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# Reflecting Open Practices on Digital Infrastructures: Functionalities and Implications of Knowledge

*Johannes Hiebl, Sylvia Kullmann, Tamara Heck, Marc Rittberger*

**Abstract:** Open practices in education focus on the actions of learners and teachers regarding openness. The sharing and collaborative creation of open educational resources is at the core of such practices. Digital infrastructures do not only provide environments for these kinds of practices but reflect ideas and implications of open practices through the functionalities they offer. Those infrastructures can be seen as drivers for enabling open practices to become default. However, a common understanding of open practices has yet to be defined. As such, designing digital infrastructures that foster open practices might be a challenge. This chapter shows the relation between open practices and digital infrastructures.

## 1 Introduction

Models of open educational practices (OEP) aim at framing concepts for openness in learning and teaching. Earlier concepts of OEP have emphasized the use and creation of open learning and teaching materials, whereas more recently, researchers have investigated the meaning of openness and its diverse interpretations regarding aspects of open pedagogy (Wiley & Hilton, 2018), empowerment, inclusion, and social justice (Koseoglu et al., 2020). However, the term “*practice*” is often used without reflecting its meaning in social science practice theory and its deeper understanding (Bellinger & Mayrberger, 2019). In this chapter, we apply practice theory (Schäfer, 2016; Schatzki, 2002) to frame the concept of OEP and to explore users’ intended socio-material practices as well as the media performativity of digital infrastructures that provide learning and teaching resources. Infrastructures as digital objects influence the knowledge and practices of their users. The article examines what infrastructures do in their digital materiality and how they prefigure

users and their construction practices, it contributes to the current debate on open practices and the design of digital infrastructures in distributed learning ecosystems.

This chapter draws upon infrastructures that enable open practices in learning and teaching. It shows current functionalities of higher education infrastructures that provide learning and teaching resources and discusses their potential to support OEP, which we frame within the practice theory. The research question is: How might OEP be shaped by current functions in digital infrastructures for learning and teaching resources? In the following, we will introduce the concept of OEP and explain practice theory as a theoretical basis in section 2. Section 3 shows the methodological approach of an assessment of infrastructure functions. Results will be discussed based on practice theory and OEP in section 4, before we conclude the chapter.

## 2 Theoretical background

### 2.1 Concepts of open practices in education

OEP deal with learning and teaching practices that embrace *openness*. While the broader concept of open education challenges existing educational systems and their accessibility and participation regarding openness (Bellinger & Mayrberger, 2019), OEP seem to focus on the actions of learners and teachers, primarily the latter group. However, there is still no single concept of OEP (Bellinger & Mayrberger, 2019).

A main aspect of OEP is the open sharing of educational content (Koseoglu et al., 2020), mostly visible in the concept of open educational resources (OER). Diverse definitions exist, and, generally, the idea of OER as “teaching, learning or research materials that are in the public domain or released with intellectual property licences that facilitate the free usage, adaptation and distribution of resources.”<sup>1</sup> OER practices are often described with the 5 Rs (Wiley, 2014). The 5 Rs demand the right for users to retain, reuse, revise, remix, and redistribute open learning materials. They also represent the ideal of an OER lifecycle (Beaven, 2018). To fulfil those requirements, the core of OER are open licences like Creative Commons<sup>2</sup>, granting appropriate rights to users to enable this lifecycle. Creation and usage of OER differ and depend on the material type and educational context. Guidelines like the OER gold standard by Fabri et al. (2020) describe best practices for different types of OER, such as slides, videos, and blogs. The guidelines aim at creating OER with openness in terms of accessible reusing and remixing activities which requires legal and technical prerequisites. However, studies have shown that barriers remain to using and sharing OER and there is a need to raise awareness of OER and knowledge of OER practices (Cardoso et al., 2019). If the sharing of OER takes place publicly, it happens in open repositories (Beaven, 2018; Cardoso et al., 2019). Otherwise, activities of sharing without licence declaration can be observed

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<sup>1</sup> <https://en.unesco.org/themes/building-knowledge-societies/oes>

<sup>2</sup> <https://creativecommons.org/>

in communities of teachers and students (Baas et al., 2019; Beaven, 2018). Beaven (2018) refers to this as “dark reuse”.

Concepts of OEP broaden the idea of OER, as (re)using and sharing learning resources alone does not contribute to openness in education. Koseoglu et al. (2020, p. 153) consider “that a core driver of a wide range of such open(ing) practices has been to improve access, equity, and inclusion, both in and through education.” A more concrete definition of what *open (educational) practices* means seems complex. Cronin (2017, p. 4) draws upon different descriptions in the literature and defines OEP as: “collaborative practices that include the creation, use, and reuse of OER, as well as pedagogical practices employing participatory technologies and social networks for interaction, peer-learning, knowledge creation, and empowerment of learners.”

