Online Infrastructures for Open Educational Resources

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Abstract

Open educational resources (OER) have generated a considerable amount of attention in recent years in the field of open, distance, and digital education (ODDE). Digital knowledge infrastructures of different kinds have enabled the creation, storage, management, sharing, and adoption of these resources across educational sectors, levels, and geographies. This chapter presents a general overview of these infrastructures, the underpinning models of OER provision, main characteristics, and key insights from research. It draws on the literature and discusses examples purposively selected to illustrate the diversity of scope,

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O. Zawacki-Richter, I. Jung (eds.), *Handbook of Open, Distance and Digital Education*,
https://doi.org/10.1007/978-981-19-0351-9_18-1

educational stages, and types of online OER infrastructures established on a global, national, regional, or institutional scale. Key challenges are also discussed, including licensing issues, concerns about quality assurance, metadata problems, the sustainability of the initiatives, and sociocultural aspects, among others. In addition to revisiting the conception and adoption of OER in different cultures, important topics to be further addressed by future ODDE research are presented.

Keywords

Open educational resources (OER) · Online infrastructures · Repositories · Massive open online courses (MOOC) · Wikis · Open textbooks · OpenCourseWare (OCW)

Introduction

The term OER was first proposed in 2002, at a UNESCO forum. While other concepts (e.g., "open content") had already tried to bring to education the principles underpinning the free software and open source movements (Wiley and Gurrell 2009), the new term helped galvanize a global community into action. Over the last two decades, a wide range of actors – including policymakers, institutional leaders, educators, students, philanthropists, and governments – have engaged in the promotion of (open) educational practices that involve the creation and release of learning resources as OER.

In 2019, UNESCO's General Conference adopted the Recommendation on Open Educational Resources, according to which OER are "learning, teaching and research materials in any format and medium that reside in the public domain or are under copyright that have been released under an open license, that permit no-cost access, re-use, re-purpose, adaptation and redistribution by others" (UNESCO 2019).

The definition, agreed after a consultation with diverse stakeholders, is compatible with licenses that prevent certain kinds of reuse (e.g., commercial), a stance contrary to certain views within the OER community advocating to avoid restrictive conditions for reuse.

This chapter focuses on digital knowledge infrastructures devoted to the creation, storage, management, and sharing of OER across diverse educational levels and geographies. While the word "infrastructure" is often associated just with technology, we adopt a broader socio-technical perspective and therefore approach knowledge infrastructures as ecologies or complex adaptive systems that "consist of numerous systems, each with unique origins and goals, which are made to interoperate by means of standards, socket layers, social practices, norms, and individual behaviors that smooth out the connections among them" (Edwards et al. 2013, p. 5). OER and MOOCs are examples of such knowledge infrastructures and are key to understanding the work of the digital in the enactments of open education

(Edwards 2015). In particular, we use the term "OER infrastructures" to talk about knowledge infrastructures articulated around the goal of providing access to educational resources that are either in the public domain or available under an open license.

The chapter reviews several OER initiatives with the aim of illustrating relevant types of experiences with different scopes and ambitions rather than offering an exhaustive catalogue. Educational levels are represented with acronyms, except from pre-K12, K-12, and schools: higher education (HE), continuing education (CE), lifelong learning (LL), and vocational education (VE).

Typology of Online OER Infrastructures

The idea that sharing educational content as freely and openly as possible on the World Wide Web may democratize learning opportunities is one of the key principles underpinning much of the discourse and practice on technology-mediated education, although its limitations have been increasingly recognized in the literature (Bayne et al. 2015) and the focus has increasingly shifted from the content to how communities engage with it.

The redefinition of open education through the rise of OER and the emergence of other open educational practices (OEP) cannot be understood without the Web as the basis for a global knowledge infrastructure, where technology and social dynamics have coevolved to form complex information ecologies.

Figure 1 shows various types of digital knowledge infrastructures, some of which are regarded as OER infrastructures. It is worth noting that it includes two types of infrastructures that may, or may not, operate as OER infrastructures. In the case of MOOCs, while they are key to understanding current trends in OEP, many of these courses are content-based that cannot be regarded as OER. In this regard, educators involved in the creation of MOOCs often do not intend to create OER or perceive it as important (Hodgkinson-Williams and Arinto 2017), despite being concerned with other aspects of OEP. In the case of open-access repositories, they are represented as entities that can work as OER infrastructures, especially when they contain collections specifically dedicated to providing access to educational resources. Even though UNESCO's definition of OER explicitly includes "research materials," in this chapter we primarily focus on initiatives devoted to sharing resources that have been specifically created for pedagogical purposes.

Therefore, this section provides an overview of different models – not necessarily associated with specific technologies – for the creation and sharing of OER, drawing on major theoretical and empirical insights from research, historical trajectory, and controversies on the topic.

