

# **The evolution of sustainability models for Open Educational**

## **Resources: insights from the literature and experts**

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## **Abstract**

The adoption of Open Educational Resources (OER) can, on the one hand, increase access and quality in higher education, but on the other hand it is raising concerns among universities and researchers about its economic sustainability. This is mainly because, unlike traditional online learning, in OER-based approaches learners do not have to pay to access learning resources, however the institution incurs costs for the production, maintenance and dissemination of OER. In this context, the United Nations Educational, Scientific and Cultural Organisation (UNESCO) has urgently called for more research on OER sustainability models in its 2019 OER recommendation. To contribute to a better understanding of this issue, this paper used the triangulation method to investigate the potential OER sustainability models that are currently implemented by universities, along with their challenges and possible developments. Through a comprehensive literature review and a 2-round Delphi method with thirty OER experts, ten OER sustainability models have been identified and analysed, where public and internal funding are the most established ones. The findings of this study could support organisations in developing their own OER sustainability strategy, facilitating OER adoption worldwide and therefore contributing to achieving the UN Sustainable Development Goals (SDGs).

**Keywords:** Open Educational Resources; distance education; revenue model; sustainability

## **1. Introduction**

Open education can be described as a *movement (...) based on a set of intuitions shared by a remarkably wide range of academics: that knowledge should be free and open to use and reuse; that collaboration should be easier, not harder; that people should receive credit and kudos for contributing to education and research; and that concepts and ideas are linked in unusual and surprising ways and not in the simple linear forms that today's textbooks present. (Baraniuk, 2008, p. 1)*

Thanks to these principles, open education can potentially increase access to and quality of higher education, fostering democratisation, competitiveness, localisation and connecting formal and informal learning (Butcher & Hoosen, 2012; Weller, 2020). In the last few years, openness has increasingly entered the higher education context and open education methods are starting to be adopted or considered as usual practices, especially in scholarly activities (Weller, 2014, 2020). At the same time, the open education movement has been evolving. Previously, content and Open Educational Resources (OER) were the key and, usually, the only focus of open education activities (Stracke et al. 2020), while at present, open education is modelled into practices, instructional designs, and open labs, and it has become the very core of Open Science (Burgos, 2020b; Nascimbeni et al., 2018).

The use of OER has been one of the drivers, if not the main one, to make this process towards openness happen (Conole & Brown, 2018). The OER concept was first by UNESCO in 2002, and was at the core of two OER World Congresses in 2012 and 2017. Recently, OER was the topic of a recommendation by UNESCO (UNESCO, 2019), where they are defined as “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 licence that permits no-cost access, re-use, repurpose, adaptation and redistribution by others”. OER is considered one of the most significant educational developments in the twenty-first century (Shear et al., 2015), able to reduce learning costs and make learning affordable for all learners. OER can also foster teaching innovation due to their capacity to be freely adapted, re-used and shared in different contexts under open licences (Hassler et al., 2014).

OER are increasingly being adopted by universities around the world as a way to reduce learning costs and to facilitate knowledge sharing and co-creation among learners (Grodecka & Śliwowski, 2014; Pitt et al., 2020). For instance, the handbook of successful open teaching practices from the OpenGame European project has reported 24 real-life cases of open teaching practices in higher education (García-Holgado, García Peñalvo, et al., 2020), showing the different impact dimensions that open teaching might have. This was further noted by the Good Intentions report (McGill et al., 2008), which examined a range of sustainability models for sharing learning resources, including international, national, institutional, sectorial, and subject discipline, and found that many were transitioning to adapting their models towards more openness, and is confirmed by more recent studies (Farrow et al., 2015).

Still, universities face difficulties in maintaining and enhancing their OER provision, with the absence of clear sustainability models, revenue models or business plans to keep producing and delivering OER being a major problem in the whole open education movement (Burgos, 2020c; De Langen & Bitter-Rijkema, 2012). For example, John Mitchell, the overseer of Stanford University’s open programmes, has predicted that, also because of this lack of economic sustainability models, the university will turn away from offering free online courses (Fischer et al., 2014). Already in 2006, Joyce (2006) pointed out that OER should be based on new sustainability models, and that these models should be investigated. More recently, Wiley et al. (2016) confirmed the urgent need for universities to find a successful model that can support the creation and publishing of OER.

