The Development and Implementation of Missing Tools and Procedures at the Interface of a University's Learning Management System, its OER Repository, and the Austrian OER Referatory

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Abstract

To enable broad access to education and generous use of educational resources, Graz University of Technology (TU Graz) also relies on Open Educational Resources (OER). This article describes the technological developments and processes that enable teachers at TU Graz to use their own learning management system (LMS)

for the publication of OER. The article describes how interfaces and processes have marked educational resources of TU Graz with metadata to offer them to a broad public via the university's own OER repository and via the Austrian OER portal of the University of Vienna. Only appropriately qualified lecturers at TU Graz are authorized to use the new OER plug-in. The article concludes with recommendations for projects in OER infrastructure implementations.

Keywords: Open Educational Resources (OER), metadata, learning objects metadata (LOM), library, repository, learning management system (LMS), training, certification, higher education, university

El desarrollo e implementación de herramientas y procedimientos que faltan en la interfaz del sistema de gestión del aprendizaje de una universidad, su repositorio de REA y el referatorio de REA de Austria

Resumen

Para permitir un acceso amplio a la educación y un uso generoso de los recursos educativos, la Universidad Tecnológica de Graz también se basa en Recursos Educativos Abiertos (en resumen, REA). Este artículo describe los desarrollos y procesos tecnológicos que permiten a los profesores de la Universidad Tecnológica de Graz utilizar su propio sistema de gestión del aprendizaje para la publicación de REA. El artículo describe cómo las interfaces y los procesos han marcado los recursos educativos de la Universidad de Tecnología de Graz con metadatos para ofrecerlos a un público amplio a través del repositorio de REA de la propia universidad y a través del portal de REA de Austria de la Universidad de Tecnología de Graz. Solo los profesores debidamente cualificados de la Universidad Tecnológica de Graz están autorizados a utilizar el nuevo complemento OER. El artículo concluye con recomendaciones para proyectos en implementaciones de infraestructura REA.

Palabras clave: Recursos educativos abiertos (REA), metadatos, LOM, biblioteca, repositorio, sistema de gestión del aprendizaje, formación, certificación, educación superior, universidad

大学学习管理系统、OER存储库及奥地利OER 门户网站界面所需工具和步骤的开发和执行

摘要

为让教育的广泛获取、教育资源的免费使用成为可能，格拉茨科技大学也依靠开放教育资源（简称OERs）。本文描述了让格拉茨科技大学教师能使用个人学习管理系统来发表OER的相关技术开发和过程。本文描述了界面和过程如何用元数据标记格拉茨科技大学的教育资源，并通过该大学的OER存储库及奥地利OER门户网站将资源提供给广泛大众。只有合格的格拉茨科技大学教师才被授权使用新OER插件。本文结论对OER基础设施执行的相关项目提出了建议。

关键词：开放教育资源（OER），元数据，学习对象元数据（LOM），图书馆，存储库，学习管理系统，培训，认证，高等教育，大学

Introduction

Open Educational Resources (OER) at German-speaking European universities

To provide broad access to education and allow for a more widespread use and re-use of educational resources, many global organizations and agencies rely on open educational resources. UNESCO (2002) defined open educational resources (OER) as "teaching, learning and research resources in any medium, digital or otherwise, that are in the public domain or published under an open licence allowing free access, use, editing and redistribution by others without or with minor restrictions. The principle of open licensing is within the existing framework of copyright law, as estab-lished by relevant international agreements and respects the authorship of a work." The European Commission (2013) also promotes OERs, with the aim of "opening up education" and improving the teaching of digital skills in schools and universities. There are also many theoretical debates on OER, for example, on the relationship between sharing and openness (Missomelius et al., 2014).

For educational resources to become modifiable and reusable for third parties in a legally compliant manner, they have to be published under a free/open license. Even though there are other licensing models, the so-called Creative Commons (CC) licensing model is best known in German-speaking Europe (http://de.creativecommons.org/). Examples for "open licenses" are "CC

BY" or "CC BY-SA." Resources for which no copyright exists anymore and resources that have been published in the public domain with a CC0 license are "open" as well. There are, however, CC licenses that do not meet the definition of "open" licenses: for example, when commercial use is prevented (CC BY-NC, CC BY-NC-SA; see also Klimpel, 2012). Using open licenses is more important in German-speaking Europe than, for example, in the USA, as there are no fair-use rules, and the re-use of schoolbooks and textbooks, for example, is only allowed to a very limited extent (Ebner, Schön, & Kumar, 2016).