Baran & AlZoubi (2020) define “open pedagogy practice as a dimension of OEP that includes teaching and learning practices while engaging in renewable assignments.” They report on practices investigated in a study on OEP and student participation. Pedagogical practices observed include peer feedback and community engagement regarding open access knowledge and awareness, as well as student agency, for instance through contribution.

Koseoglu & Bozkurt (2018) emphasize the *practices* in OEP, i.e., the processes in education, as opposed to any outcomes like OER: “[W]e define OEP ideally as a broad range of practices that are informed by open education initiatives and movements and that embody the values and visions of openness” (Koseoglu & Bozkurt, 2018, p. 455). Practices, thus, include open approaches in education, which might be influenced by factors of culture, pedagogy, technology, legal issues, financing, and labour (Hodgkinson-Williams, 2014; Koseoglu & Bozkurt, 2018). This description of OEP covers the concepts for investigating open practices in education as an umbrella term. By emphasizing external factors, it considers OEP as a concept within an environment that needs to be drawn upon to understand OEP and their impact on education. Within practice theory, we stress this deeper relationship of practices and the environment.

## 2.2 Practice theory as a basis for studying OEP

Practice theory incorporates interpretative and structuralist culture theory (Reckwitz, 2002). It draws upon two major questions: (1) Which options for action do actors have within cultural orders? (2) How do cultural orders develop by reproduction and transformation? (Schäfer, 2016, p. 10). Practice theory does not view actions as isolated, but as connected. Practices are collections of actions and sets of rules and resources. The “identity” of a practice depends on its social context and its relation to other practices, including past ones (Schäfer, 2016, p. 11). The core of practice theory focuses on an identification of differences between social practices (Schäfer, 2016, p. 12). Praxeologically, social order is understood as a temporal process for which a course has to be analysed (Schäfer, 2016, p. 13). Practices in their physicality, in their understanding of practice and social situation, and the

competent execution of situationally adequate practices are attributed to an incorporated tacit knowledge (Schäfer, 2016, p. 13). Practice theories emphasize the materiality of the social, in the relevance and usage of artefacts, technologies, spaces, media, and images (Knorr Cetina, 2001; Schäfer, 2016, pp. 13–14). Practice theories acknowledge that there is a continuing generation of practices whose forms are changing historically and locally, and, therefore, the “essence” of individuality and society is changing as well (Schäfer, 2016, pp. 12–13).

If we take OEP as a “broad range of practices that are informed by open education initiatives and movements” (Koseoglu & Bozkurt, 2018, p. 455), practice theory spans three relevant dimensions of entangled socio-material practices that can be investigated, i.e., transformation, reproduction, and action capabilities (compare to Schäfer, 2016).

Regarding open educational practices, transformation considers intended achievements of OEP in terms of their political framing, as is visible in OER definitions and policies. Reproduction considers intended achievements of OEP provided in digital infrastructures that offer OER as a kind of output of practices. Infrastructures do not only provide OER reuse and sharing and other participatory OEP, such as student engagement. They also reflect ideas of OEP and their application in digital environments. Action capabilities consider how epistemic cultures affect the usage of infrastructures to *do* OEP. Action capabilities are affected by transformation and reproduction instances. In this sense, practice theory does not ask for a concrete definition of OEP but focuses on practices that are being shaped within those dimensions. The theory emphasizes that the dimensions are interwoven and may even be interdependent.

According to the literature, the understanding of OEP has evolved and newer sources draw upon aspects similar to the understanding in practice theory. As Koseoglu et al. (2020, p. 153) state, “First of all, such practices [OEP] have historicity. They are situated within socio-economic, cultural, political, and technological contexts, and shaped by worldviews, participants, and available resources (human and non-human)”. The authors further state that those practices “should be better understood as a multidimensional and interdisciplinary construct that encompasses a diverse range of open(ing) practices” (Koseoglu et al., 2020, p. 153). Thus, practice theory and newer approaches to OEP consider practices within the context of other influencing factors. Practice theory stresses the inter-relational dependencies between practices, actors, and contexts: practices are shaped in contexts, and they shape the context itself. Furthermore, Koseoglu et al. (2020) see the conceptual approach of to OEP closely related to a discussion on openness and digitization. Whereas the latter might be concretely described as a technical component in digital services and systems, understandings of openness are multiple and provisional (Koseoglu et al., 2020). An assessment of all inter-relational dependencies and contexts relevant for OEP would go beyond the constraints of this chapter. In the following, we approach OEP through existing digital infrastructures and their functions and how they impact OEP regarding transformation, reproduction, and actions capabilities.