A number of studies have tackled this problem of OER sustainability models, both by academics (Burgos, 2017, 2020c; De Langen, 2013) and by international organisations advocating for OER (see for example Miao et al., 2016). Since 2012, in line with the wave of interest raised by the Massive Open Online Course (MOOC) phenomenon in higher education (García-Peñalvo et al., 2018), research investigating open education sustainability models has been increasingly focussing on MOOCs’ sustainability models. Since then, even when reports tackle both OER and MOOCs (as in the case of

the 2016 D-Transform report), the major focus is on MOOCs. Given the peculiar characteristics of MOOCs, which in the eyes of many observers cannot be considered OER due to the fact that in most cases their contents are not provided through open licences (Rodriguez, 2013; Stracke et al., 2020), the findings of research on MOOCs sustainability cannot be automatically extended to OER in general. In the meantime, a number of developments using emerging technologies have taken place in the OER domain (Howard, 2019), such as the exploration of artificial intelligence methods to search for OER and the use of blockchain to protect OER authors (Marjit & Kumar, 2020). Similarly, to keep up with this rapid development, the number of institutional OER policies is growing as well. Therefore, the OER ecosystem and its possible sustainability strategies are different today from just a decade ago. Given the importance of the OER sustainability models in facilitating OER adoption worldwide and therefore in contributing to achieving Sustainable Development Goals (mainly but not only SDG 4), UNESCO called for more research on OER sustainability models (among four other objectives) in its recent OER recommendation (UNESCO, 2019). One study (Huang et al., 2020a) recently focused on those five UNESCO OER objectives, but it did not cover OER sustainability models.

Given this background, and in line with UNESCO's definition of OER (presented above), the aim of this study is to investigate the possible sustainability models that can be implemented in order to support the production and use of OER in higher education. It should be noted that this study focuses exclusively on higher education, due to the difficulty of generalising sustainability challenges and dynamics to other sectors such as school education, that work with a very different structure and logic. Specifically, this study aims to answer the following research questions:

**RQ1.** What are the potential OER sustainability models that can be implemented in contemporary higher education systems?

**RQ2.** What are the possible limitations and the main challenges of these OER sustainability models?

To answer these questions, this study uses two data collection methods, namely a comprehensive literature review and a Delphi survey among OER experts. The rest of this paper is structured as follows: Section 2 details the research methodology followed in this study, Section 3 presents the obtained results, while Section 4 discusses them. Finally, Section 5 concludes the paper with a summary of the findings and potential future research directions.

## **2. Methodology**

To collect data about the possible OER sustainability models that are being and could be implemented, this paper uses the triangulation method, which is widely adopted in social science to increase the credibility and validity of the obtained findings in qualitative research (Cheng et al., 2018). Triangulation is considered as the use of

multiple methods or data sources to develop a comprehensive understanding of phenomena or to increase the trustworthiness of the obtained findings (Patton, 1999). In this context, the data in this study was collected through two methods – a comprehensive literature review and an expert survey. Specifically, as a first step, the findings about OER sustainability models were first collected from the literature based on a comprehensive literature review. Then, to further increase the validity of these obtained findings, they were reviewed and validated by OER experts using two-round Delphi method. Each of the methods (literature review and Delphi) are discussed in the subsequent sections.

## 2.1. Literature review

### 2.1.1. Search strategy and selection criteria

A comprehensive literature review was conducted to identify the reported OER economic sustainability models. Several search keywords, as shown in Table 1, were used in various electronic databases, including ScienceDirect, Taylor and Francis online and IEEE Xplore Digital Library. Additionally, García-Holgado, Marcos-Pablos, et al. (2020) further suggested that results from research projects should be included in the literature review. In this context, since several international projects have tackled OER sustainability models, this study expanded its search strategy beyond scientific databases (mentioned above), by including the search engine Google in order to identify the reports produced by projects that met those criteria.

**Table 1. Search keywords**

<b>Topics</b>	<b>Search keywords</b>
Education	Open education OR open educational resources OR open educational practices OR open license OR open-access
AND Models	Sustainability models OR funding models OR business models OR financial models

After searching the relevant databases, two authors analysed the retrieved academic papers by titles, abstracts, and if necessary, by full text, based on a pre-defined inclusion and exclusion criteria, as shown in Table 2.

**Table 2. Inclusion and exclusion criteria**

<b>Inclusion criteria</b>	<b>Exclusion criteria</b>
Papers written in English	Papers which are not written in English
Papers that discuss sustainability models in OER	Papers that discuss sustainability models in other fields, e.g. online learning in general or MOOCs
Papers that list examples of sustainable models	Papers that discuss sustainability models in a generic way

