

A Comparative Study of National Infrastructures for Digital (Open) Educational Resources in Higher Education

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Abstract

This paper reports on the first stage of an international comparative study for the project “*Digital educational architectures: Open learning resources in distributed learning infrastructures–EduArc*”, funded by the German Federal Ministry of Education and Research. This study reviews the situation of digital educational resources (or (O)ER) framed within the digital transformation of ten different Higher Education (HE) systems (Australia, Canada, China, Germany, Japan, South Africa, South Korea, Spain, Turkey and the United States). Following a comparative case study approach, we investigated issues related to the existence of policies, quality assurance mechanisms and measures for the promotion of change in supporting infrastructure development for (O)ER at the national level in HE in the different countries. The results of this mainly documentary research highlight differences and similarities, which are largely due to variations in these countries’ political structure organisation. The discussion and conclusion point at the importance of understanding each country’s context and culture, in order to understand the differences between them, as well as the challenges they face.

Keywords: digital educational resources, comparative case study, digital infrastructures, digitalisation policies, digital transformation, open educational resources (OER)

Introduction

Digital transformation is broadly defined as “a cultural, technological, and workforce shift” (EDUCAUSE, 2018, p. 6). Whilst such transformation is undoubtedly driven by technological developments, it also encompasses a variety of transformation including pedagogical, instructional, and learning changes. A specific area of practice and research that has emerged over recent years is the concept of *open* (Weller, 2014), in the context of which, massive open online courses (MOOCs) and the creation, distribution and use of open educational resources (OER) occur, intended to open up education to new audiences and enable access to study (Orr, Rimini & van Damme, 2015). However, with research

focusing on the pedagogical merits and challenges of OER, the technical side of their distribution and storage has not yet been thoroughly analysed, let alone the establishment of standardised practice in higher education (HE). At first glance, it can be stated that OER are being produced somewhere, sometime, by someone. However, accessing them easily, beyond institutional IT systems –and subsequently leading to potentially higher use and acceptance amongst students and staff– is still an idea, rather than established practice. Despite an increasing number of initiatives in HE to establish OER repositories, such as *open*, institution-specific and state-wide initiatives, individualistic solutions are being sought. These individualistic initiatives can prohibit potential users and contributors being able to identify them (Atenas, Havemann & Priego, 2014), which arguably works against the very idea of *open*. Considering that educational materials within some repositories may not be open, we will hereafter use (O)ER to refer to both open and non-open educational resources.

The project *EduArc* (<https://uol.de/coer/research-projects/projects/eduarc>) approaches this topic by seeking to model possible solutions to conceptualisations of either centralised repositories or hubs, enabling users and contributors' greater access to (O)ER. In order to have the broader perspective in mind while developing such distributed technological solutions, an international comparative study across different levels (macro, meso and micro level, see Zawacki-Richter, 2009) is being conducted by the Center for Open Education Research – COER (<http://www.uol.de/coer>). Therefore, the present article is an exploration of preliminary project findings, focusing on the status and issues of international (O)ER infrastructure, quality, policy and change at the macro level (national and province/state). The framing of the study explores digital transformation in HE within the countries under investigation, which are COER members' countries of origin (Australia, Canada, China, Germany, Japan, South Africa, South Korea, Spain, Turkey and the United States), from a comparative view, mainly based on documentary research.

Theoretical and conceptual framework

The most relevant concepts within the framework of this study are digital educational materials ((O)ER), OER and educational repositories, as components of digital transformation in HE (Rodés-Paragarino, Gewerc-Barujel & Llamas-Nistal, 2016), which are represented in Figure 1 and described and contextualised as follows:

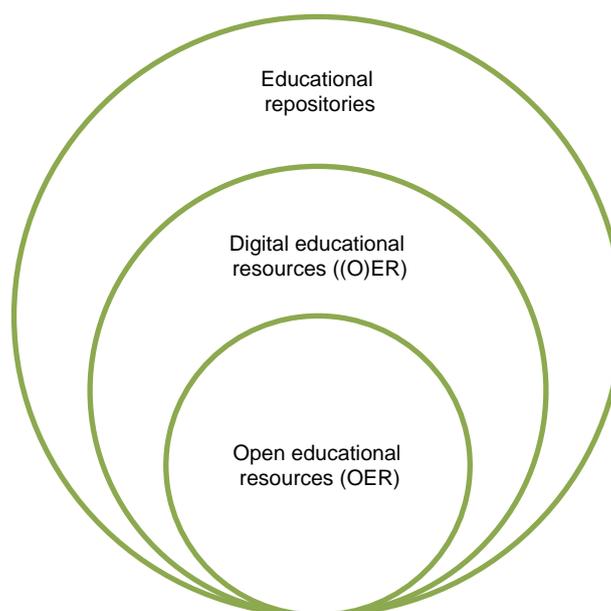


Figure 1: Conceptual framework of the study.

According to Fernández-Pampillón (2014, p. 155), digital educational materials are “any digital entity that may be used for learning, teaching and training”. This understanding would also apply to our study, with the consideration that research outputs (articles, books, conference proceedings, master and doctoral thesis, etc.) were not included as digital educational materials.

When (O)ER are licensed with an open licence, they can be considered OER. Whilst it is recognised that a new OER definition was recently published by UNESCO (2019), the previous UNESCO definition of OER had received broad agreement across the countries under investigation, which was the available definition at the time of this study:

Open Education Resources (OER) are teaching, learning and research materials in any medium – digital or otherwise– that reside in the public domain or have been released under an open license that permits no-cost access, use, adaptation and redistribution by others with no limited restrictions (UNESCO, 2012, p. 1)

The main value of OER and their repositories is to achieve education for all, enabling universal education (Caswell, Henson, Jensen & Wiley, 2008) and, therefore, countries are encouraged to foster awareness and support capacity building for creating, using and sharing OER, along with understanding and using open licensing of digital educational materials (Marcus-Quinn & Diggins, 2013). However, as conceptions of (O)ER differ, OER may look rather different too, depending on whether education is regarded as a public or private good in each country. For instance, in the U.S., education is considered a private good where students bear most of the costs of HE (Saunders, 2010), and therefore, (O)ER are usually not (completely) free; whereas in Germany, education is a fundamental value and considered a public good (Kehm, 2017), and (O)ER are usually free. On another level, (O)ER can be considered as part of an educational system’s ideology, as noted in South Africa (Apple, 2010; Arinto, Hodgkinson-Williams, King, Cartmill & Willmers, 2017; Bernstein, 2015). The recently published recommendation on OER by UNESCO (2019) may offer new momentum at the international level in supporting strategic cooperation between Member States in OER development and sharing.

On the other hand, one of the polemic issues around (O)ER discussed in the literature concerns the difficulty to find them (Atenas et al., 2014). Repositories of (O)ER are “digital databases that house learning content, applications and tools such as texts, papers, videos, audio recordings, multimedia applications and social networking tools” (McGreal, 2011, as cited in Atenas & Havemann, 2014, p. 3). Therefore, these repositories aim at collecting (O)ER and their metadata to ease their search and make them visible, but they also present other challenges, for instance, the lack of use of educational standardised metadata. As Koutsomitropoulos, Alexopoulos, Solomou and Papatheodorou (2010) note, (O)ER require a more specialised treatment and characterisation than other kinds of digital objects; thus, the importance of using learning object metadata standards. However, studies on the evaluation of OER repositories show that few of them include the use of educational standardised metadata recommended for transferring information across repositories (Atenas & Havemann, 2013; Santos-Hermosa, Ferran-Ferrer & Abadal, 2017). On the other hand, as noted by Rodés-Paragarino et al. (2016), learning about the dimensions of the adoption of (O)ER by teachers is especially relevant to improve the usability of educational repositories. The main findings of the systematic literature review presented by Rodés-Paragarino et al. (2016) include: a shortage of teachers’ use and reuse of patterns of educational repositories, the lack of presence of studies that explore the reality of the potential of the use of (O)ER in HE, and the importance of cultural and institutional factors, as well as individual characteristics and professional experiences in the way teachers use educational repositories.