Still, the term ‘practice’ bears one limitation regarding the investigation of OEP in infrastructures. Practices must always be seen as physical, bodily practices because bodies are not extrasocial. Bodies are products and sources of the social and point to subtle differences (Bourdieu) and disciplining orders (Foucault) of the social. Bodies affect the course of practices, take part in practices, and are shaped by practices – they incorporate sociality. Cultivated practices can be questioned by new technologies and business models (Kuhlen, 2012). As such, infrastructures like OER repositories play a central role in supporting OEP. They provide learning and teaching resources and their functions set the potentials and barriers of user behaviour to practice openness in those infrastructures. Infrastructures are part of an ecosystem for learning and teaching that shall enable an unfolding of OEP potentials. To fulfil this goal, functions of infrastructures need to map onto intended open practices. With the rise of OER initiatives and funding opportunities to establish OEP, new digital infrastructures, specifically OER repositories, are being developed with the main goal to provide OER and make them searchable and shareable.

To create OER, various practices are needed, such as generating texts and graphics, creating video and audio material, searching for and combining material, licensing, but also providing information on created OER and their practice. These practices are entangled with their material infrastructure. The social context of OER becomes apparent in the technical framing through infrastructures and in the political framing through policies and guidelines (Hiebl, 2021). In this regard, it must be considered that the observation of OER is always an observation from the perspective of a final product with high demands. Thus, educational resources in their construction practices can only retrospectively be declared as OER. Digital OER are, in several ways, “relationally and ecologically” entangled with infrastructures (Star, 1999) and “intra-actively” entangled with their users (Barad, 2010). As participants order objects such as OER, they are ordered by them, namely, by their different technical and media-related performances and (un-)availability in archives, their edition at virtual workplaces, and their usage in virtual education rooms.

In order to leverage the potentials of digitisation for university education, a distributed learning ecosystem across universities is required that provides digital educational resources for shared use (cf. Kerres & Heinen, 2015). For the university sector, a feasibility study run on behalf of the German Federal Ministry of Education and Research (BMBF) by Deutscher Bildungsserver (2016) showed, regarding the infrastructure of OER, that an increasing amount of digital content exists on learning platforms and that technologies are available to provide this via repositories. A solution is necessary that is based on a networked, federated infrastructure of local repositories (cf. Heinen et al., 2016) and that enables the targeted use of the opportunities of OER. Given their definition as teaching, learning, and research materials, OER already are ubiquitous at universities, in open access servers for publications and research data or in learning management systems. However, this openly accessible material has not been created specifically for educational purposes. To provide educational material, i.e., OER embracing all five user rights (Wiley, 2014), and a pedagogical concept, higher education institutions have started to provide either

new infrastructures (like OER repositories) or new functions within existing infrastructures (like OER search within learning management systems).

To study how using and sharing of OER might be shaped as reproduction of intended achievements of OEP within these digital infrastructures, we investigate higher education services that provide learning and teaching material. In the following, we introduce our sample of OER infrastructures and our set of analytic categories, before we discuss the results regarding potentially shaped practices.

### 2.3 OER-providing digital infrastructures

In general, there are three types of OER-providing services: services that house content primarily on site and follow a centralised model – we refer to them as repositories –, services that provide links to learning objects housed elsewhere – similar to referatories (Heinen et al., 2016) –, and hybrids that provide both. Not all OER-providing digital infrastructures and services are referred to as such explicitly. As said above, OER are often provided via existing infrastructures like learning management systems or open access servers. The latter have often been designed for open access research publications and now also allow storage of OER. The framing of learning objects as OER might complicate a comprehensive understanding of OER infrastructures and their functions. If there is no common understanding, intended users might find it harder to search and find appropriate OER. Findability is a crucial quality criterion for open infrastructure and resources (compare DINI certificate<sup>3</sup> and FAIR principles<sup>4</sup>). The lack of a common understanding makes it harder for users to adopt and embrace further OEP, like creating and reusing OER, or to engage in more collaboration and participation (Baran & AlZoubi, 2020; Heck et al., 2020). In summary, it is hard to gain an overview of the landscape of OER-providing digital infrastructures and services in higher education. To provide an overview and help users identify relevant OER infrastructures, an institutionalized overview by universities and ministries of culture would be desirable.

## 3 Method

### 3.1 Sample of assessed infrastructures

We searched for digital infrastructures from November 2020 until January 2021. The sample we analyse here is a sub-sample we searched for and created in a university course. To identify services that provide OER, websites of 118 state-operated, German-language universities in Germany, Austria, and Switzerland<sup>5</sup> were

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<sup>3</sup> <https://doi.org/10.18452/21759>

<sup>4</sup> <https://doi.org/10.1038/sdata.2016.18>

<sup>5</sup> The list of universities compiled on:

[https://de.wikipedia.org/wiki/Liste\\_der\\_Hochschulen\\_in\\_Deutschland](https://de.wikipedia.org/wiki/Liste_der_Hochschulen_in_Deutschland);  
[https://de.wikipedia.org/wiki/Liste\\_der\\_Universit%C3%A4ten\\_in\\_%C3%96sterreich](https://de.wikipedia.org/wiki/Liste_der_Universit%C3%A4ten_in_%C3%96sterreich);  
[https://de.wikipedia.org/wiki/Liste\\_der\\_Hochschulen\\_in\\_der\\_Schweiz](https://de.wikipedia.org/wiki/Liste_der_Hochschulen_in_der_Schweiz)

searched with the German terms for “open educational resources”, “OER”, “repository”, “learning material”, and “teaching material”, using the websites’ search slots. From each search, we chose the first ten results that led to a page containing learning, teaching, or research material. Eventually, we retrieved 164 potentially relevant links that led to learning, teaching, and research material. The links were first sorted into four groups, and the two most relevant groups A and B were considered for analysis (Fig. 1).