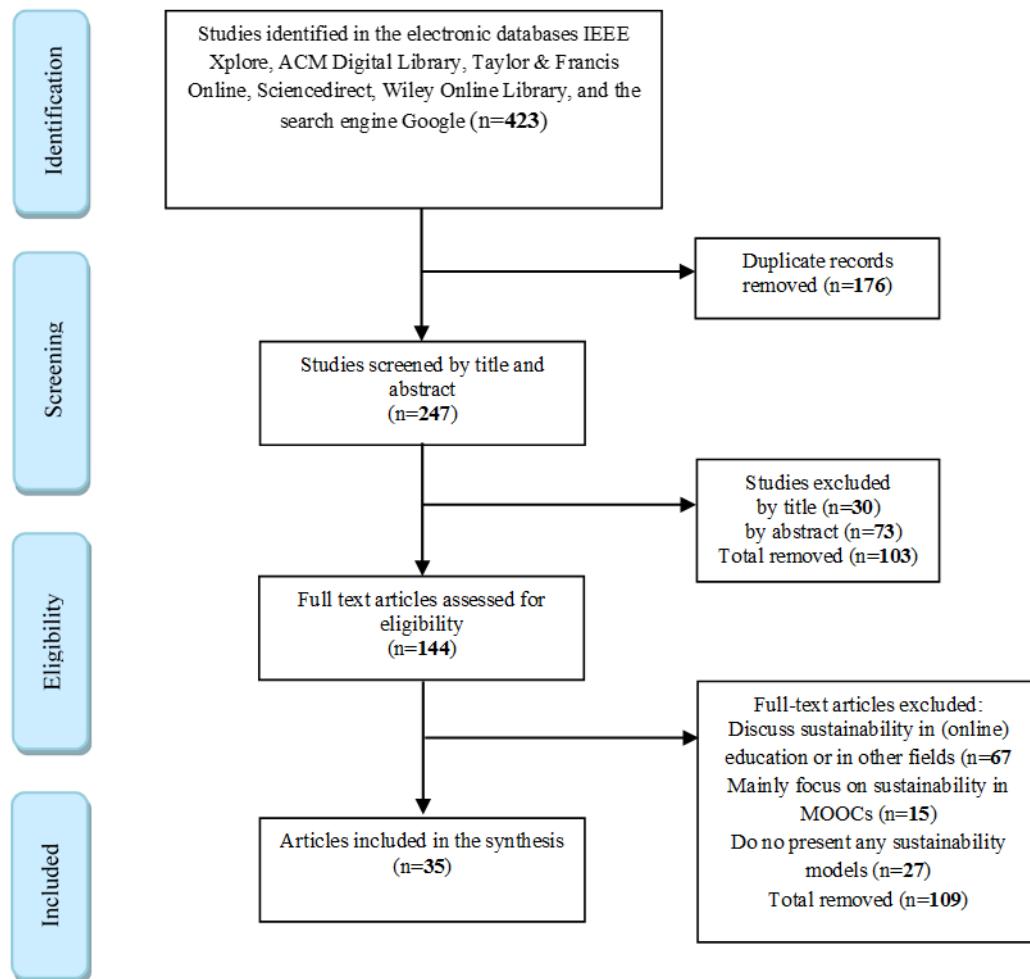
Specifically, we have deliberately excluded from the used keywords the word MOOC, for two main reasons. First, as we said before, MOOCs' nature as OER is often questioned by researchers (Stracke et al., 2020) and therefore the principles beyond a decision to launch a MOOC initiative can be different from the ones underpinning the open education priorities within a university. Second, it is seen that most studies related to sustainability analyses have recently been focussing mostly on MOOCs and that the findings cannot be automatically extended to OER, because of the different economic and production mechanisms between the specific contexts of MOOCs and OER, which are related but require some dedicated, and separate approaches (Nascimbeni et al., 2020; Stracke et al., 2020).

As it appears from these keywords, the research tackled sustainability mainly from an economic point of view. The authors acknowledge that if, on the one hand, sustainability must be sought along all the nine pillars of open education, which are access, content, data, research results, licensing, accreditation, policy, interoperability and technology (Burgos, 2020a), on the other hand, universities need resources to maintain the production, update and dissemination of OER. Also, it must be noted that economic sustainability should not be confused with OER-based revenue production. Even if some revenue scheme exists in some of the models emerging from the research, the focus has not been on how a university can generate an investment return or profit out of their production of OER; on the contrary, the authors focus on how the production can maximise the effect of the OER supply within the existing budget boundaries, expanding access and quality of its learning offer through a sustainable OER provision, that includes, but it is not restricted to, an economic layer (De Langen, 2013).

### **2.1.2. Selected papers and quality assessment**

This research yielded a total of 423 articles from 2007 to 2019. After removing

duplicated papers, 247 papers remained. 103 papers were then removed based on screening the title and abstract. The remaining 144 papers were considered and assessed as full texts. 89 of these papers did not pass the inclusion and exclusion criteria. Thus, as a total number, 35 research studies were used in the analysis process where 17 are journal papers, 11 are reports from international projects lead by, for instance, by UNESCO, the European Commission or the Commonwealth of Learning, 6 conference papers and 1 book chapter. Figure 1 presents the full results of the selection process as recommended by the PRISMA group (Moher et al., 2010).