Regarding OER in the context of universities in German-speaking Europe, there are specific issues compared to other countries (see Ebner, Schön, & Kumar, 2016, Mruck et al., 2013). First, attending public universities does not involve expensive fees, which means that OER are not suitable as a potential marketing tool to attract future students. Furthermore, academic freedom is considered a significant aspect of the university sector so that faculty cannot, e.g., be forced to publish teaching materials as OER. However, OER are perceived as a potential means to boost the public image and the impact of a university and to help spread its materials.

It may be obvious from the above that it is difficult to introduce and implement OER strategies at European universities and to implement processes that actively support the creation and publication of OER. In Austria, the most important initiative on OER in higher education was the project

"Open Education Austria," which was co-financed by the Federal Ministry of Education, Science, and Research. The project, the first phase of which lasted from June 2016 to December 2018, was renewed in March 2020 as "Open Education Austria Advanced" with additional partners. Its aims include expanding the OER infrastructure for Austrian universities until 2024 and the further development of a system for the OER certification of teachers and universities (Ebner 2018; Ebner, Freisleben-Teutscher, Gröblinger, et al., 2016; Ebner, Kopp, Freisleben-Teutscher, et al., 2016). One sub-project concerns the expansion of the service and technology infrastructure for publishing OER within the partner universities and for sharing experiences and solutions with others (see Figure 1). A prototype for an application enabling the automatic transfer of OER from a learning management system (LMS) into a library system has been developed.

This paper describes the development of an OER plug-in that can be selected by appropriately qualified lecturers of the Graz University of Technology (TU Graz). It will allow them to label learning resources in the LMS (Moodle) with the corresponding OER metadata, to transfer them into the university's repository and to make them available via other (planned) services, in particular those for doing research on the Austrian OER portal, which is being developed and is hosted by the University of Vienna. Teachers and students worldwide will then be able to search for OERs via the OER portal to access materials of the library of TU Graz.

Before we present the more detailed methods and results of our development, we would like to discuss the background and current state of the debate on educational resources and metadata.
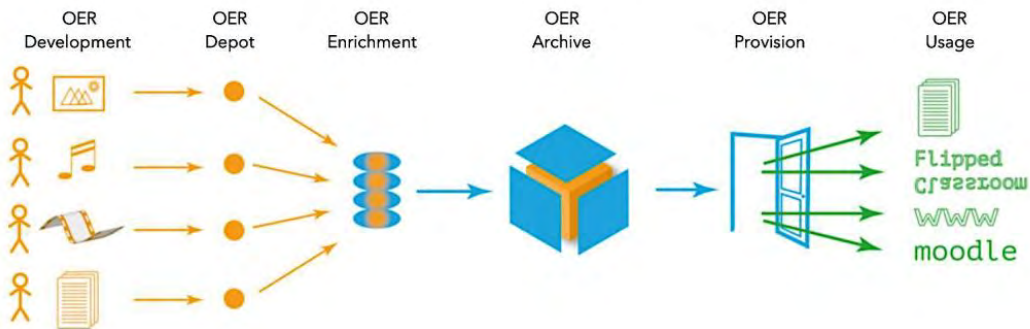

Figure 1. Schematic Representation of the Technical Infrastructure for Making OER Available within the Open Educational Austria Advanced Project

Source: Open Education Austria Advanced (2020-05-19).

Review of the Literature

Metadata Standards for OER

To make OERs available to others, they must also be findable and researchable. The use and embedding of open licensing in the source code is only a first step. To enable teachers to conduct granular research, for example, on specific target groups or teaching topics, more precise descriptions—so-called metadata—are necessary. As freely available educational resources emerged on the Internet, research projects that specifically addressed this challenge were undertaken. For example, the 2005–2008 EC-funded project CALIBRATE attempted to develop a common search and exchange facility via various national education servers of participating ministries of education.

The basis for such an exchange of resources is uniform descriptions of the materials, i.e., standards for the metadata of the resources. There are different approaches and proposals for classifications of metadata of (free) educational materials or learning objects (see e.g., Pohl, 2014). OERs are very diverse, which is a challenge (Ebner et al., 2015): OERs are of varying granularity, from individual images to complete courses; they can be static or dynamic; and they can be individual, rigid documents or dynamic developments, such as wiki systems. In addition, there are a variety of technical formats (from courses to apps to video), different curricula, different target groups, and also different producers within the entire educational sector.

Barker and Campbell (2010) provided an overview of standards for metadata of educational resources.