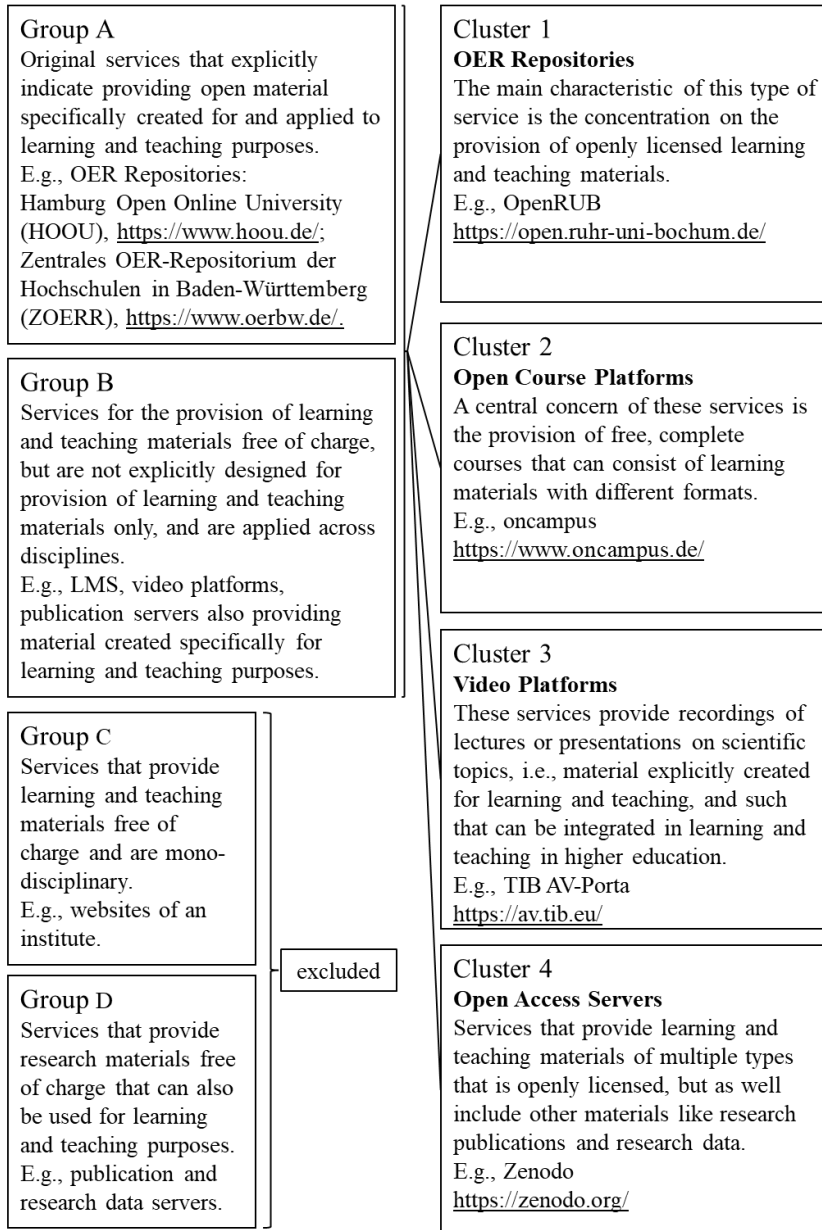


Figure 1: population clustering.

### 3.2 Limitations

Our list of 164 links is, obviously, not exhaustive. We only searched on websites of state-operated universities in three countries, universities of applied sciences, and private as well as confessional universities were excluded. The selected search terms were intended to cover very general searches lay users might perform. We did not run a discipline-specific search, which would possibly have led to more results. We deliberately excluded all search results that came after the first ten to keep the amount of data reasonably manageable. Moreover, it is unclear to what extent the used type of browser and the search engine of the respective university websites influenced the search results. Regardless of these limitations, we consider the identified results adequate for identifying relevant OER infrastructures as we found a sufficient number of repositories of OER and services called differently but providing accessible educational resources, i.e., our list is not limited to services explicitly labelled OER repositories.