Although there are some studies that evaluate the repositories of (O)ER (e.g. Atenas & Havemann, 2013; Santos-Hermosa et al., 2017), there is a paucity of research related to the macro level factors that influence the development of (O)ER infrastructures in HE from an international comparative perspective, i.e. making a comparison of the state of digital transformation around the world, which is the focus of this study.

Research methods

The study followed a comparative case study approach, with a focus on examining the research questions in different cases (the countries) to better understand a particular topic ((O)ER national infrastructures), as well as the differences and similarities between the cases, without the intention of drawing statistically generalisable conclusions (Yin, 2009). Fourteen international experts from the COER were commissioned to prepare reports for 10 countries. For this first stage, the experts primarily undertook desk research of government/organisation websites and available literature. Where information was difficult to obtain, some used informal interviews and questionnaires to source relevant information. The final 10 reports were then used as data for this study. These reports were analysed through the comparison of additional data in form of descriptive statistics for the description of the countries' specific contexts and through thematic analysis according to the four elements that are within the focus of the research questions (infrastructure, quality, policy and change).

The first part of the comparative case study reports on the comparison of the status of digital transformation of the countries. The second part reports on the contextual descriptions in terms of HE systems. Both are useful in order to understand the similarities and differences in terms of infrastructure, quality, policy and change.

Once a draft of this report was generated, it was shared with the experts originally involved in analysing their own country's context. The results of the comparative work were discussed, and experts were invited to examine the report and offer suggestions. Once experts and the team of researchers agreed on the content of the report, the researchers finalised the study for submission to this journal.

The research questions of the study focused on the above-mentioned four elements, as follows:

- What is the influence of country-specific contexts on the development of national / state-wide infrastructure for the dissemination of (O)ER in HE?
- What is the influence of country-specific contexts on the development of national standards for the creation, dissemination and quality assurance of (O)ER in HE?
- What is the influence of country-specific contexts on the development of national / state-wide policies for (O)ER digital infrastructures and their implementation in HE?
- What is the influence of country-specific contexts on the promotion of change at the national level in terms of funding, managing and promoting (O)ER digital infrastructures in HE?

Results

Contexts

While ICT indexes can inform us about the general status of digital transformation of countries, as we will introduce later in this section, we need to put this status in the background to look at HE, which is the context of our study. Therefore, a description of the HE context for each of the countries

involved in the study follows. Within the countries under investigation in this project, China has both the largest population and the largest number of university students (see Table 1), but it is the United States that has the largest number of higher education institutions (HEIs). Countries such as Japan and South Korea are experiencing a decrease in the number of HE students due to their ageing populations, whereas in Turkey a demand for HE is growing, given that a large majority of the population are young citizens.

Table 1. Summary of HE systems and population data, ranked on number of students

Country	Population (Millions)	Number of HE students (Millions)	Number of HEIs
China	1,404	37.8	2,914 (2,631 universities and colleges)
United States	327	20.2	4,298 (2,818 universities)
Turkey	83	7.5	205 (200 universities)
Germany	83	2.8	396 (121 universities & 218 universities of applied sciences)
Spain	47	2.2	3,375 (84 universities)
Australia	25	1.5	176 (40 universities)
Canada	38	1.4	234 (72 universities)
South Africa	58	1.0*	143 (43 universities)
South Korea	52	0.7	359 (191 universities)
Japan	127	0.7	1,200 (778 universities)

*public sector

The differentiation between private and public HE systems is also relevant in understanding the differences between these countries (see Figure 2). On the extreme left of the spectrum, approximately 80% of HEIs in South Korea and Japan are private, and so too are around 62% of HEIs in the U.S., both non-profit and for profit. In South Africa, only 23 out of 143 HEIs are state-funded and the rest are private (84%). On the other extreme of the spectrum, the majority of German and 75% of the Chinese HEIs are state-funded, with HEIs in China affiliated with the Chinese Ministry of Education, with other ministries or with provincial governments. Turkey and Spain have a higher number of public HEIs than private ones: Turkey has 129 public universities, 71 non-profit foundation universities and 5 foundation vocational schools, whereas Spain has 2,230 public HEIs, 50 of which are universities¹, and 34% of the HEIs are private (n = 1,145, 34 universities).