**Figure 1. Flowchart of the comprehensive review process**

To assess the overall quality of each selected paper, the following four criteria were used, where each one focuses on different quality issue. Each Quality Criterion (QC) is a Yes/No question corresponding to a score of 1 or 0 respectively namely:

**QC1.** Did the study report the sources and details of outcome assessment?

**QC2.** Did the study compare its reported results with previous results?

**QC3.** Did the study conduct validity or reliability tests during the quantitative analysis?

**QC4.** Did the study involve a statistical analysis of significance during the quantitative assessment?

The final score of a given study is the average of the four achieved scores across criterion. Many studies in the literature used similar strategies for assessing quality (Miller, 2015; Spolaôr & Benitti 2017). The quality scores of the selected papers showed that: 15 studies reported the sources and details of outcome assessment (QC1), accounting for 42.85% of the total studies; (2) 1 study compared its results with other results (QC2), accounting for 2.85% of the total studies; (3) 1 study conducted validity or reliability tests during the quantitative analysis (QC3), accounting for 2.85% of the total studies; and, (4) no study involve a statistical analysis of significance during the quantitative assessment. As it can be seen from the quality assessment results, most of the papers (except one study, Okoli & Wang, 2015) focused on using one data source to collect data, namely scientific literature. Additionally, all the studies used only qualitative analysis. Therefore, this current study contribute to the existing literature by using several data sources, namely literature and experts with both qualitative and quantitative analysis (as discussed above) to draw conclusions about OER sustainability models.

### **2.1.3. Final obtained sustainability models**

Among these 35 studies, the collected sustainability models were first split into different categories, in line with a well-known classification of possible sustainability models (Downes, 2007), via a card sorting method. This method is used to organise and improve the architecture of the information. It is an established method for knowledge elicitation by creating different categories of collected information, where it has been widely applied in several fields, including psychology, robotics, knowledge engineering, software engineering, and web site design (Cheng et al., 2018; Nurmuliani et al., 2004).

To ensure the reliability of the final obtained categories, two researchers in this study participated in the categorisation process based on the definitions of the sustainability models reported in the literature. For instance, sustainability models that are talking about funds from individuals, private associations, community, etc., were all categorised under the Donations model. Particularly, in cases when the categorisation was different, an agreement was reached through discussions. At the end, eight OER sustainability models were identified, namely: (1) Institutional: universities cover the costs of OER as part of their mission/mandate; (2) Government: OER are funded through public support by national or local public funding; (3) Endowment: the funding for OER is provided by charities or foundations; (4) Membership: the university pays to be part of a larger OER consortium that handles the creation and delivery of OER, as in the case of the OER Universitas consortium; (5) Donations: OER are funded through public and/or private donations; (6) Freemium: OER are funded by converting a number of users into paying customers; (7) Creator-pay: the creators of the OER pay for their development and dissemination; and, (8) Sponsorship: the cost of OER is borne by sponsors in return for advertising and promotion.

To obtain further input about OER sustainability models, experts were invited to offer



their comments about these models, as discussed in the next section.

## **2.2. Expert survey (Delphi method)**

Questionnaires are widely used to investigate individuals' perceptions and behaviours in a specific topic (Cheng et al., 2018). In this context, a 2-round Delphi survey with OER experts was conducted via email, composed of two rounds of inquiry. Before the survey, experts were first contacted to check their interest in participating in this research. Additionally, the authors explicitly informed the experts that their participation would be anonymous. The experts were chosen based on their profiles, which should include: (1) OER as their research interest; (2) good publication record in this area; (3) relevant position in an active OER organisation. As a result, 30 experts (among 40 invited experts, meaning a 75% of active response) participated in this research, including OER UNESCO chairs in several countries, editors of OER journals, professors, and researchers working on OER in several leading organisations, such as UNESCO, COL, OECD and ALECSO. Despite that the experts were carefully chosen for this study to ensure the reliability of the findings, we further asked them to rate their familiarity with OER, on a scale from 1 to 5 (where 1 is not familiar and 5 very familiar), as well as to write down their teaching experience in years. The experts had an average of 4.48 related to the familiarity with OER, which reflect their high level of expertise and appropriateness for this study. The experts also had an average of 22 years as a teaching experience. The data was collected from the Delphi survey over a 3-month period to give the experts enough time for a detailed response. To ensure a high quality feedback during the Delphi method and that the given feedback would not be outweighed by personal beliefs, the experts were asked to keep in mind several factors suggested by Rowe and Wright (2001), including that the feedback should be easy to read, straight to the point, and without personal political opinions.

In the first round of the survey (See Appendix 1), the experts were requested to: (1) review and validate the eight identified OER sustainability models (see above section); (2) further enhance the name and description of each model, if needed; and (3) propose potential OER sustainability models based on their expertise that had not been identified during the literature review. Specifically, the questions that the experts answered were: (1) Based on your experience, please rate these models (the 8 provided models) according to their frequency of being used in higher education; (2) For the models that you have rated, can you please provide the reasons for your choice?; and, (3) Do you have any suggestions, or can you identify other sustainability models?.