### 3.3 Development of assessed categories

We examined the functions via document analysis (Flick, 2018) by means of qualitative content analysis (Mayring, 2014). We developed deductive categories on the basis of the existing research about OER repositories (Sampson et al., 2013; Santos-Hermosa et al., 2017; Zervas et al., 2014), i.e., 15 categories for general description of the services and 32 categories and 67 sub-categories for description of the functions. During the analysis, we included further inductive categories that describe relevant functions. This led ultimately to 19 categories for general description, and 46 categories and 184 sub-categories for description of the functions. In the following, we focus on the 46 categories, which we merged into 16 categories and, in turn, assigned to the four core functions relevant for OEP. Each of these 16 categories asks if the underlying function enables socio-material practices.<sup>6</sup>

## 4. Results and discussion

Our analysis and results section consists of two parts. First, we group the retrieved infrastructures (164 links) into four groups showing different types of digital infrastructures (section 4.1). We then analyse the functions of infrastructures belonging to the two most relevant groups more in-depth (section 4.2). The impact of those functions on OEP is discussed in section 4.3.

### 4.1 Types of digital infrastructures

By grouping the infrastructures (Fig. 1), we aim to distinguish two major differences that we see as relevant for intended users regarding OEP: the purpose of the service

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<sup>6</sup> The full list of services and categories is available at OSF:  
[https://osf.io/btdcw/?view\\_only=cb236ff464244230be9cb14eb9702602](https://osf.io/btdcw/?view_only=cb236ff464244230be9cb14eb9702602)

and the provision of material. Group A services, designed to provide OER and explicitly stating their purpose, e.g., through their names, allow users to identify the purpose of the service and provided resources. Furthermore, services designed explicitly for OER allow easy implementation of functions necessary to make OEP visible (Heck et al., 2020). Group B services provide learning and teaching materials like OER, but also other material that is accessible free of charge. The services' functions might be suitable for OEP, but they do not focus on these purposes. For example, open access servers focus on searching and finding material and not on any collaborative aspects of OEP like editing and remixing OER. Learning management systems might have a higher potential regarding their functions. Still, our analysis shows (see 4.2) that current services from category A often lack relevant functions necessary to foster the concept of OEP.

In the analysis, we concentrated on the nine services allocated to group A and the 28 services in group B to focus on infrastructures that offer materials created solely for teaching purposes and on multidisciplinary services that might enable participation beyond disciplinary and institutional boundaries. Services in group C did not offer multidisciplinary materials and were excluded for analysis. In services in group D, we did not find any labelled educational material.

#### **4.2 Functions of OER infrastructures**

We grouped the 37 infrastructures from groups A and B in four main clusters considering the provided content. Cluster 1: Five infrastructures are explicit original OER services. The main characteristic of these services is the focus on the provision of OER. Cluster 2: Nine services are open course platforms. These services focus on the provision of free, complete courses that consist of learning material with different formats. Cluster 3: Seven services are video platforms that contain only audio-visual material. These services provide recordings of lectures or presentations on scientific topics, i.e., material explicitly created for learning and teaching, and such that can be used for learning and teaching. Cluster 4: Sixteen of the services are classified as open access servers that provide learning and teaching materials of multiple types that are openly licensed, but also include other material, such as research publications and research data. Table 1<sup>7</sup> shows a summarised version of 16 (merged) categories relevant for OEP, i.e., functional items that allow and might shape social practices related to OEP, and their occurrence in the 37 infrastructures. The categories are aligned to four core functions explained next.

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<sup>7</sup> Full code table online:

[https://osf.io/btdcw/?view\\_only=cb236ff464244230be9cb14eb9702602](https://osf.io/btdcw/?view_only=cb236ff464244230be9cb14eb9702602)

Table 1. OER practice enabling categories.

core function	(merged) category	code	cluster			
			1 n=5	2 n=9	3 n=7	4 n=16
search	advanced search	sf01bi	5	7	7	15
search	save search query	sf07bi	2	0	1	2
search	sorting of results and result page look	rb03sf0506 bi	3	2	5	14
organise	save watch lists/collections/search result	rb0102sf08	2	5	2	4
organise	search function and folders for own material	uf0412	2	0	2	2
organise	view metadata/material details	md05	5	1	7	16
organise	download metadata/citation	md0607	1	0	2	9
help (manual function)	manual/help	um010203 040609	5	5	5	14
delivery	add new (and supplementary) material	up010809	4	3	3	11
delivery	add metadata	up0305	4	2	5	13
delivery	default licences	up04	3	1	3	12
delivery	automatic reminder and restrictions	um05up06	0		0	2
Other functionalities	social interactions	rb04uf0910	3	9	5	11
Other functionalities	recommendations	qa01	1	1	5	0
Other functionalities	quantifying	qa02sf0304	4	5	7	16
Other functionalities	editing options	uf03bi	0	2	1	2

### 4.3 Impact on practices

Atenas & Havemann (2014) suggest the key themes search, share, reuse, and collaborate as leading concepts in the development of services for learning resources. Our analysis shows that the services mainly cover four core functions: 1) search, 2) organise, 3) help (manual function), and 4) delivery. Functions fostering collaboration, such as social tagging, commenting, and user communities play a minor role. Next, we discuss these functions on the OEP concept in relation to performed socio-material practices.