Figure 2: Spectrum Private HE system - Public HE system.

¹In Spain, HE includes university education, advanced vocational training and specialised education (artistic education, professional Plastic Arts and Design studies, and advanced Sports education).

As a macro factor connected to the development of (O)ER infrastructures, gaining an understanding of how the countries vary in terms of digital transformation provides some insights into the current situation. One of the most recent indexes that could be considered for this purpose is the *ICT Development Index* (see Table 2). This Index looks at indicators connected to ICT infrastructure and access (ICT readiness: availability of technology, such as telephone, mobile-cellular telephone, computer, and Internet access in households), ICT intensity (ICT use of Internet) and ICT skills (ICT capability: schooling) (ITU, 2017a). Looking at the countries of this study, we find within the 10 first positions South Korea (2nd) and Japan (10th), which stand out as the two most developed countries included in our study in terms of ICT, being closely followed within the 10 next positions by Germany (12th), Australia (14th) and the United States (16th). Spain and Canada come next (27th and 29th, respectively), and Turkey (67th), China (80th) and South Africa (92th) are in last positions of the Index.

Table 2. IDI 2017 Rank of the countries of this international comparison (out of 176 countries)

IDI 2017 Rank	Country	IDI 2017 Value	IDI 2016 Rank	IDI 2016 Value	Rank Change
2	South Korea	8.85	1	8.80	<
10	Japan	8.43	11	8.32	>
12	Germany	8.39	13	8.20	>
14	Australia	8.24	16	8.08	>
16	United States	8.18	15	8.13	<
27	Spain	7.79	27	7.61	-
29	Canada	7.77	26	7.64	<
67	Turkey	6.08	72	5.66	>
80	China	5.60	83	5.17	>
92	South Africa	4.96	88	4.91	<

Source: own presentation based on data of the ICT Development Index 2017 (ITU, 2017b)

The *Index of Readiness for Digital Lifelong Learning (IRDLL)* (Beblavy, Baiocco, Kilhoffer, Akgüç & Jacquot, 2019) gives a supplementary perspective to the *ICT Development Index*, and provides another approach to digital transformation, more connected to learning, although only focused on European countries. This Index includes items related to learning participation and outcomes, institutions and policies for digital learning, availability and use of digital learning. Of the two EU countries in this present study, Spain is ranked 8th and Germany 27th, essentially having flipped their positions from the *ICT Development Index*. The report highlights for Germany that, “while Germany has a strong economy and fairly good education system, investment in digital infrastructure and programs is sorely lacking,” and “German policymakers are aware of the importance of digitalisation, but efforts to date lack ambition” (Beblavy et al., 2019, p. 53). On the other hand, the report states for Spain that “in higher education, blended learning and virtual campuses are more and more widespread” but “the autonomy of universities prevents the development of a comprehensive national digitalisation strategy in higher education” (Beblavy et al., 2019, p. 68).

Infrastructure

Our first research question focused on the influence of country-specific contexts on the development of national / state-wide infrastructures for the dissemination of (O)ER in HE. The comparison of the different situations in the countries shows that, in order to understand HEI (O)ER infrastructure (or the lack thereof), the level of political structure centralisation should be examined as a cornerstone element of the cultural context, as this also influences the structure of the HEIs (see Figure 3).



Figure 3: Spectrum Centralised HE system-Decentralised HE system.

At the national or state level, countries in this study with a highly decentralised HE system do not have (O)ER infrastructures or have underdeveloped infrastructures at the macro level, as is the case in Germany and Canada, where education is a mandate of the provinces or states and not of the national government. In the case of the U.S., initiatives are also highly decentralised and collaboration between states about infrastructure happens, but without national coordination². Examples include *Utah Open Courseware (OCW)*, *Galileo Open Learning Materials*, the *North Carolina Open Learning Object Repository* or *Open Syllabus*. Platforms arising from individual or company initiatives are used nation-wide (and worldwide). This strategy allows copyright for hosted (O)ER to be maintained as a private good in the U.S. Examples are *iTunes U*, *Coursera* and *edX* for MOOCs.