Ziedorn et al. (2013) compiled a corresponding overview of usable metadata standards for OER. As a long-term goal, one should "achieve a standardisation of the metadata schema (whether an existing one or a newly developed one by the International Organization for Standardization (ISO))" (Derr & Neumann, 2013, p. 10). In particular Edusharing e. V. and the German OER Metadata Group are working in this field, the latter with the aim of "achieving harmonisation of OER metadata in the German-speaking world and to develop a recommendation on this" (OER Metadata Group, 2015). With digital OERs, many projects use and extend the standards of learning objects, e.g., the standard "Learning Objects Metadata" (LOM) (Rensing, 2013). LOM is an open standard developed and published by the Institute of Electrical and Electronics Engineers (IEEE) organization (Wikipedia, 2019). LOM is divided into different categories that cover partial aspects of metadata. Other publications on metadata and OER favor the approach of the Learning Registry Metadata Initiative (LRMI): "The LRMI standard enables the mapping of the dynamic process of user interaction (rating, indexing, versioning, etc.) as an integral part of OER" (Steiner, 2017, p. 53). In 2020, "LOM for Higher Education OER Repositories," i.e., a "Description of the XML Schema Definition of the Metadata Profile for Open Educational Resources in Higher Education" was published by the OER Metadata Group, a working group of German-speaking universities (KIM-AG, 2020; Menzel & Pohl, 2020).

Methodology

This article documents the development and implementation of the technical infrastructure and process that enable lecturers at TU Graz to (1) provide self-created learning and teaching resources with an open license and (2) transfer these OERs from the LMS to the repository at TU Graz. The aim is to make these resources searchable and findable on the (planned) Austria-wide referatory for OERs, an OER subject portal of the University of Vienna. Besides technical solutions, lecturer qualifications and authorizations are necessary steps in the process.

Two key developments were necessary for this. First, the existing technical systems had to be identified and then converted so that OERs could be created, which then could be searched by others. This required technical analyses and developments. Second, a process had to be created and implemented that qualifies teachers to develop and publish OERs.

In this paper, we describe the technical analyses and developments of the awarding of the learning and teaching resources of TU Graz as OER, i.e., the selection of the corresponding metadata standard and the awards used, as well as the technical implementations in the form of a plug-in for the university's own LMS and developments of application programming interfaces (API). Methodically, procedures of technical analysis and prototype development are used in software development. We also describe the development and imple-

mentation of the qualification and certification process. In this way, we document the procedures and experiences in a socio-scientific-descriptive way. We also used internal working papers, documentation, and a project presentation as a basis for this contribution (Ebner et al., 2017; Haas, 2018; Ladurner, 2019). A short version of this contribution was already presented and will be published in conference proceedings in German (Ladurner et al., 2020).

Findings

In the following, we describe the individual development steps and their results in the development of the technical and social implementation of the plug-in and the APIs into the technical infrastructure and processes of the OER publication at TU Graz.

Analysis of the initial situation at TU Graz

The following technologies and processes were established at TU Graz at the end of 2017, at the beginning of the implementation concerning educational resources.

"TeachCenter" is the name of the LMS at TU Graz. At the end of 2017, it was based on the open source software Moodle, version 3.1. At TU Graz, Moodle was extended by a web service for user synchronization and synchronization, course registrations, and de-registrations. In addition, a user interface was developed that corresponds to the corporate identity of TU Graz. Courses are created and maintained at the

request of the lecturers. The TU Graz TeachCenter contained about 1,200 courses in 2017; currently (May 2020), there are more than 2,000 courses (Ebner et al., 2020). Courses in the LMS are linked to one or more courses at TU-GRAZonline, the campus management system and corresponding user administration. TUGRAZonline is the central administration system for TU Graz staff and students. Students can register for their courses, and lecturers can carry out administrative tasks (e.g., input exam results) to manage courses.

There are two ways to upload a file into a course. The first possibility is to upload the file by using "drag & drop" on the "main page" of the course. Files uploaded that way will be stored with the system-wide standard license "All rights reserved" and the instructor will be entered as author. The second possibility is to select and upload files via "Add file." Here teachers have the option of specifying the author and the license used. The licenses and authorship of materials can be adjusted later (by clicking on "Edit" and "Settings").

The repository of TU Graz is a proprietary development, written in PHP. In order for the resources in the repository to be ordered and searched, additional information about the materials is required, so-called "metadata," which describe the materials. The repository of TU Graz has implemented the Machine Exchange Format for Libraries (MAB) (German National Library, 2019) for this purpose. It is used in the library program Aleph as a database format for storing bibliographic

data. The development of the format has been discontinued and is being replaced by MARC21 (Deutsche Nationalbibliothek, 2019). MAB is a data format that divides the information into fields. A field comprises a three-digit number, an indicator, and 1-n subfields (which in turn comprise a subfield identifier and subfield values). Some fields can be repeated and some cannot. This means that TU Graz's repository is not designed for teaching and learning resources.