#### 4.3.1 Search

The search function enables reproduction of findable and accessible learning and teaching materials by bodily search practices, interwoven with the user interface. Figure 2 shows the search environment of the TIB AV-Portal for scientific videos as an example. The core function “*search*” enables socio-material practice within a web application most obviously. Searching, or rather the service of finding, is performed in interaction with the users as the searchers. Searching practices can be allocated to two levels. On the first level of searching, a user applies a practice of performing the search for learning material; on the second level, a user acquires the actual resource. In our material, we discovered three search categories. First, the category of *advanced search* describes whether the search function of the web application offers two or more fields for a search query, additional metadata fields to be searched in, and filters to refine the search. Second, the category *save search query* examines if users can save their search queries within the web application. Saved search queries offer a form of memory function. This can reproduce search

The image shows a screenshot of the TIB AV-Portal search interface. The browser address bar contains 'manual/help (um010203040609)'. The search bar has the text 'Search for people, places, topics...'. Below the search bar, there are several annotations in boxes with arrows pointing to specific parts of the interface:

- recommendations (qa01)**: Points to the 'SUBJECTS PUBLISHER RECOMMENDATIONS OPEN DATA FAQ' navigation bar.
- quantifying (qa02sf0304)**: Points to the search results count '1-36 out of 34444 results'.
- add new (and supplementary) material (up010809)**: Points to the 'Add new (and supplementary) material' button.
- sorting of results and result page look (rb03sf0506bi)**: Points to the 'Sort by: Relevance Title Publication Year' dropdown menu.
- view metadata/material details (md05)**: Points to the 'View metadata/material details' button.
- social interactions (rb04uf0910)**: Points to the 'Social interactions' button.
- advanced search (sf01bi)**: Points to the 'Advanced search' section on the left sidebar.

The search results page displays a list of video thumbnails and titles, such as 'Supplemental videos of the paper "High-resolution inventory to capture glacier disintegration in the Austrian Silvretta"', 'How to share MariaDB like a Pro?', 'RETURNING clause ... Have your cake and eat it too!', and 'On binary quartic: Three equations and related topics'.

Figure 2: search environment of TIB AV-Portal.

practices without necessarily memorising used search terms or filters. Third, the category of *sorting of results and result page design* describes options for sorting and listing search results and granular material, for example, by alphabetical order of titles, relevance, date of last change, date of generation, institutional origin, author, publisher, and so on. Also, users' switching between result page designs, e.g., from tiles to lists, is considered to have an impact on sorting practices. Sorting practices can influence the selection of material in terms of displaying material on top of a list or by giving detailed (metadata) information about the material via lists and tiles.

#### 4.3.2 Organise

The organise function enables users to practice cultures of collaboration and sorting materials, which can be understood as epistemic cultures. The core function “*organise*” mostly focuses on practices of arranging learning and teaching materials within the web application. For example, for subsequently saving and storing a resource, organisation practices such as creations of lists, user collections, or saving the search query become relevant. In our empirical material, we discovered four categories of organizing. First, the category *save watch lists/collections/search results* examines the options to add material to watch lists or to create collections from material (uploads or references) by users, either in private lists/collections or in shared lists/collections. These are practices of sorting and listing to organise material and to make it obtainable for prospective use. Second, the category *search function and folders for one's own material* describes whether the web application offers a folder view (and creation) to manage user-created material. Additionally, we looked for an internal search function for each user's own material. The creation of folders is a sorting practice in its own right. The users prepare their folders with a specific idea of what they would like to sort with specific categories and attributes. Third, the category *view metadata/material details* examines whether users can see (educational) metadata of single resources. Users' understanding of educational metadata influences the selection practices for resources. This practice can also be seen as part of the search practices. The category “*download metadata/citation*” describes the ability to download and store metadata (e.g., XML) and/or citation data (e.g., BIBTEX, RIS, TEXT). In contrast to our other categories, this category does not focus on functions within the web application. Nevertheless, we consider citation of OER an underestimated factor of OER reuse. Availability of information about correct citation in a familiar format could facilitate OER citation practices and OER use and influence the selection of material. This leads us to our next core function, the help (manual) function.

### 4.3.3 Help

The core function *help (manual function)* is researched through the category *manual/help*. It is part of manual and help pages and “how to”-descriptions for the service itself, its technical features, and legal conditions, but also regarding explaining OER and licence types, OER authoring, and editing options. The help function supports practices of self-information and self-socialisation for becoming a competent user of the service. Users need to be educated to become competent users, which is made possible by help functions such as information pages that describe how to use the online service. In this regard, questions about copyright issues need to be answered, too. Legal questions play a crucial part in providing and enabling the release of open-licence learning and teaching materials. Moreover, manuals describe how to release OER. This can either be done by the user or by editorial assistance of the service.