In Germany, where many provinces have developed or are developing their own repositories, the creation of parallel structures and the potential lack of interoperability have become evident. A possible solution is to create a central hub for all of them (Kerres, Hölterhof, Scharnberg & Schröder, 2019). Other countries, such as South Africa, state that there is no plan for such national infrastructure, even though they manifest interest for it due to its potential value to raise the profile of OER across institutions and general public³. This potential value of OER, but at the same time lack of awareness, also is highlighted in Turkey (Kursun, 2011).

Many countries with a rather centralised HE system have national infrastructures, but most of them are not specifically targeted at HE or (O)ER, with some exceptions. For instance, in Spain, the public agency *Foundation for Science and Technology (FECYT)* has developed a national infrastructure to harvest institutional repositories, thematic repositories, journal portals and open access journals (RECOLECTA).

In terms of (O)ER production at the national level (see Figure 4), which involves (O)ER initiatives and repositories available, most countries have embraced OCW and MOOCs, which are considered

²An important exception to this is the Creative Commons (CC) licensing. It was created in the U.S. to meet the requirements of the national legal copyright system. CC continues to be a foundational element of many OER initiatives, as the “open” in open education is often about open licensing.

³In interview with a number of key researchers, scholars, practitioners and national departments in the South African context.

two of the most popular OER initiatives in HE. The U.S., South Korea and China are high producers of (O)ER, whereas countries such as Japan and Germany are producing less OER at the national level, despite their position in the IDI 2017 rank. Furthermore, Canada and the U.S. are considered the OER pioneers, and many of their initiatives have been popularised and replicated in other countries. Examples are the Canadian *Connectivism and Connective Knowledge* MOOC (2008) and the popular U.S. *MIT Open Courseware* (2001).



Figure 4: Spectrum Low production of (O)ER - High production of (O)ER.

In South Korea and Japan, MOOCs and OCW have been/are being developed; however, (O)ER production in South Korea is much higher than in Japan. Japan's OCW and JMOOC are two membership-based consortia without governmental support. This could explain the differences in OER development and sharing compared to South Korea, where the main actors in OER infrastructure are two organisations funded by the Ministry of Education - the *Korea Education and Research Information Service* (KERIS), which is in charge of developing, managing and evaluating OER for HEI, including KOCW and videos; and the *National Institute for Lifelong Education* (NILE), which is hosting and developing K-MOOCs.

China is very much focused on the development of MOOCs (often called “top or high quality open courses” or “State-benchmarking Open Courses”) through its own national repository and other centralised platforms, for example, iCourse or the Chinese University MOOC (CUM). All of the repositories are operated (to a lesser or greater degree) by organisations that are affiliated with the Ministry of Education. In Spain, *OCW-Universia* unified different Spanish university OCW under the same infrastructure. Many Spanish universities use *MiríadaX*, a platform for Iberoamerican MOOCs, supported by the private telecommunications company Telefonica, for developing and hosting them. Along the same lines, in the context of the *Turkish Academy of Sciences (TUBA)*, some Turkish HEIs took part in the *OCW Project*.

Even though innovative digital practices permeate the HE sector in Canada (e.g., MOOCs and *Desire2Learn* are Canadian innovations), there is a general belief that the sector must engage in radical transformation to remain relevant and successfully respond to the needs and pressures of a digital society (Bates, 2019). Furthermore, the lack of national oversight could be a major reason why this country seems to be rather an exception in the full adoption of these OER initiatives, and especially of OCWs. Across the Pacific Ocean, Australia has made some move toward national repositories. The *Learning & Teaching repository* houses OER materials from projects funded by the Australian Government between 1994 and 2018 and is run by the consortium *Open Universities Australia*.

Quality

The second research question addresses the influence of country-specific contexts on the development of national standards for the creation, dissemination and quality assurance of (O)ER

in HE. Although not as prominent as for infrastructure, the level of political structure centralisation also has some effects on the quality issue for (O)ER and their repositories across countries.

A clear example of the effect of a centralised political structure on quality is China, where as early as May 2000, the Ministry of Education issued *Technical Specifications for Modern Distance Education Resources Construction*. This non-mandatory standard focuses on the guidelines for resource developers, production requirements, and functions of the management system. Nowadays, the *Chinese e-Learning Technology Standardisation Committee* has developed and issued numerous national standards and association standards on educational digitalisation.