In the second round (See Appendix 2), after obtaining the final set of sustainability models (from the literature and first round), the experts were requested to answer the following questions: (1) rate the maturity of the final validated OER sustainability models (from the literature and the first round) from 1 to 4, where: 1 corresponds to established model; 2 to emergent model; 3 to future potential model and 4 to inapplicable model; (2) provide some examples for each model; and (3) list potential limitations related to each OER sustainability model.

### **3. Results: What are the potential OER sustainability models that can be implemented in contemporary higher education systems?**

#### **3.1. Results of the first Delphi method round**

During the first round of the Delphi method, the experts gave different inputs about the provided eight sustainability models extracted from the literature (see above). Despite that we started from the widely used classification of OER sustainability models proposed by Downes (2007), the experts gave several inputs which led to a new classification of ten OER sustainability models. In this classification, some models remained the same, such as the Sponsorship model. However, some previous models were merged together as they have a common description/goal, or because the main stakeholders could be involved in more than one model. For instance, in the previous classification where governmental and institutional models were provided separately, most experts highlighted that many universities are having mainly governmental funding, so at the end the government is still responsible on both of these models. Therefore, separating them is not the accurate way. They further suggested renaming them as public and internal models with new definitions. Additionally, the experts suggested that Donation and Endowment models (which were provided as separate models in the first round) to be merged together. Finally, the experts suggested new OER sustainability models that were not provided before in Downes' classification, such as Community based-model, Offering learning-related data to companies model, and Producing OER on demand model. Based on the all the inputs provided by the experts through the Delphi questionnaire, the following ten OER sustainability models were identified and validated.

*(1) Through internal funding (e.g. OER support programme):* the university covers the costs of creating, delivering and disseminating OER as part of its annual budget in line with its mission/mandate, as in the case of the Monterey Institute's HippoCampus initiative (Okoli & Wang, 2015). As noted by De Langen (2013), the funding to sustain institutional OER initiatives can come from private or public sources (De Langen, 2013).

*(2) By participating in OER networks:* the university pays to be part of a larger consortium that handles the university's OER-related activities, such as the creation, delivery and dissemination of OER. This is the case, for example, of universities participating in the OERu consortium, where membership fees are used to cover the central infrastructure costs (Hoosen & Butcher, 2019), or of the partners in the Merlot project (Okoli & Wang, 2015). In some cases, these networks can take care of OER-based accreditation and financially support individual OER providers.

*(3) Through public funding:* OER are funded through international, national or local public funding, typically through grants and funded projects (Annand, 2015; Kanwar et al., 2010). Hoosen and Butcher (2019) mentioned that OER funding is

usually provided by governments and multinational organisations such as the European Commission, ALECSO or the United Nations. As an example, the Chinese Ministry of Education has recently invested significantly to support OER projects, such as the Chinese Quality Course (Huang et al., 2020b). Also, different public funding sources can co-exist: in Brazil for example, federal funding (Secretariat of Basic Education) can be complemented by state funds (Secretariat of Education of the State of São Paulo) (Jones, 2015; Lashley et al., 2017).

- (4) Through endowments/donations: funding for OER is provided by charities or foundations or collected through private donations, including crowdfunding. Wiley stated that through endowment models universities obtain base funding, and that these projects proceed based on the interest of the funders (Wiley, 2007). Okoli and Wang (2015) also stated that donations and grants are popular models where non-profit organisations strategically manage the funding. Donations can be complementary to other funding models, as in the case of the MIT, which relies on private donations to complement its internal funding to support open OER production (Helsdingen et al., 2010; Schuwer & Janssen, 2013).
- (5) Through sponsorship/advertisement: the cost of OER is supported by sponsors in return for a specific service such as advertising and promotion. Okoli and Wang (2015) highlighted that OER providers can gain money from their free educational resources by including paid advertisements. Notably, the information conveyed by this model can range from intrusive commercial messages to more subtle and politically correct inputs (Helsdingen et al., 2010; Wiley, 2007. Wiley, 2014).
- (6) By offering services to learners: the cost of OER is covered by offering services to learners, such as OER customisation, tutoring, recognition, including through freemium models and micro-payments such as tokenised services (Geser et al., 2019; Law & Perryman, 2017). These freemium models can include everything that learners consider valuable, such as exams and accreditation (Bacsich, 2016; Orr et al., 2018; Perryman et al., 2013). Fischer et al. (2014) highlighted that one of these services could be provision of learning certificates after completion of OER-based courses. For example, the OERu model is considering assessment and accreditation as services that complement OER-based studies and that can build up fully OER-based degrees at a much lower cost than traditional degrees (Mackintosh et al., 2011; Wang & Wang, 2017). Flat World Knowledge (Hilton III & Wiley, 2011) and WikiEducator (Helsdingen et al., 2010) are also applying this strategy.
- (7) By offering learning-related data to companies: the cost of OER is addressed by selling data and analytics about learners' activities (Darwish, 2019). Fischer et al. (2014) highlighted that universities can earn money from OER by selling reports about learners or teachers to companies, which can use them in legitimate ways, for example to enhance their learning experiences or to connect learners to job opportunities, but also through less transparent approaches (O'Neil, 2016; Xydopoulos et al., 2015).
- (8) By producing OER on demand: the institution produces OER on behalf of other actors such as training centres, companies or student organisations, that pay to release the OER under their brand and conditions (Herrera, 2010). This is, for

example, the case of Brazil's Programa Nacional do Livro Didático (Horta Nogueira et al., 2018).