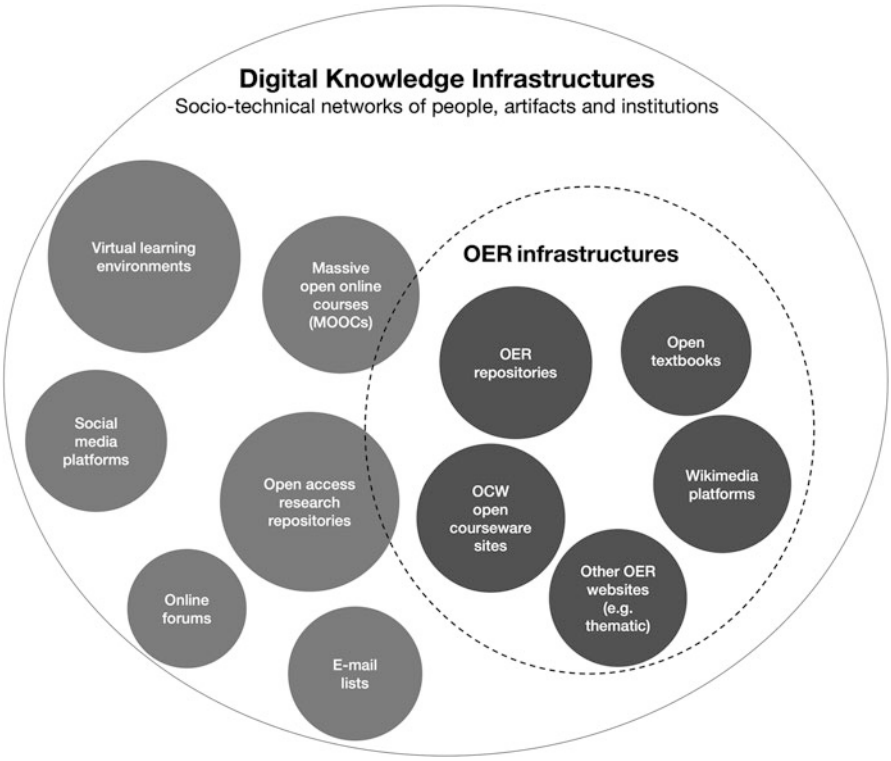

Fig. 1 Relations between digital knowledge infrastructures and OER infrastructures

OER Repositories

An online repository is a special type of website created to store large collections of artifacts in a highly structured way, thanks to the use of detailed metadata. DSpace is, for example, a widely used software package chosen by HE institutions from all over the world to run their repositories. While they are most often dedicated to storing research publications, they might also include collections of teaching and learning resources, and there are also repositories entirely focused on educational content and, more specifically, OER.

The history of OER repositories (ROER) dates back to the first steps of learning objects in 2000 in the context of distance education and were hence called learning object repositories: central databases containing a broad range of individual learning objects. Repositories are the most widespread type of OER infrastructure, providing permanent access and enhancing visibility while enabling the search and retrieval via metadata, which are key elements to represent and organize OER (Mouriño-García et al. 2018).

ROER can be classified depending on the type of content they store (McGreal 2008): (a) online collections of archived content, (b) portals that mainly store links

and metadata to materials from others (i.e., referatories), and (c) repositories that combine the role as a content provider and portal. Another type of classification is based on the nature of the content or the provider (Clements et al. 2015): (a) thematic repositories that include resources from a certain topic, (b) national repositories that relate to nationwide portals that include contents for all topics, and (c) federated repositories (aggregators) that harvest metadata from other repositories.

There are some review studies on OER repositories but focused almost exclusively on HE. For instance, the review by Santos-Hermosa et al. (2017) of 110 ROER in HE found out that more than 75% were institutional repositories (the rest were national repositories), and most of the ROER examined have been created in Europe (over 70%) and North America (over 15%). Also, findings from three HE qualitative studies described in a systematic review (Rodes-Paragarino et al. 2016) highlight (a) that the implementation of local repositories increases the use and reuse of OER; (b) the importance of considering technological, cultural, and pedagogical aspects when integrating ROER in an institution; and (c) the preference for a subject-based repository.

OpenCourseWare

OpenCourseWare (OCW) is a model for the provision of OER that was originally conceived, and first implemented, at the Massachusetts Institute of Technology (MIT) as the result of a "study aimed at defining and evaluating MIT's options in the changing educational environment of the Internet" (Abelson 2008, p. 165). In the Spring of 2001, MIT launched OCW as a way of offering access to high-quality learning resources and ultimately pursuing the idea of education as an universal right (Caswell et al. 2008). Following a highly structured approach and with generous media production support, it involved the creation of a comprehensive collection of high-quality educational resources by MIT academics (Abelson et al. 2021). The use of an open license (CC-BY-NC-SA) enables not only learners all over the world to take advantage of those resources as the basis for self-regulated learning but also educators and curriculum developers to reuse and adapt to their own contexts and communities. The OCW model focuses on the provision of content for self-directed learning and self-assessment resources, but it does not offer any opportunities for interaction with either educators or other learners.

While it was predated by other initiatives with similar goals, OCW managed to build a critical mass of attention around this type of OEP, leading to the coinage of the term OER and resulting in a considerable number of university leaders all over the world becoming interested in replicating the model (Carson and Forward 2010).