However, most of the countries under investigation do not have any official national standards or quality frameworks specifically for (O)ER and their infrastructure and, therefore, political structure centralisation does not seem to have a high impact on them: this has been predominantly an issue left to institutions (e.g. South Africa) or even to individual faculty members (e.g. Japan). Despite this, some countries do have checklists, guidelines or evaluation guides related to (O)ER. In Spain, for example, the *Network of Spanish University Libraries* (REBIUN) is currently developing a guide for the evaluation of educational repositories, and it has produced multiple studies and reports on the status of the Spanish digital university repositories. In Germany, Mayrberger, Zawacki-Richter and Müskens (2018) proposed a quality assurance instrument for OER in the context of a HE network in Northern Germany. Likewise, Australia has developed different guidelines related to (O)ER such as the *Feasibility Protocol*, to assist HEIs to make informed decisions on the adoption of OER at various levels; alongside *Supporting OER engagement at Australian Universities*, which provides advice on intellectual property rights, copyright and policy. In South Korea, KERIS has developed *A Guidebook for Digital Content Development and Management* to ensure the acceptable quality of online resources and OCW to evaluate open digital content and online courses developed under the projects funded by the Ministry of Education, and to provide best practices. There are also official documents such as the *Guidelines for K-MOOC Development and Management* for edX, which help guide KOCW and K-MOOC development.

The actors involved in OER quality are diverse, depending on the country; however, governments, agencies, librarians and other working groups are usually involved. For example, in Spain an *Association for Standardisation* exists, but the working group on repositories of REBIUN and the working group on trends in (O)ER and quality criteria in new learning environments of CRUE (*Conference of Rectors of the Spanish Universities*) are also relevant actors in the quality of (O)ER. On the other hand, the case of the U.S. is unique, since many digital education organisations are involved in defining quality for (O)ER, such as *Quality Matters* or the *Online Learning Consortium*, *Educause*, the *Association for the Advancement of Computing in Education* and the *Association for Educational Communications and Technology*. Alternatively, public agencies are deeply involved in (O)ER quality in South Korea and China.

Policy

The third research question explores the influence of country-specific contexts on the development of national/state-wide policies for (O)ER digital infrastructures and their implementation in HE. This issue is strongly influenced by the country's political structure, which may or may not boost the (O)ER infrastructure development.

In the case of decentralised countries, there are rather non-binding recommendations published by different actors (e.g. U.S. and Germany), whereas in centralised countries (e.g. South Africa and China), laws and regulations define policies regarding (O)ER infrastructure. For example, the current action plans in China, the *Action Plan for Educational Digitalisation 2.0* and the *Education*

Modernisation 2035 Initiative, point towards the acceleration of digitalisation in education, including the development of (O)ER, and especially, MOOCs, with digital transformation being one of 10 strategic priorities for education modernisation. On the other hand, an action plan has not been developed or provided the necessary follow-through or funding in Japan. For example, whilst the *Grand Plan for Japanese Higher Education 2040* highlights the importance of using ICT to improve teaching and learning in HE, it does not establish follow-up plans or support.

South Korea is highlighted as the first country to implement a digital strategy, as early as 1996, and since then and every five years, the basic plan of education informatisation has been established and implemented (Lim, Lee & Choi, 2019). The digital strategy *e-Campus Vision for Higher Education* (2002) involved South Korean government support in the establishment and implementation of e-learning support centres in universities across 10 different regions of the country, as well as funded collaborative content development among universities (*Centres for Teaching and Learning*) since 2000. In Turkey, the *Vision 2023 Framework* is regarded as the national roadmap with six macro themes, one of which is *Education, Science and Technology*. One of the actions taken within this Framework was the HE Council's (HEC) *Digital Transformation Project* that was intended to support and assist the Turkish HE institutions to complete their digital transformation processes. As the first step in this project, MOOC-like courses that focused on the improvement of digital skills of the faculty members and students were developed and piloted in nine Turkish universities.