(9) *By relying on OER authors*: individual authors offer to produce OER, either from within or outside their workplace and work time. Further, the authors can be from the corporate or the public sector. There is a number of potential settings (sort of a shading), depending on whether a public-sector author creates OER during their work time, or a private-sector author creates OER outside their work time, for instance at home.

(10) *Community-based model*: the university relies on a community whose members bear the cost of producing OER, as a combination of any of the previous models (Mengual-Andrés & Payà Rico, 2018; OERup! Project, 2014; Wang, 2019). Okoli and Wang (2015) deemed that this is a “prosumer” model, where members of a community create materials for others to use. Wikipedia, WikiEducator, and Phil Preprints adopt this model (Okoli & Wang, 2015). Okoli and Wang (2015) identified two potential sustainability models that can be regarded as variations of the community-based model, namely: OER are created by classroom-based student cohorts to be re-used by other students, and content is co-created by students (Okoli & Wang, 2015).

### **3.2. Results of the second Delphi method round**

After validating the ten OER sustainability models in the first round (described above), the experts were requested in the second round of the Delphi method to rate the “maturity of the models” from 1 to 4, where 1 corresponds to an established model; 2 to an emergent model; 3 to a future potential model, and 4 to an inapplicable model within present conditions. Additionally, the 8 A. TLILI ET AL. experts were requested to provide some examples for each model. Table 3 shows the models ordered from the most established to the least established ones, based on each model's rating mean and Standard Deviation (SD). Interestingly, it can be seen in Table 3 that some OER sustainability models, including models 3, 1, 8, 5 and 7, had low SD, which implies that the experts shared the same thoughts about these models, however they had different thoughts about the other OER sustainability models. This could be due to different reasons, such as the culture, as discussed in the next section. It should be noted that Table 3 listed all the examples given by the experts, in higher education and non-higher education contexts, to further clarify for readers how the OER sustainability models could be implemented.

**Table 3. Results of the maturity of the OER model based on the experts' rating**

#Model	Mean	SD	Examples <sup>1</sup>
Model 3. <b>Through public funding</b>	1.35	0.69	BCCampus, ClassCode
Model 1. <b>Through internal funding</b>	1.69	0.97	U. of Edinburgh, U. of Tasmania, U. of Southern Queensland, UK Open University, Cadi Ayyad University, UNISA, Fiocruz (RJ)
Model 4. <b>Through endowments/donations</b>	2	1.02	Wikipedia, MedOANet, PASTEUR4OA, OpenStax College, Khan Academy
Model 2. <b>By participating in an OER network</b>	2.15	1.01	OERu, African Health OER Network, DigiLL, Open University of Brazil
Model 6. <b>By offering services to learners</b>	2.31	1.01	Khan Academy, Lumen Learning, Siyavula, OpenStax
Model 9. <b>By relying on OER authors</b>	2.36	1.22	Jörn Loviscach
Model 10. <b>Community-based model</b>	2.62	1.13	Educred.ro, OER communities in OSGeo or Mastodon
Model 8. <b>By producing OER on-demand</b>	2.85	0.78	PNLD programme (federal textbook programme in Brazil)
Model 5. <b>Through sponsorship /advertisement</b>	3.16	0.94	Global Text Project
Model 7. <b>By offering learning-related data to companies</b>	3.54	0.76	Hootsuite Academy

#### **4. Discussion: what are the possible limitations and the main challenges of OER sustainability models?**

Some general considerations emerged from the Delphi questionnaires that can complement the rating presented above. First, many organisations do not use a single model but rather a combination of them. For example, in a university we can have a community-based model used by a department or a teaching group, complemented by participation in an international network and supported through public funding. As a real-life case, Wikipedia implements models 4 and 10. Second, whatever model – or combination of models – is chosen, it is important to embed it in a long term strategy, either under the label of open education or others, such as e-learning and learning innovation. The university management must be aware of the importance and benefit of OER and have full buy-in for the selected model. Third, the issue of OER production

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<sup>1</sup> It should be noted that even if the paper focuses on Higher Education, Table 1 lists all the examples provided by the experts, both within Higher Education and in other contexts.

shall be separated from OER distribution, since institutions need to understand the complexity of OER production – and can decide not to invest in producing OER – as well as the cost associated with OER distribution and with using OER produced by others. Fourth, models must be connected with purposes and values, meaning that if OER are considered a “public good”, then this needs to be reflected in the sustainability model. Values-driven approaches can help implement service-based models, as pragmatic approaches in the absence of public funding, without moving away from the ethos of the OER and the open education movement. Last but not least, all those models should be envisioned as general patterns to be applied in the very diverse national and institutional contexts, where political and cultural environments will be more conducive or averse to particular visions and approaches. For example, some models are inapplicable in certain regions like the South Mediterranean, due to the common mindset that charity funding should be allocated to humanitarian causes rather than the sustainable dissemination of knowledge, while they might work in more “mature” environments such as the US, Canada or western Europe.