A special feature that should be noted is the TUbe video portal of TU Graz, where course recordings and videos of lecturers can be filed, stored, and embedded in the LMS.

Schematically, as shown in Figure 2, the initial situation 2017 lacks interfaces that, on the one hand, transfer the materials from the LMS of TU Graz to the repository of the University Library of TU Graz. On the other hand, it enables the transfer of metadata to the Austrian OER portal.

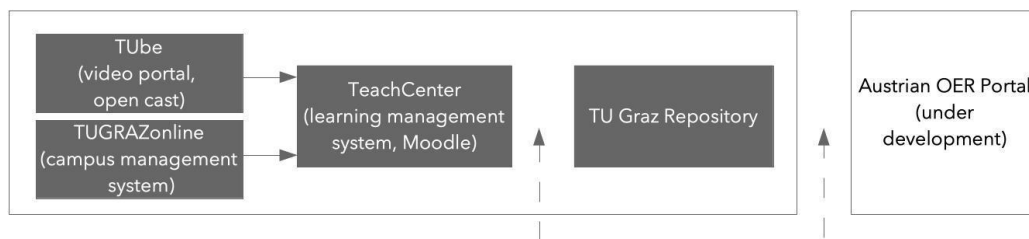OER Infrastructure of TU Graz – Initial Status end of 2017

Figure 2. Schematic Representation of the Initial Technical Infrastructure for Making OER Available at TU Graz

Note: Status End 2017.

For the sake of completeness, it should be pointed out that there is another platform for openly licensed materials at TU Graz, the MOOC platform imoox.at, where lecturers create OERs. As with the LMS TeachCenter and the TUbe video portal, there is currently no way of making the materials available to others for research purposes via the university's own repository or the Austrian OER portal developed by the TU Graz.

Sketch of the technical solution and development procedure

In order to transfer the data from the TeachCenter to the TU Graz repository or the Austrian OER portal, it is necessary to give lecturers the opportunity to supplement the corresponding metadata and develop interfaces (API). Figure 3 shows the necessary LMS plug-in and location of the API.

The procedure for the development was as follows. First, we determined how the OER should be described in the repository, i.e., which metadata should be used. To do this, we needed to choose a standard and discover which data already existed, which data was necessary, and which data had to be added by the teachers.
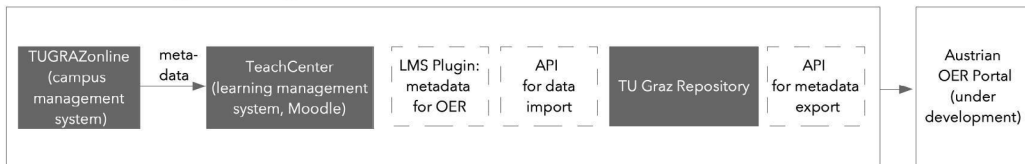
Needed Technology for Missing Links

Figure 3. Missing Technologies—Rough Concept of the Technical Solution

Choice of metadata standard and analysis and of available metadata

Since MAB is not designed for OERs, a standard had to be sought that could describe learning and teaching resources. The metadata standard LOM was already in use in several projects at the time of the analysis, and the LOM metadata can also be translated (Educa.ch, 2017). LOM was therefore selected, and the repository data model was adapted to LOM. This means that additional fields—corresponding to LOM semantics—were implemented.

Since we assumed that teachers are not very keen on entering additional metadata on their learning objects and units into a system, the question now arose which LOM metadata is already in the Campus Management System. To enable a coherent procedure, this equivalence check of metadata and LOM analysis and selection of relevant metadata was carried out in cooperation with the University of Vienna, which is interested in a joint procedure and selection for the Austrian OER portal and its own repository. Therefore, the metadata from the systems of TU Graz and the metadata of the Austrian OER portal of the University of Vienna were compared with LOM.

An equivalence list (see Table 1) was elaborated. It shows which of the LOM data are available in the information systems of the two universities.

The comparison of LOM of the metadata of the information systems of TU Graz and the University of Vienna shows that there are large overlaps. However, there are also fields in the systems of TU Graz that are not available at the University of Vienna (e.g., *resourceType*). Since the universities are striving for a compatible solution, this field is not considered further. Some LOM fields that are also present in the equivalence list in the information systems of both universities were not selected (for example, cost, reference program) because they do not appear to be relevant.

