM-DE.doc.

Statistisches Bundesamt (Destatis) (2020). *Systematik der Fächergruppen, Studienbereiche und Studienfächer*. Retrieved August 09, 2021, from https://www.destatis.de/DE/Methoden/ Klassifikationen/Bildung/studenten-pruefungsstatistik.pdf.

Steiner, T. (2017). Metadaten und OER: Geschichte einer Beziehung. *Synergie—Fachmagazin für Digitalisierung in der Lehre, 4,* 51–55. urn:nbn:de:0111-pedocs-157415.

Universität Duisburg-Essen. (2021). *DuEPublico: Lehr- und Lernmaterial*. https://duepublico.uni-duisburg-essen.de/.

Wiesner, A. (2010). *Activity Tree Harvesting—Entdeckung*. KIT Scientific Publishing. https://doi.org/10.5445/KSP/1000017793

Zhang, X., Tlili, A., Nascimbeni, F., Burgos, D., Huang, R., Ting-Wen, C., Jemni, M., & Khribi, M. K. (2020). Accessibility within open educational resources and practices for disabled learners: A systematic literature review. *Smart Learning Environments, 7*(1), 1–19.

Ziedorn, F., Derr, E., & Neumann, J. (2013). *Metadaten für Open Educational Resources (OER) Eine Handreichung für die öffentliche Hand.* Technische Informationsbibliothek (TIB). urn:nbn:de:0111-opus-80245.