MOOCs

Massive open online courses (MOOCs) are online, open-access, and free courses that allow the enrolment of an unlimited number of students. While they are often

considered under the umbrella of OER, this has been questioned (Stracke et al. 2019) as relatively few of them are fully free or carry an open license.

MOOCs were preceded by both open online courses and the OER movement but started as such with the open online course "Connectivism and Connective Knowledge" (CCK08) organized by George Siemens and Stephen Downes (Canada) in 2008. This first MOOC focused on network formation, defining the connectivist approach (cMOOC), whereas in 2011 the content-focused MOOC emerged (xMOOCs), as proposed by Norvig and Thrun (USA) (Stracke et al. 2019).

MOOCs have attracted broad attention in research in open, distance, and digital education in the last years. Some of the most salient topics are quality assurance, which is also shared by ROER, their instructional design or pedagogical model, and learning analytics (Rasheed et al. 2019; Zawacki-Richter et al. 2018).

Open Textbooks

Open textbooks can be regarded as a specific type of OER. They have gained ground in certain contexts where the price of textbooks is particularly high, such as the USA or Canada, operating as an important barrier to access to education. Indeed, there are cases of HE institutions offering zero-textbook-cost degrees, for example, in California, where all required readings are available as open textbooks or other types of OER. This has also generated particular interest in Australia.

Wikimedia Platforms

Wikipedia is not only the biggest and most popular OER of all times, consistently ranked among the most visited websites worldwide, but also one of the most successful examples of commons-based peer-production (Benkler 2006). Wikimedia, the US-based nonprofit organization behind Wikipedia, maintains a wider range of OER infrastructures, including Wikidata, Wikimedia Commons, Wikivoyage, and Wikibooks. All of them are wikis, a type of website that users can edit directly on their web browser, enabling them to quickly revise content and add hyperlinks. Wikimedia also maintains MediaWiki, the open-source content management system underpinning all these platforms, as well as other wiki-based OER initiatives, such as the WikiEducator community [https://wikieducator.org/].

Global, Cross-Border, National, and Regional Infrastructures

OER infrastructures tend to be hosted at an institutional level, taking, for instance, the form of repositories, OCW sites, or open textbook collections. However, there are also joint initiatives in which several institutions and organizations within the same countries or internationally come together to launch an OER infrastructure. In some cases, initiatives that started locally reached a global scope eventually.

In this section, a non-exhaustive list of OER infrastructures has been purposely selected to illustrate the OER scene across the globe, including examples of both live and discontinued initiatives at different educational levels in the six continents. The emphasis is made on global, national, and regional infrastructures, although in some cases institutional or thematic infrastructures are also highlighted.

Global Actors and Infrastructures

Intergovernmental entities such as UNESCO, the European Union, or the Commonwealth of Learning have played an important role in promoting OER, though instead of establishing their own OER infrastructures they have tended to support other organizations in doing so. Likewise, private organizations like the Hewlett Foundation have funded OER initiatives of different kinds globally, such as the OER World Map [https://oerworldmap.org/] or the Global OER Graduate Network [http://go-gn.net/].

The OER infrastructures discussed in this section are the result of international collaborations that involve partner institutions across the globe (i.e., in two or more continents).

OER Repositories

One of the most global, well-known ROER is the Multimedia Educational Resource for Learning and Online Teaching (**MERLOT)** [https://merlot.org/], which was developed by the California State University (US) in 1997 as the university's open library of free learning resources, derived from a 1994 nationally funded project (Hanley 2015). Nowadays, the MERLOT consortium is a global initiative constituted by over 40 HE systems, individual institutions of HE, consortia, professional academic organizations, digital libraries, education industries, and over 125,000 individuals (also beyond the USA) and forms a case study of sustainability for OER projects (with a high presence of HE OER), moving from an institutional initiative to a community-sustained project (Okewole and Knokh 2016).

OER Commons [https://www.oercommons.org/] is a digital public library and collaboration platform launched by the global nonprofit US-based Institute for the Study of Knowledge Management in Education in 2007, supported in part by the William and Flora Hewlett Foundation, as part of the foundation's worldwide OER initiative. It counts with contributors from all over the world, covering all education levels.

OpenCourseWare

Due to the large number of organizations seeking advice from MIT on how to establish their own OCW initiatives, the OCW Consortium was launched in 2006 with the aim of facilitating and promoting the adoption of the OCW model. In addition, several regional associate consortiums were established with the aim of promoting the OCW model within specific geographies, for example, the Universia-OCW Consortium in the Iberoamerican region (Latin American countries, Portugal,

and Spain) and the Japan OCW Consortium, the Korea OCW Consortium, the Taiwan OpenCourseWare Consortium, or the Turkish OpenCourseWare Consortium.

After a few years, the OCW model proved to be difficult to sustain for many institutions, and its popularity declined, reflected on the rebranding of the OCW Consortium as the Open Education Consortium. Likewise, the associate consortiums either disappeared or rebranded themselves to address open education more generally too.