Schematically, therefore, there are different metadata identified as necessary based on a selection of metadata based on the LOM schema. They can be taken from different existing sources, namely the information systems of TU Graz and the file itself. However, a part must still be supplemented by the authors themselves or must be editable by them. Figure 4 gives an overview of the different sources.

Table 1. Equivalence List of the Fields of the Campus Management System of TU Graz, the Austrian OER Portal of the University of Vienna and the LOM Standard.

| | *Documentation* | | | *Repository: OER API* | |
teachcenter		openlib	description[static]	vienna	lom
		1000	unique id		
		1050	children ids		
		1051	all child ids		
	C	1102	child type [course]		
	O	1600	creation date node		
	U	1601	modification date node		
title course	R	331	title	title course	
science field	S	1800	science field	science field	
location	E	1507	location [graz]	location	coverage [1.6]
intended end user role		1801	intended end user role [learner]	intended end user role	intended end user role [5.5]
context		1802	context [university]	context	context [5.6]
course language		1301	language	course language	
		1000	unique id		
		1050	children ids		
		1051	all child ids		
		1052	root ids		
		1053	parent ids		
		1102	child type [unit]		
		1600	creation date node		
		1602	modification date node		
institute		1803	institute	institute	
year		1401	year	year	
semester	U	1409	semester	semester	
description	N	1500	abstract	description	
university lecturer	I	100	author 1	university lecturer	contribute [2.3]
	T	103	corporate body 1	corporate body lecturer	role [2.3.1]
contributor		104	author 2	contributor	

categories	710		subject	categories	
course type	1804		course type	course type	structure [1.7]
	1000	F	unique id	unique identifier	identifier [1.1] [3.1]
	1052		root ids		
	1053		parent ids		
	1102		child type [file]		
	1600		creation date node		contribution to metadata [3.2]
	1601		modification date node		contribution to metadata [3.2]
author	100		author	author	author [2.3]
	103		corporate body	corporate body	role [2.3.1]
filename	331		title	filename	title [1.2]
filesize	1200pb		filesize	filesize	size [4.2]
	1200pa		filename[hash value of file]		
abstract	1500	F	abstract	abstract	
file language	1301	I	language	file language	language [1.3]
cost	1709	L	cost [none]	cost	cost [6.1]
		E	copyright a. other restrictions [yes]	copyright other restrictions	copyright and other restrictions [6.2]
licence	1701		licence [cc-*]	licence	description of rights [6.3]
reference program	1214		reference program	reference program	name of required technology [4.4.1.2]
categories	710		subject	categories	
subjects	710		subject	subjects	
file creation date	1604		file creation date	date	version [2.1] [2.3.3]
	1602		file modification date		
oefos	1508		oefos	oefos	
resourceType	1109		resource type		
		L		metadaten link	location [4.3]
		I		download link	
		N		id	
		K			
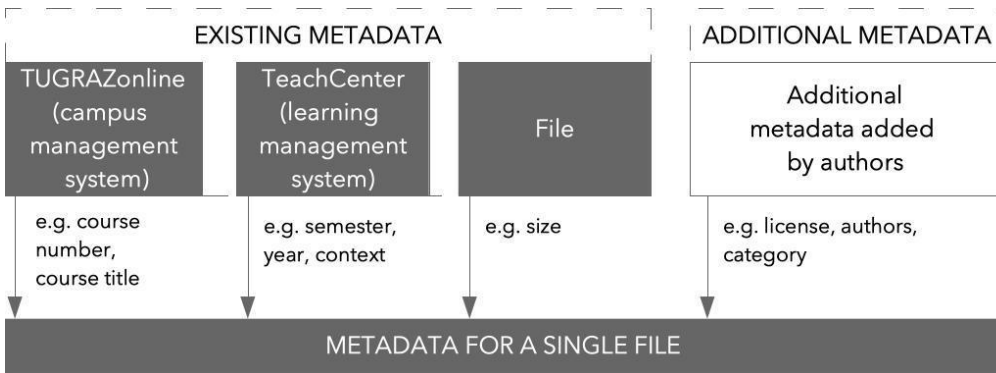
Figure 4. Overview of Sources of Existing and Necessary Metadata