In the case of some mid- and all highly decentralised countries, although there are working papers that aim to influence national/province policy, there is no national educational policy. For instance, in Spain, we can highlight *ICT 360º, Digital Transformation at the University and UniversiTIC 2017. The Analysis of ICT in Spanish Universities*, which outline the trends regarding digital transformation at universities and propose strategic lines of action. In the case of Australia, provinces have the power to legislate on education, but the national government dominates HE policy. Nevertheless, the Australian Government currently has no explicit OER or OEP policies, framework or regulation for use in HE (Bossu & Stagg, 2018; Stagg, Nguyen, Bossu, Partridge, Funk & Judith, 2018).

Given the lack of a central educational agency, the *Council of Ministers of Education in Canada* (CMEC) serves as an overarching body for the discussion of common interests and provides a forum to discuss policy issues, a means by which to consult and cooperate with national education organisations and the national government. Similarly, in Germany, the *Standing Conference of Ministers of Education and Cultural Affairs* (KMK) and the German national government make recommendations that aim to develop policies in the field of digital transformation, for instance, the strategy papers *Education in the Digital World* and *Shaping digitalisation*. In the first recommendation, the states promulgate a joint understanding on the role, challenges and measures to be taken, in order to ensure appropriate education on all levels in the context of digital transformation, with OER being one of the action and development areas.

The federal government in the U.S. has developed the initiative *GoOpen*, which supports using OER to transform teaching and learning, but leaves the participation up to individual states and institutions. Decision-makers in the U.S. are not only decentralised by states, but also by markets. On the other hand, the national government of South Africa has developed several policies where OER are referred to, with the most recent being the *Call for comments on the open learning policy framework for South African post-school education and training (2017)*, but there is no overarching national digital infrastructure policy with regard to OER in HE. Interestingly enough, (O)ER are a featured part of the country's HE strategy for enabling and broadening access to HE in Turkey, where the number

of university students has been increasing in recent years (TUSIAD, 2017), and in South Africa, where access is a matter of discussion (DHET, 2014a; 2014b; 2017).

Change

The last research question of this study is related to the influence of country-specific contexts on the promotion of change at the national level in terms of funding, managing and promoting (O)ER digital infrastructures in HE. Again, countries' varying political structure is a relevant element, although not prominent.

The most relevant action for the promotion of (O)ER and their infrastructure at the macro level consists of national digital strategies (involving government investment/budget) or national funding initiatives, which all countries in the study have, except Japan. These are not usually just focused on (O)ER and their infrastructure, but digital education aspects are highlighted. In the case of the U.S., the federal government does have funding bodies for special educational funding initiatives, but it does not provide operational funding for education at any level. The Canadian national funding agency SSHRC (the *Social Science and Humanities Research Council*) provides generous funding for projects in national competitions. In Germany, four large-scale tenders were announced between 2016 and 2020 through the national government within the funding line *Research in Digital Higher Education*. The 2016 tender funded 20 projects related to OER (Mayrberger, 2018). South Korea has several funding schemes for HE digital transformation, which is also an evaluation criterion of HEIs, as does China, especially for the creation, development and sharing of MOOCs. In South Africa, the National Treasury dedicates and channels public funding for OER. Another measure includes the *Teaching Development Grants* funded by the South African Department of Higher Education and Training, which will be used to encourage collaborative development and use of OER, and the policy allows for the sharing of OER with other countries, especially when these are released under an open license that permits adaptation (DHET, 2014b).

Some of the countries under investigation also have private funding initiatives, with private institutions particularly involved in (O)ER initiatives in specific countries (see Figure 5). Crucially, private foundations have been an important source of funding for (O)ER initiatives in the U.S. The Hewlett Foundation has provided strong support to open education initiatives, along with others such as the Gates Foundation and the Open Society Foundation. However, individual start-up companies (such as TeacherTube) and organisations (such as Khan Academy) have also initiated what some might consider open education. Also, U.S. companies, such as Google and Microsoft, have also been particularly interested in South African education, providing funding for digital education related projects. In the case of Spain, academic networks and organisations have been offering modest funds for one-year projects, prizes or awards for the creation of (O)ER (in the past, OCW; and now MOOCs). Additionally, the creation (and teaching) of (O)ER/MOOCs is regarded as a complementary merit for university teacher accreditations. Honourable titles and funding in the form of online course subsidies are available for the development of MOOCs in China.