### 4.3.4 Delivery

The delivery function prefigures user practices performatively, e.g., via determined licence models. Transformation of practices and the political framing of OER are implemented in OER infrastructures. The core function *delivery* mostly concerns uploading of material. Of course, there are other publication practices via libraries or editing boards, which we do not mention because we focus on user interaction within the web applications. In the delivery function, the social context of OER becomes apparent in the technical framing through infrastructures and in the political framing through policies and guidelines. In our empirical material, we discovered four categories of delivery. First, the category *add new (and supplementary) material* describes if users can directly add new or supplementary material to the service via upload or reference. Only through practices of delivery via uploading or referencing material, the concept of OER is fully as sharing is as essential as (re)using OER. Uploading is a practice full of prerequisites. A competent user needs to understand the idea of OER and open licences. Users need to know how to attribute and reference material. This can be achieved by the help (manual function). Uploading is also predetermined by the web application itself and its interface. Figure 3 and 4 show the upload environment of the TIB AV-Portal for scientific videos as an example. Second, the category *add metadata* examines if users can describe material via metadata and (prescribed) terms. These metadata fields could be (co-)authors, (sub-)titles, formats (e.g., pdf, docx, txt), access rights/licence, size, class of material (learning, teaching, research), semester, granularity (e.g., worksheet, single lesson, course, textbook), competencies, and so on. The terms could be uniquely identified or entered as free-format text. The category examines uploading options of metadata when adding new material and editing options of metadata for existing material. Describing practices are deeply interwoven with the material itself but must be considered as practices in their own right. They gain value through

their necessity for the search function. The use of metadata standards by infrastructures plays a major role here (Vagliano et al., 2020). Third, the category “*default licences*” examines the provided licence models (e.g., CC 0, CC BY, CC BY-SA) that can be specified via the upload function. It is related to, but more restrictive than naming licences (freely) by metadata. This prefigures possible practices of choice. Fourth, the merged category *automatic reminder and restrictions* describes technical reminders (e.g., pop-ups) when uploading or downloading material to correctly use OER material in terms of reuse and reference material. It also asks whether the web application enforces uploading material in open formats. Remixing and revising OER is easier when the resource is shared in an open format, and standards recommend this (Fabri et al., 2020). This, again, would require teachers to change tools and practices, which they might see as an obstacle as the way they are currently creating slides is working very well for them (Heller et al., 2020). Infrastructures showing OER formats or offering filters to searchers allow easy assessment of practically revised or remixed resources. However, in our analysis, none of the web applications had implemented measures to support the usage of open formats.

The screenshot displays the 'Optional information' step (3) of a five-step upload process. The steps are: 1. General information, 2. Description of the video, 3. Optional information, 4. Legal information, and 5. Upload. The form includes the following fields and options:

- Contributors:** Surname, first name (input field) and Specify name ID (optional) (checkbox).
- Producer:** Surname, first name (input field) and Specify name ID (optional) (checkbox).
- Place of production:** e.g. Hanover (input field).
- Year(s) of production:** e.g. 2018 or 2010-2011 (input field).
- Genre:** A dropdown menu.
- Keywords:** One keyword per new line (input field) with a plus sign (+) button.
- Abstract:** A large text area.
- Special features of the video:** Here you can specify technical features in the video. (input field).

At the top, a search bar contains the text 'add new (and supplementary) material (up010809)'. At the bottom, there are three buttons: 'Back', 'add metadata (up0305)', and 'Next'.

Figure 3: upload environment in the TIB AV-Portal (metadata).



Search for people, places, topics ...

General information Description of the video Optional information Legal information Upload

### Legal information

Which **license form** should be used for the provided video material and additional materials?\*

CC BY 3.0 DE (our recommendation) ← default licences (up04)

You chose:

**CC-Attribution – Germany 3.0**  
(CC BY 3.0 DE)

A summary and legally binding version of the license text can be found [here](#). ↗ ← manual/help (um010203040609)

Copyright holder\*

One name per line

Surname, first name

\* Licensor declares that it has all necessary rights and authority to allow TIB the use of the Materials, Preview Files and Metadata pursuant to the terms and conditions set forth in this Agreement and that this Agreement does not infringe the copyright of any third party. Licensor shall indemnify TIB against any charges, costs or damages brought forth by third parties against TIB claiming that the use of the Materials in accordance with this Agreement constitutes an infringement of copyright. The parties will cooperate closely to prevent any claims by third parties.

\* TIB may extract the Licensor's logo from the website of the Licensor, adapt it in size if necessary for TIB's portals and use it to label the non-textual materials of the Licensor within TIB's portals.