Data model of the metadata

The metadata in the repository is managed in nodes, which are arranged in a tree structure. The nodes are stored in XML files. A node consists of several fields. A field is divided into field number, field indicator, and subfields. Subfields are divided into subfield *identifier* and subfield *value*. Subfields can occur several times in a field. Field number and field indicator are unique in the field. However, fields with the same number and field indicator can be used more than once. The tree structure depends on which object is catalogued. The type *journal* or *book* is presented here as an example: journals are divided into *journal → volume → issue → article*. Books are divided into *book → chapter → subChapter* etc. The OER metadata is also structured in a tree structure. There is information concerning a course (top level), information concerning a year or semester (unit, middle level), and information concerning the file directly (lowest level, see Figure 5).
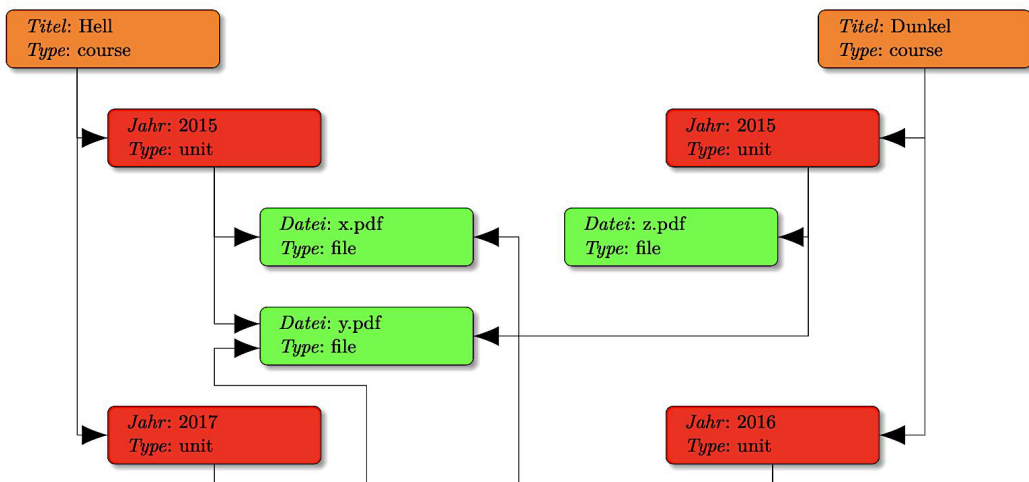
Figure 5. Tree Structure of OER Metadata Using the Example of Two Courses (Hell [Light]) and Dunkel [Dark])

Source: Ladurner (2018, Figure 1).

Automatic provision of metadata for OER

The analysis and selection showed for TU Graz that the following metadata can be provided by the LMS, the file itself, or the campus management system: *author* (if not explicitly entered, the person who uploaded the file is used here), *license* (if not explicitly set, the default license is entered here "all rights reserved," but all CC licenses are also available), *name* of the file, *file size* and *file type* (Mime Type), upload date and change date, course (*language, course type, teachers*), *faculty/institute* (*studies, semester*), *name of the person* who uploaded the file, and *keywords* (*tags, if used*). For some fields and metadata, however, an input mask had to be creat-

ed in the LMS to allow users to specify or adjust the metadata.

Interface development of the plug-in in the learning management system (LMS)

A plug-in for the LMS has therefore been developed for teachers, in which they can specify which files may be placed under a CC license and exported to the repository. Since the LMS does not require metadata for individual files, some of them have to be added by the course instructor. All instructors will see the menu item "OER plug-in." Only authorized persons can upload files. Persons without authorization will receive information on what OERs are and how to get permission to publish OERs (see Figure 6).
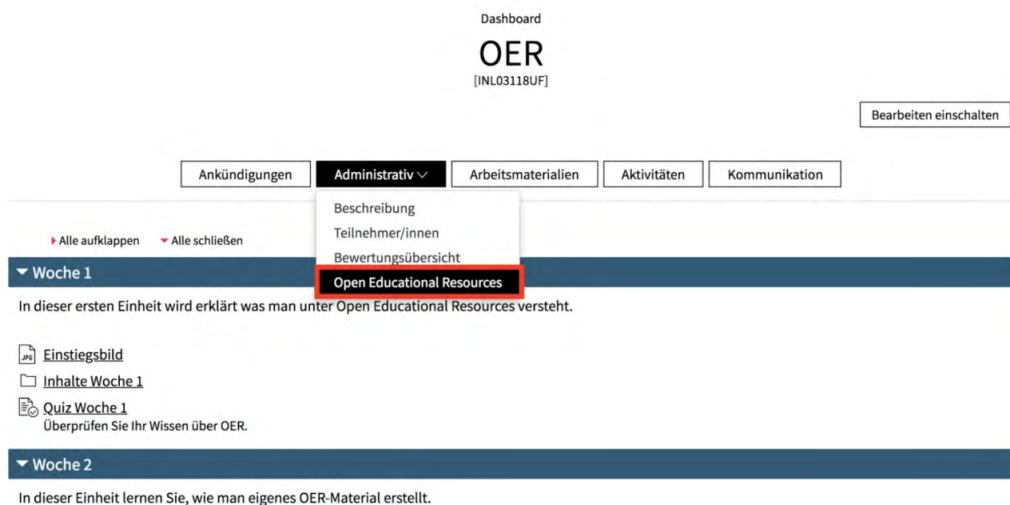
Figure 6. Screenshot of the Plug-In (Access to the Plug-In)