OCW initiatives do not rely on a centralized OER infrastructure or even use the same technologies. However, some OER infrastructures attempted to make it easier to find content across OCW sites around the world or within regions (e.g., Serendipity [http://serendipity.utpl.edu.ec], an OCW search engine). Likewise, associated consortiums like OCW-Universia implemented their own platforms to aggregate resources published by their members on their respective OCW sites.

MOOCs

Most MOOC platforms follow the xMOOC model, focus on HE and CE, and were established in the USA but soon started to offer courses provided by educational institutions across the world.

Coursera [https://www.coursera.org/] was created by professors at Stanford University (USA) in 2012, as an independent for-profit technology, and currently has over 200 HE institutions and companies as partners all over the world. MIT and Harvard launched the MOOC platform **edX** [https://www.edx.org] for HE in 2012, through the incorporation of their MITx platform (USA). In 2013, the platform was released as open-source software.

Also in the English-speaking realm, **FutureLearn** [https://www.futurelearn.com/] was launched by the UK's Open University in 2013 with a clear focus on British universities, but nowadays includes partner institutions around the world. Apart from CE courses, several universities also offer full degrees, both undergraduate and postgraduate, on this platform. A distinctive feature of FutureLearn is that all courses are based on a social learning approach, designed according to the principles of visible learning – as inspired by the work of John Hattie – and a community support model that comes from Diana Laurillard's conversational framework.

Established in Spain in 2013 as a joint initiative between Telefonica Educación Digital and Universia, **MiriadaX** [https://miriadax.net/] is the first Iberoamerican MOOC platform. Now it has over 100 educational partners from Latin America, Portugal, and Spain.

The **OERu** [https://oeru.org/] – coordinated by the OER Foundation from New Zealand and with partners in Africa, Asia, Europe, Middle East, North America, and Oceania – is an independent and not-for-profit network of universities, which provide online courses that can be taken either for self-directed interest (for free) or as learning for credit (on a fee-for-service basis).

Building on MOOC platforms, and other free online courses from around the Web, the **P2P University** [https://www.p2pu.org/] provides an OER infrastructure that does not focus on the delivery of content, but enables learners based in the same cities, all over the world, to form learning communities and take together, as a kind

of local cohort, the online free courses offered by third-party platforms (many of them MOOC platforms). Based on peer and community learning from an equity approach, it is closer to the cMOOC approaches than to the xMOOC ones, despite building primarily on the latter.

Open Textbooks

Apart from websites offering or listing individual textbooks by subject and level (e.g., the Open Textbook Library [https://open.umn.edu/opentextbooks/]), it is worth mentioning the existence of platforms specifically designed to support the authoring, release, remix, and creation of derivative versions of open textbooks and, more generally, open books.

Pressbooks [https://pressbooks.org] and **Manifold** [https://manifoldapp.org] are two examples of platforms specifically designed to author, enrich with multimedia content, and share textbooks (open or otherwise), which can be read online and exported in multiple formats. Despite being initiated in North America, and with institutions making use of both platforms primarily in Canada and the USA, universities from other continents have started to work with these platforms.

Wikimedia

Launched in 2001, **Wikipedia** has now more than six million articles in English and many over 300 different languages. While it cannot be treated as a scholarly or even a reliable resource, as an OER infrastructure it has enormous value for active learning and outreach in HE (Petrucco and Ferranti 2020; Poulter and Sheppard 2020). While the infrastructure of Wikipedia and its sibling platforms is maintained by the Wikimedia Foundation, they rely on a global community of volunteers, and there are Wikimedia chapters established as independent charitable organizations in many countries.

National, Regional, and Institutional Actors and Infrastructures

Africa

Several regional and national OER infrastructures have been established over the last decades in Africa, especially in the sub-Saharan area. It is worth noting the international dimension of various initiatives that pool together contributions from different countries, most notably OER Africa [https://oerafrica.org/] and the African Virtual University [https://oer.avu.org/] in HE (both have been affiliated with the OCW Consortium) and Teacher Education in Sub-Saharan Africa (TESSA) [https://www.tessafrica.net] in relation to schools.

The three initiatives include ROER with a regional scope that include partner institutions in multiple African countries and count with the support from different organizations: the William and Flora Hewlett Foundation (USA) in the case of OER Africa (initiated in 2008), The Open University (UK) for the TESSA project (launched in 2010), and the African Development Bank for the African Virtual University (initiated in 2011). Likewise, there are some examples of sizable

institutional initiatives for HE in that area, such as the National Open University of Nigeria's OCW site (launched in 2010, but no longer active) or the OpenUCT of University of Cape Town in South Africa.

Regarding the north of Africa, it is worth mentioning the case of Morocco, where a national OER Declaration was launched in 2016 and some institutions have established their own institutional initiatives aimed at sharing educational resources and offering MOOCs (Zaatri et al. 2020). There is also a recent national initiative in Morocco, launched in 2019 with French support, known as Maroc Université Numérique [https://www.mun.ma/] that offers MOOCs provided by various Moroccan universities for HE.