Figure 5: Spectrum Private funding - Public funding.

Agents at this level are mostly national and provincial governments (e.g. Spain, South Korea, Germany and China), national funding agencies (e.g. Canada) and private organisations (e.g. U.S.). However, other bodies could also be involved, depending on the country. In Australia, the macro level agents for change are government, university and industry bodies. In the case of Germany, the *Hochschulforum Digitalisierung* (HFD) is an important think tank, advisory body and actor that promotes policy-practice-research dialogue. It can be considered as a major driver of change as it has high public visibility and collates expertise from both research and teaching as well as policy making. It operates with national funding. Community-platforms relevant for the promotion of change in the field of OER in Germany are *OERinfo* and the *OER World Map*.

Although there are agents for change at the macro level, change has been reported to happen mostly at the other levels in the majority of countries. For instance, change especially occurs at the institutional level in South Africa, Turkey⁴, Japan, Australia and Spain; and at the micro level (led by individual faculty members) in the U.S. and Japan, but also in Australia. In the case of Canada and Germany, agents for change are mostly located at the provincial/state level. Exceptions include China⁵ and South Korea, where change happens mainly at the national level.

Discussion and conclusions

This study contributes to the field with an international comparative approach to further understand the factors behind (O)ER infrastructure at the national level, some of which were initially covered in the *Open and Distance Education* volumes (Qayyum & Zawacki-Richter, 2018; Zawacki-Richter & Qayyum, 2019). Overall, and despite the differences among countries, the key value of OER and their repositories of enabling universal education (Caswell et al., 2008) seem to be a work in progress. Although some countries (concretely, Turkey and South Africa) include the goal “broadening or enabling access to HE” in their policies, their real practices show that there is still more to do for its actual realisation. On the other hand, as Archer and Prinsloo (2017, p. 279) note, OER and MOOCs require an ethics of caring that “recognises that the change brought about as technology, not only represents a disruption in access to knowledge, but is also a product of a changing society”. Despite the technological focus of the project in which this study is framed, our perspectives shed light on cultural, social and economic aspects linked to the issue of digital infrastructures of (O)ER that are in dynamic change. These contextual aspects have to be considered as challenges that each country manages its own way.

Therefore, we consider that findings from this study could serve as a wake-up call for national/provincial organisations, to see countries comparatively reviewed and therefore justify their push for the improvement of (O)ER infrastructure. It is vital to acknowledge that it is not possible to understand national (O)ER infrastructure and the associated support elements without analysing and understanding the differences of context and culture, as became clear from the analysis above. Aspects such as the political context and the socioeconomic situation have been shown to be a major influence on how HE (O)ER infrastructures are - or are not - developed and how change takes place. National and provincial legislation and recommendations, as well as measures for promoting change such as the provision of funding or the acknowledgement of merits, influence the development of (O)ER infrastructure in HE. Quality assurance mechanisms, such as the

⁴Although Turkey has a highly centralised system, the change, or initiatives regarding OER, comes from public institutions that have a long history of open education, such as Anadolu, Ataturk and METU.

⁵Change in China also happens at the meso and micro levels, although compared to the Government, the other forces are far less significant.

development of standards and ensuring its compliance, may be in place to ensure not only the interoperability between infrastructures but also the quality of (O)ER content.

The method of this study should be acknowledged as its most important limitation. This report relied heavily on the expertise and knowledge of academic experts from the countries under investigation to conduct desk research and obtain data and general information on the topic. This method could potentially lead to subjective views and a non-exhaustive retrieval of information, since a systematic approach to obtain prior research may not necessarily have been followed. Therefore, some gaps within the results may be present; these can be addressed in a more systematic way in the future. Also, the study has rather a descriptive character than a critical perspective. Such a perspective would be in line with studies, such as the one by Knox (2013), which brings another approach to the topic that could be considered in future work. Next steps will also analyse the meso (institutional level) and the micro levels (teaching and learning level) of the various countries and provide a more holistic overview of the current state of (O)ER dissemination and use.

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