Figure 7 shows part of the plug-in, and provides an example to illustrate that the metadata in the plug-in comes from different sources. The semester and context are from the LMS (Teach-

Center) and the complete course description comes from the campus management system (TUGRAZonline). The information about the file size is taken from the file itself. This means that

teachers need and can only edit relatively few metadata: file name, language, resource type, role, author (originator), CC-license, keywords, and the OEFOS classification.
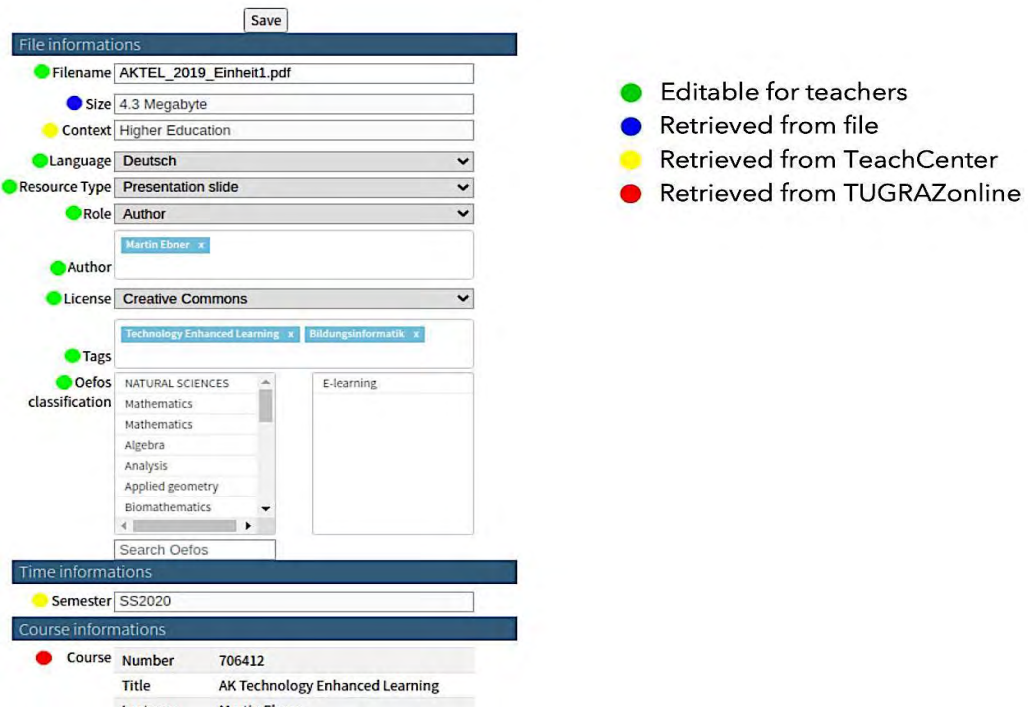

Figure 7. Screenshot of the Plug-In and Legend of the Origin of the Data and Possibilities for Data Input by the Teachers (Selection)

Development of Application Programming Interface (API)

The API is divided into an import and an export direction. The LMS is offered a Representational State Transfer (REST)-API, which allows users to import the entire course as a ZIP file into the repository of TU Graz. The API is kept very simple for this purpose. A token is responsible for authentication and the file pairs are packed in a ZIP file. A file pair comprises a file for metadata and a downloadable file. Like the repository of TU Graz, the API was programmed in PHP.

We defined the following for the API import:

- The *Uniform Resource Locator* (URL) is https://openlib.tugraz.at/upload.php.

- The *token* identifies the importing institution and thus gives it the right to upload files.

- A ZIP file is defined as a *package* that contains file pairs (JavaScript Object Notation [JSON] file for the metadata and a file without a file extension, which represents the

described file). A course can be divided into several packages.

- We base the error messages on Simple Web-service Offering Repository Deposit (SWORD) (*AllGood, AuthenticationFailed, BadRequest ContentMalformed, DigestMismatch, ServerError,ValidationFailed*, etc.).