Asia

In Asia, most of the national or regional OER infrastructures are developed, maintained, and funded by governmental sources, except from Japan.

National MOOC platforms are especially popular in the eastern region of Asia (China, Japan, South Korea) (Marín et al. 2020a). In China, MOOCs are the most prominent OER format ("top- or high-quality open courses" or "state-benchmarking open courses") (Yijun et al. 2020), many as academia-industry collaborations. Two examples of MOOC platforms are the China Open Resources for Education (CORE, launched in 2003, discontinued) and the Chinese MOOC platform Chinese University MOOC (CUM) [https://www.icourse163.com/] (launched in 2013). In South Korea, the KOCW [http://www.kocw.net/home/index.do] (launched in 2009) and the K-MOOC platform [http://www.kmooc.kr/] (launched in 2015) are the national platforms for OpenCourseWare and MOOCs, respectively. Similarly, Japan has its national OpenCourseWare (Japan OCW, launched in 2003, discontinued) and MOOC platform (JMOOC [https://www.jmooc.jp/], launched in 2013) but are maintained by a membership-based consortium of HE institutions (and businesses, in the case of the JMOOC), instead of governmental organizations, which is the case for China and South Korea. All these platforms focus especially on HE, CE, and LL. On the other hand, ROER seem to be well represented in India for HE and schools (Dhanarajan and Porter 2013; Ganapathi 2018). Concretely, eGyanKosh [http://www.egyankosh.ac.in/] was developed in 2005 by the Indira Gandhi National Open University for HE, and the National Repository of OER [https://nroer.gov.in] was developed in 2013 by the Indian government for schools.

Middle East

Edraak [https://www.edraak.org/] is a nonprofit MOOC platform launched in 2013 based in Jordan but targeted at the whole Arab-speaking world for schools and CE (Wimpenny et al. 2016). Several institutional MOOC platforms in Turkey (e.g., AKADEMA by Anadolu University or Atademix by Erzurum Ataturk University) (Marín et al. 2020a) and the discontinued Turkish HE ROER initiative, which started in 2007 "National Open Course Materials" (Tisoglu et al. 2020), are relevant examples too. The YOK Dersleri Platform [https://yokdersleri.yok.gov.tr] stands out for being created as a reaction to the COVID-19 emergency in 2020 by the HE Council to offer HE courses and materials.

Europe

Europe has been one of the most important players in promoting OER worldwide. The EU has created a framework to support HE institution in opening up education (dos Santos et al. 2016), and several countries have developed a full range of initiatives, some of which have been discontinued revealing sustainability issues (e.g., Jorum, Open Education Europe) (see Fig. 2). This is a key challenge affecting OER infrastructures, common to other continents, that will be discussed later.

Many of the ROER from Europe are institutional, especially based on HE institutions. Also, it is characteristic that some countries include province- or state-based infrastructures; this is the case for Germany (Marín et al. 2020b). Some national infrastructures have expanded their influence within and even beyond Europe. For instance, MiriadaX was launched in Spain but quickly became a quick infrastructure in Iberoamerican countries. Likewise, FutureLearn started in the UK but is currently used in many other countries to offer their own MOOCs, such as HE institutions from Australia or the Netherlands.

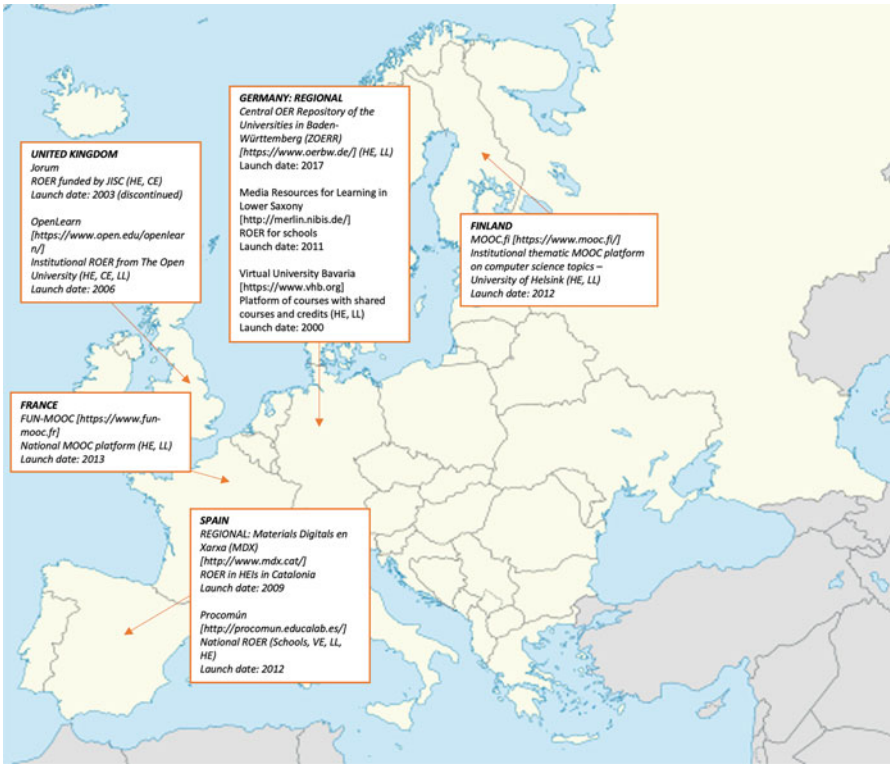

Fig. 2 Examples of national and regional digital infrastructures in Europe. (Note: The original figure of the Europe map was created by Commons user Alexrk2, CC BY-SA 3.0, shared via Wikimedia Commons). To see the figure in high resolution, see https://doi.org/10.5281/zenodo.6352308