To facilitate the implementation of the OER sustainability models, the experts were also requested to mention the limitations of each model that stakeholders should pay attention to before adopting that specific approach in their respective contexts. Below are the collected limitations for each model. The limitations of Model 1 **Through internal funding** have to do with the scarce resources within universities, with the low priority assigned to OER in many universities, both by leadership and teachers, and with the administrative complications connected to providing financial incentives to faculty who produce OER. In more general terms, the persistence of traditional publishing models and the low awareness and capacity of faculty to produce OER represent systemic obstacles to the implementation of such a model.

Organisations that plan to sustain their OER work **by participating in an OER network** (Model 2) need to have access to a relevant network in terms of language, culture, capacity and need to cope with both the budget required to work within such networks, including and going beyond the membership fees, and with the low perception of the long-term value of joining an OER network by leaders and faculty. Two other barriers exist: at the level of the educators, the resistance to using resources developed in other institutions, and at the level of management, the difficulty of recognising credits for courses taken outside the university.

Sustaining OER activities **through public funding** (Model 3) is made difficult by the scarce funding lines for OER, especially outside countries such as the US or Canada, coupled with the limited awareness of possibilities and fundraising capacity within universities. Also, support relying on projects often depends on unstable public policy priorities, is not continuous (and this can negatively influence OER updating), and brings the need to ensure sustainability of results after the end of funded projects.

Model 4, **based on endowments and donations**, is limited in its efficacy by the low

interest of possible supporters in OER and open education, especially in certain regions and countries, and by the need to ensure sustainability of results after the end of the donation. From within the university, the limited awareness of possibilities and the often low fundraising capacity can represent problems, together with the fact that faculty may view these donations as impinging on their academic freedom.

**Sponsorship and advertisement** (Model 5) also have to deal with faculty who may view this (a) as limiting their academic freedom, (b) related to the low capacity of selecting the right sponsor, and (c) the little degree of management of sponsorships. Also, experts noted that this model is not fully in line with the ethos of OER and open education and that it is an impossible model for public institutions in many contexts.

Model 6, which relies on **offering services to learners**, needs to be able to keep the OER open for everybody, even in a freemium model, and to integrate the OER fees in a broader service ecosystem. Other limitations are the lack of needed capacity and infrastructure for implementing the model within many universities and the fact that the model is not fully in line with the values and principles of OER.

Institutions that want to sustain their OER activities by **offering learning-related data to companies** (Model 7) need to consider that this might be an impossible model in many contexts from a data privacy and data protection point of view and an approach not fully in line with ethos of OER and open education; also, the organisation might lack the needed capacity and infrastructure for implementing the model.

Model 8, **producing OER on-demand**, requires a shift towards a new business mindset, similar to the one of traditional publishers, as well as internal capacity and infrastructure. Also, it can be undermined by the low cost-effectiveness of universities when producing OER and by the need to make sure that the “client” respects the OER ethos.

When relying on **OER authors** (Model 9), it is important to consider two factors: (1) the need to create and maintain incentives and visibility to sustain authors’ motivation; and (2) the fact that this model is difficult to be sustained, since it strongly depends on the willingness of authors, and to be scaled, since it is based on voluntary time donation.

Lastly, the limitations of Model 10 (**community-based model**) are the difficulty of having access to relevant communities in terms of language, culture, capacity and the work needed to design a clear strategy with overall coordination, logistics and responsibilities. Similar to the previous one, this model is also demanding in terms of sustainability and scalability, since it depends on the motivation of stakeholders that are external to the organisation.

Three further considerations emerge from the literature that are transversal to all these models. First, collaboration between and among universities, apart from being an inner characteristic connected to working with OER (Nascimbeni et al., 2020), can be a way

to achieve cost advantage and economies of scale (De Langen, 2013), both in the case of equal collaboration and in cases where a young university is mentored by an established one, as with the relationship between the UK and the Hong Kong Open Universities. Second, the “loss-leader model”, where a product or service is sold at an unprofitable price to attract more customers or to sell other products and services (Loss Leader Strategy, 2019), is typical of MOOCs but is not uncommon in the OER field (Bacsich, 2016). Third, the use of OER, especially when they are considered part of a large open education programme, can contribute to a revision of the technology that universities are using, towards the adoption of open technological standards: this “replacement model” can produce some cost savings from software licences and ICT infrastructure which can be invested into OER (Wiley, 2007).