\* For the use of the Metadata and Preview Files the conditions of the Creative Commons License CC0 1.0 Universal (CC0 1.0) Public Domain Dedication shall apply.  
[Click here to view summary and legally binding version of the license.](#)

\* The Licensor confirms that the material does not contain music, for which, if used as described above, the rights must be licensed separately by a collecting society or other institution.

Back Next

Figure 4: upload environment in the TIB AV-Portal (help and licences).

#### 4.3.4 Other functionalities

Other functionalities that enable and influence practices are the interaction and information function and the editing section. Interaction and information is about social interactions, quantifying, and recommendations, as well as *editing options* as a functionality of its own.

The merged category *social interactions* examines if users are able to interact with each other within the web application: via a forum, wiki, blogs, via chat/messenger, via establishing groups/networks within the service, via rating/commenting on individual material, or via social tagging (e.g., user X can see user Y's material and keywords saved in user Y's user environment). It also examines whether users can share material with other users within the service (privately or in public) and interactions via newsletter and via RSS feed. The category describes options (on the search and/or results page) for sending resource requests, suggestions, and problems to a team of editors and for sending requests, feedback, and problems with the web application to service staff. These interaction practices are closely related to collaborative practices of learning and teaching, community building, social visibility, and

technical service. However, we must bear in mind that these practices can be enabled within a web application, but many of them can also be done outside the service and be part of everyday communication practices.

The category “*recommendations*” describes whether the web application gives recommendations (recommender system) for material, either based on user profiles or by editorial staff. Recommendations can influence the selection of material by making material visible users would not consider selecting by themselves.

The category *quantifying* examines if the web application gives any kind of metrics or statistics (e.g., number of users that opened a single object, number of downloads of a single object, number of citations of a single object, number of participants). It also examines if the user obtains information on the number of search results by display or the number of search results per filter and/or sub-category. Quantifying in terms of metrics or statistics can influence the selection practices of material. Quantified information about the number of users, number of downloads, number of search results, and so on can also be considered a kind of recommendation.

The category *editing options* asks whether the service has an editor (text, graphic, audio, video) on the web page to edit material directly and save changes. This is a core function of constructing learning and teaching materials. However, it is usually not available in web applications for finding and storing learning and teaching materials. It is a function of highly specialized software. Users mostly have to be trained to use this software properly. Nevertheless, for OER and their implied promises, editing options could enable many practices within the web applications and foster collaborative working, using open licences and open formats.

The analysis of the infrastructure functions does not show a clear tendency towards certain functions in any of the four clusters (explicit OER, video, course, mixed). Relevant search functions are provided by almost all services. The availability of further functions varies in our analysed infrastructures. A positive development is that many universities offer their own digital infrastructures to share learning material. Affiliated users can decide for a local service that is connected to other institutional digital services. However, so far, these infrastructures are not connected within a common learning ecosystem. One reason might be a high level of independence and autonomy of higher education institutions (see chapter Otto and Kerres); another the long-standing systems that were not designed to be part of a distributed learning ecosystem.

Moreover, as our analysis shows, the diversity of such infrastructures regarding functionality and accessibility might be a barrier to a broad adaptation of the services and approaching OEP, especially in higher education, where researchers and educators often change their affiliation. Distributed, non-connected infrastructures hinder more effective communication and collaboration on OEP within related disciplines and beyond institutions in higher education, a benefit researchers might aim for (Kullmann et al., 2021). We can see that higher education has started establishing digital infrastructures to foster sharing and finding OER, but core functions for

OEP are missing and infrastructures are not connected within a distributed learning ecosystem.

## 5 Conclusion

Considering practice theory, we aimed to frame OEP regarding capabilities of socio-material practices in current OER infrastructures in higher education. We explored how OEP can be shaped by current functions in digital infrastructures for learning and teaching resources. Transformation and the political framing of OER are implemented in OER infrastructures. In a performative way, infrastructures prefigure user practices especially through the delivery function, where specific licence models are determined. The political framing and the idea of openness are inscribed in the delivery function. The search function is part of reproduction via infrastructures. Bodily search practices are interwoven with the user interface and the findable and accessible learning and teaching materials. Action capabilities are affected by transformation and reproduction instances. Cultures of collaboration and cultures of sorting material can be understood as epistemic cultures. The organise function allows users to practice cultures of collaboration and sorting material. The help function enables using the other functionalities by self-information and self-socialisation to become a competent user of the service.

Our research shows that current infrastructures can be a basis for OEP, however, services and functions are diverse and infrastructures are still not connected. An open distributed learning ecosystem for higher education in Germany has still to be established, although there are promising projects like ZOERR and OERspäti that contribute to a growing ecosystem. Besides this framing and relevant discussions on OER infrastructure developments, research needs to investigate open educational practices in learning and teaching contexts and their impact on and benefits for teachers (Albion et al., 2017) and students (Baran & AlZoubi, 2020; Wiley & Hilton, 2018).

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