North America

North America has played a central role in the rise and expansion of the OER movement, with many pioneering initiatives and funding bodies concerned with OER in that region, most notably in the USA and Canada. The MIT sparked a global wave of interest on OER through OCW (with the OCW MIT [www.ocw.mit.edu], created in 2001), and then various US-based platforms put xMOOCs under the spotlight (e.g., Udemy since 2010: [https://www.udemy.com] or Udacity since 2011 [https://www.udacity.com], both with a focus on vocational courses), while Canada-based initiatives promoted more cMOOCs.

Despite its global reach, the largest OER, Wikipedia, extensively relies on the US-based Wikimedia Foundation. The USA has also led the way in terms of OER-based credit-bearing courses recognized across colleges, through initiatives such as the Saylor Academy [https://Saylor.org] (created in 2008), and in promoting the creation and adoption of open textbooks, through initiatives such as OpenStax [https://openstax.org/] (launched in 2012) and LibreTexts.

Although most efforts have been focused on HE, initiatives such as Khan Academy [https://www.khanacademy.org/] (created in 2008) cover the pre-K12 and K12 curriculum.

Education in Canada is governed at a provincial or territorial level, and there are various provincial open education initiatives. BC Campus OpenEd [https://open.bccampus.ca/] in British Columbia is one of the best known among those initiatives since 2011 in HE and LL, with a special focus recently on open textbooks. In addition, as mentioned before in global infrastructures, the first MOOC was organized at Manitoba University in 2008 and resulted in the definition of the model of connectivist MOOCs that has been then adapted by many other institutions worldwide.

Sometimes the USA and Canada are approached as a single region, such as in the case of WikiEducation [https://wikiedu.org/], which supports the adoption of Wikipedia for teaching and learning in HE with a special focus on these two countries, established as spin-off of Wikimedia 2013.

In the case of Mexico, a few institutions joined the OCW Consortium, and some launched their own OCW sites, namely, the Universidad de Monterrey and the Tecnológico de Monterrey. However, neither of the two websites are currently online. A current Mexican MOOC platform is the Plataforma Abierta de Innovación edX [https://www.aprendoencasa.plai.mx/edx] developed by the State Government of Jalisco in 2019 that provides access to a selection of international edX courses with the possibility of certification (CE, LL).

South America

According to Hodgkinson-Williams and Arinto (2017), with the exception of Brazil, open education is still in its infancy in South America, and the debate around the adoption of OER is incipient, especially in countries like Chile or Guatemala. However, the open education community in the continent is active and counts with several organizations that promote OER in the region, such as: OE LATAM [https://

www.oelatam.org/], a regional node of the open education consortium OE GLOBAL; the Mercosur network for accessibility and collaborative generation of OER (REMAR); or EDUTEKA, Colombian initiative for schools and lifelong learning developed by the Foundation Gabriel Piedrahita Uribe and the School of Educational Sciences of the University of Icesi [https://eduteka.icesi.edu.co/].

Some countries have specific national and institutional policies related to open education in the context of HE (e.g., Colombia, Uruguay). There are a few institutional ROER in HE (e.g., Universidad Nacional de Costa Rica), while some OER initiatives have now been discontinued (e.g., Universidad Técnica Particular de Loja's OCW for HE in Ecuador or the Center for Distance HE of the State of Rio de Janeiro, a consortium of the six public universities of Rio de Janeiro funded by the state government of the city) (dos Santos et al. 2012).

The Universidad de la República (Uruguay) is one of the most important players in the continent in promoting OER. Apart from having a program of virtual learning environments (ProEVA) that promotes OER and OEP and a research and innovation strand on accessible OER (Núcleo REAA), it has also engaged in different EU-funded OER projects in this field (Hodgkinson-Williams and Arinto 2017).

It is worth highlighting that the interest of OER infrastructures in this area is remarkably stronger in schools than other educational stages, which is in contrast with other continents and reflects the need to provide educational opportunities to every child, also in rural areas (see Fig. 3).

Oceania

Most of the activity in the field of OER is linked to the OER Foundation and Otago Polytechnic, which hosts a UNESCO-ICDE Chair in OER and is behind the National Centre for Open Education Practice [https://coep.nz/]. This center was established by Otago Polytechnic and the Ara Institute of Canterbury in 2019 to provide leadership, networking, and support on OER and OEP adoption to HE institutions and practitioners in New Zealand. The OER Foundation – established in New Zealand but reaching global scope through OERu and WikiEducator – has channelled much of the activity in relation to OER infrastructures in this region.