The metadata are displayed as shown in Table 1 for the *course*, the *unit*, and the individual *file*.

The interface for the export of metadata, especially for the Austrian OER portal, has also been deliberately kept simple. The metadata is packed into a JSON file and exported via REST. The metadata has the same structure as the files that are imported. However, the attribute on the left is added. This contains *id*, *course*, and *file*. In addition, it adds the attribute location with TU Graz to *course*. The files themselves remain in the repository and are accessible via a persistent identifier. The upload is then carried out again via REST to the test instance (https://portal.openeducation.at/upload/json/v1/openlib.tugraz.at).

Unfortunately, it was overlooked that the API should also be implemented via a standard. The error codes were thus still adapted to SWORD (Sword, 2019). However, the changeover to SWORD has been put on hold for the time being.

Process modeling: OER certification of instructors

Besides the technical solutions, it is also necessary to create processes for

the teaching staff so they can produce OERs and avoid legal pitfalls. As shown in Figure 8, they offered OER training at TU Graz for this purpose. Lecturers who successfully complete this further training in the scope of one ECTS (equivalent to 25 hours) and create OERs are given the opportunity to activate the plug-in. The training includes classroom training and successful participation in the MOOC on OER, which is available on the platform iMooX. at. For successful participation in the MOOC, it is necessary to take several tests per unit. Certification for OERs is not understood in the sense of quality control relating to the resources but in terms of quality control relating to their creators. Teachers are trained to ensure that they know the legal requirements for dealing with and creating OERs.

We base the OER further education and OER certification on the proposals on OER of the *Forum Neue Medien in der Lehre Austria* (Ebner, Kopp, Freisleben-Teutscher, et al., 2016) and their white paper on OER certification in Austria (Ebner, 2018; Ebner, Freisleben-Teutscher, Gröblinger, et al., 2016).

Implementation and usage

So far, we have implemented the processes and tools at the TU Graz and they are all already in use. After an OER training and OER certification, seven lecturers at TU Graz have activated the plug-in. Some of them had already used it during the previous semester, so that the corresponding files and metadata can be found in the repository of TU Graz and are also already searchable

in the Austrian OER portal. In the first semester, data from four courses were transferred from the LMS to the OER repository of TU Graz. Figure 9 shows a screenshot of course documents that are now available with an open license.

Figure 8. Process Modeling of Qualification and Rights Allocation for the Publication of OER at TU Graz

Figure 9. Screenshot of an Entry for Openly Licensed Course Materials in the OER Repository ("TU GRAZ OPEN Library")
Source: https://openlib.tugraz.at/design-patterns.

The transfer of the metadata of the OER materials from the TU GRAZ OPEN Library is also implemented and executable (see Figure 10).

Next Steps and Recommendations

We have described and presented the steps in our development here in detail to give others the opportunity to develop similar interfaces and to implement similar processes at their institutions. Implementing the plug-in and interfaces has already gone through further adjustments. The OER plugin has been adapted for the version of Moodle in use (3.5). An adaptation to Moodle 3.9 is planned for 2021.

The developed technologies and processes are in productive use; we have implemented the corresponding processes and technologies at TU Graz.

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Figure 10. Screenshot of the Metadata of OER Materials of TU Graz
in the Austrian OER Portal of the University of Vienna

Source: https://portal.openeducation.at/?q=technology%20enhanced%20learning

The plug-in is in use and, as shown, the export of the materials has already been carried out successfully. A far-reaching internal rollout of the OER certification and use of the OER plug-in at TU Graz has not yet started, however. The same applies to the Austrian OER portal of the University of Vienna, whose extensions and the public launch are still pending while it is already in productive mode.

As shown, videos are uploaded and made available on a separate platform (TUbe) at TU Graz. A plug-in for the collection of metadata and interface to the TU GRAZ OPEN Library is one of the next steps. These further developments, including the implementation of an Austria-wide OER certification, will

be continued until 2024 as part of the "Open Education Austria Advanced" project.

Finally, we would like to make the following recommendations to similar OER infrastructure projects:

- Look closely: it surprised us to find that there is an impressive amount of metadata that is more or less implicitly available for educational resources, e.g., for which degree program or in which semester they are used.

- Avoid additional effort: you should keep the additional workload for the creators of OERs as low as possible in the system. You should therefore

concentrate on the most necessary data.

- Think big and develop together: if possible, use and exploit metadata that can be made available by many others.

- Use standards: under no circumstances should we reinvent the world of metadata. Using standards facilitates compatibility. This applies not only to metadata but also to the development of APIs.

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