In the case of Australia, various universities have now launched institutional OER initiatives, mainly MOOCs and ROER, despite the lack of support from the federal government in terms of funding or policy aimed at fostering OER infrastructures and practice (Stagg et al. 2018). For instance, the University of Tasmania has a MOOC thematic platform on dementia [https://mooc.utas.edu.au/], and the Swinburne University of Technology has its ROER for digital media and also hosts the Swinburne History and Art Collections [https://commons.swinburne.edu.au/]. There is also some interuniversity collaboration in this field, as shown by the Open Textbook Initiative for HE established in 2018 by five Australian HEIs [https://emedia.rmit.edu.au/oer/], and the funding of the National Centre for Student Equity in HE is providing for Australian Open Textbooks as Social Justice Project by Deakin University.

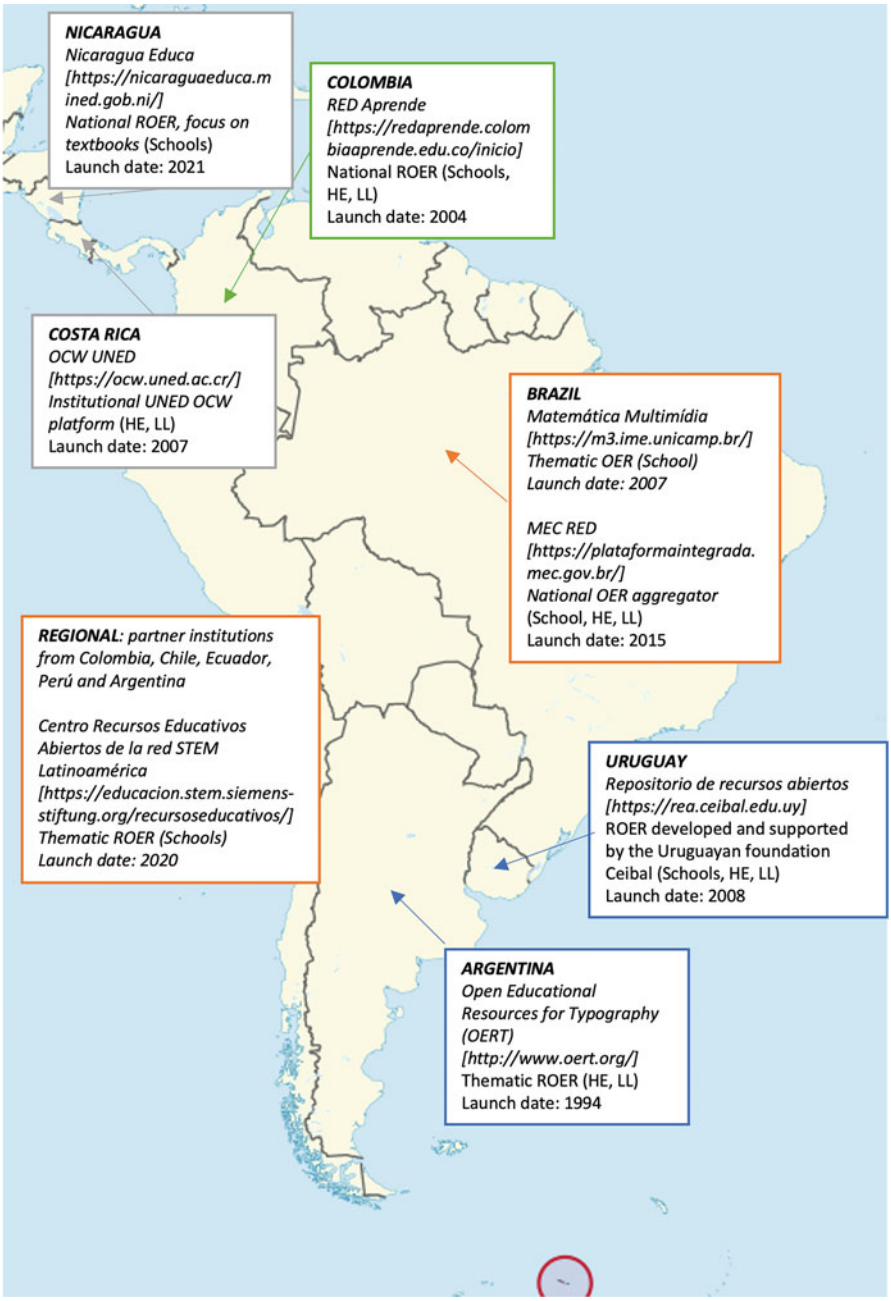

Fig. 3 Examples of national and regional digital infrastructures in South America. (Note: The original figure of the South America map was created by TUBS, CC BY-SA 3.0, shared via Wikimedia Commons). To see the figure in high resolution, see https://doi.org/10.5281/zenodo.6352308

Challenges and Future Research

The OER infrastructure scene offers many challenges and open questions, which also point towards directions for future research.

One of the most common challenges is the lack of awareness, including knowing that OER infrastructures exist and understanding the concept and its purpose, which has been identified – along with the lack of incentives – as a major barrier to engagement with OER (Baas et al. 2019; Bates et al. 2007).

The absence or non-systematic use of metadata and inaccurate labelling, especially regarding pedagogical/educational metadata, is one of the problems that makes searchability and findability of OER difficult, especially in the case of repositories (de Deus and Barbosa 2020; Rodes-Paragarino et al. 2016; Santos-Hermosa et al. 2017).

More generally, quality assurance has always been a major issue in OER infrastructures, a topic addressed by several authors (Atenas and Havemann 2014; Bates et al. 2007; Camilleri et al. 2014; Clements et al. 2015). Users' concerns about quality of content stored in OER infrastructures is a common aspect across the literature related to the topic too (Bates et al. 2007).

The sociotechnical, pedagogical, and cultural aspects of OER infrastructures and their adoption in different contexts are also an important topic, as suggested by both the examples presented here and the literature (Rodes-Paragarino et al. 2016). Cultural differences and preference for locally produced courses underline the importance of developing localized content and having situated OER initiatives (Cachia et al. 2020; Hatakka 2009; Rodes-Paragarino et al. 2016; Ruipérez-Valiente et al. 2020).

While OER infrastructures generally aspire to achieve a global reach, Global North perspectives and content produced in English are dominating the scene and creating considerable cultural biases and imbalances. That is the case even for truly global initiatives where contributions from anyone are welcome, such as Wikipedia. Despite this, Wikimedia editors, as in other OER communities happens, are largely skewed towards white, male, Western populations, which has resulted in a number of biases affecting the topics and perspectives included in Wikipedia and the rest of the projects (Konieczny and Klein 2018).

Related to this geographical issue, most of the OER research so far and many infrastructures have been developed in Europe and North America, by and for HE (Santos-Hermosa et al. 2017); hence, there is also room for improvement in this sense. Scarce research and infrastructures could be found for schools (with exception from South America) and even none specific for VE. Future research should include more voices from the Global South and cover other educational stages different from HE.

Licensing choices is also a contentious topic, with some purist voices claiming that any resources that do not comply with the 5-Rs principle should not be regarded as OER, while others – including the most recent definition recognized by UNESCO – consider that licenses preventing commercial uses or derivative works are equally valid for the release of OER. This creates situations such as the one presented by the

platform TED Talks, which publishes their videos under the Creative Commons BY-NC-ND license for personal use for free, but other types of use within an organization (e.g., for training) require a license for a fee (TED Conferences, LLC n.d.). At the same time, the OER status of some MOOCs platforms such as Coursera or Udacity has been questioned due to not using open licenses (Stracke et al. 2019).

Finally, the sustainability of OER and their infrastructures is a clear challenge to the continuity of initiatives (Orr et al. 2015) – as shown by some of the national, regional, and institutional cases discussed here – and there is not a single business model that may work in every context. For example, the decision to not continue the UKOER program (2009–2012) and the subsequent retirement of the UK OER national repository (Jorum) implied a shift from funding and responsibility at national level to individual institutions, favoring a devolved model where institutions have to find their own resources and meant optimizing resources by, for instance, including OER collections into open-access research repositories (Risquez et al. 2020).

Future research in the context of OER infrastructures should follow different directions, in addition to the ones already previously mentioned. Some research points towards learning analytics' practices to measure users' interactions with OER and interoperability between OER infrastructures (Yassine et al. 2016). Also, some authors have advocated for going a step further in establishing OER infrastructures and embracing OEP as the basis for a deeper pedagogical turn (Atenas and Havemann 2014).

Conclusion

In this chapter an overview of the main OER infrastructures worldwide, and key challenges, has been provided. The landscape of OER infrastructures shows that there is still room for improvement through research in terms of sustainability, interoperability, users' awareness, quality assurance, licensing issues, and their socio-technical, pedagogical, and cultural aspects.

The Web gave rise to the emergence of e-learning as an academic field devoted to exploring and researching its use for teaching and learning, followed by a range of theories and approaches with their own flavors and terms, such as online learning, networked learning, and connected learning, while also forcing to redefine other established and more general concepts and fields such as distance learning, open education, or educational technology. The value of the Web in reconfiguring the way we share and access educational content has been demonstrated through successful OER infrastructures for some time now, but further research is needed to fully understand how to maximize its potential in different institutional, cultural, and social contexts.

Although technical issues related to the OER infrastructures are important for further developments, it is key to recognize that neither the use of digital resources for teaching and learning are uniform within or across countries nor are OER's

conceptions and perceptions the same in every context, and these aspects decisively influence the development and sustainability of OER infrastructures.

Cross-References

► Quality Assurance of Open Educational Resources: OER Quality Assurance

Acknowledgments Grant RYC2019-028398-I funded by MCIN/AEI/ 10.13039/501100011033 and FSE "El FSE invierte en tu futuro"

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