When looking at these models, it is important to consider that they are generally composed of three aspects. First, the way OER are financed, noting that the various financial models shape the resulting services but are also the element of a business model which needs refining as services go through various stages of maturity, and that non-economic ways to sustain OER, such as tenure decisions and teacher professional development practice, can have an influence in the decisions by universities on which OER sustainability model, or combination of models, to adopt. Second, the service model adopted, noting that often there may be several tiers to a “market” – the primary group/community on which the service is closely modelled and also possibly secondary markets that the service can serve. Third, the role of suppliers and consumers, that can often be from the same sector, community or group, noting that the groups that are contributing may not actually be consuming; consumers may also be suppliers but not necessarily (McGill et al., 2008). Keeping this in mind, it is important to understand the challenges that these models bear. First, especially in Europe, there are legal and ethical issues concerning selling and trading data of courses attendees and credit-bearing certificates (Burgos, 2020c). Ethical issues about showing advertisements to students are also to be considered when the advertising model is adopted, even though advertising is successful in many other fields (Okoli & Wang, 2015). Additionally, cultural questions could be raised such as whether users are willing to pay for special services, such as certificates, especially in those education systems that are mainly based on public funding; still, services that seem to have a low acceptance by users due to cultural resistances should also be tried out, to assess their success (Fischer et al., 2014). This consideration points to the need to consider some general issues related to OER such as the different levels of openness of licenses and the impact of fair use doctrines. Furthermore, in the government-funding model, OER funding can be fluctuating following governmental financial cycles and political priorities. Similarly, while donations are helpful and can definitely support OER, their continuity over time seems to be a common problem (Okoli & Wang, 2015).

## **5. Conclusions, implications and future directions**

The POERUP project, which focused on policies for the uptake of OER noted in 2013



that everything seemed in place for OER to move from pilot projects to a further stage of maturity: platforms had been created, large quantities of open resources existed, MOOCs were being offered and certification systems were being deployed; still, an ongoing challenge was to identify sustainability models appropriate for the longer term development and use of OER (POERUP, 2013). In line with this position, which is still valid today and is even more critical as UNESCO has recently called for OER sustainability models in its OER Recommendation (UNESCO, 2019), this paper presented a comprehensive investigation from both the literature and from experts' perspectives on OER sustainability models that higher education stakeholders are actually implementing and could further adopt in their respective contexts. Out of the list of ten models that we have developed thanks to the different research iterations, it was found that public and internal funding are the most established models, and that at the same time an assorted group of other possibilities to fund OER exist, all of which are valid depending on the university context, strategy and target public. What seems clear is that any sustainability model must be part of an institution's OER strategy from its design, so that sustainability is guaranteed, or at least addressed, in the early stages. In addition, it appears that universities should adopt different sustainability models in the different steps of their OER journey, and that a flexible combination of models that can cater for external opportunities, beyond funding, at the same time valorising the OER-related assets within the institution, is probably the most viable option. These findings have important implications for the OER-related research community, since they enrich and update the debate on OER sustainability that somehow started with the work of Downes (2007) and reached its peak just before the wave of interest for MOOCs landed (Stracke et al., 2020), by taking a full picture of OER sustainability in a moment when the educational setting has changes substantially with respect to 2007. Furthermore, the paper can serve as a reflection tool for those higher education leaders and policy makers who are interested in embedding OER within their institutions in a long term and strategic perspective, since it opens up a range of options that can help designing sensible and tailored OER sustainability strategies.

It should be noted that this study has several limitations that should be acknowledged and further researched. For instance, this study did not conduct any experimental studies. Also, the search findings might be limited due to the search keywords used.

However, despite these limitations, this study presents a solid ground related to the OER sustainability models, hence contributing towards achieving the UN Sustainable Development Goals (SDGs) connected to the use of OER, especially SDG #4 (Equity and high-quality education for all), which works as a backbone to some other SDGs, e.g. Good Health (#3), Economic Growth (#8) and Reduced Inequality (#10).

Future research should focus on further investigating the potential sustainability models and on declining their application for the development of different types of resources (e.g. OpenCourseWare, Opentextbooks and MOOCs), and comparing them to those identified for generic OER, along some of the starting ideas proposed by the experts who took part in this study. In addition, future research should include applied formulas

for sustainability in practice, so that some field data are elicited and contrasted, based on actual exploitation of success case studies: this could help provide a generic set of indicators for exploitation models in open education, supported with facts and impactful, sustained implementations. Again, the cases proposed by the experts and listed in the present paper could represent a first list of practices to be analysed. Finally, it would be important to explore OER sustainability models in other educational sectors such as school education or vocational education, since these sectors work with different logic and structure compared to higher education. However, we might learn from the experiences of those universities that are currently embedding OER sustainability models within their strategies.

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# APPENDIX I

## Delphi Questionnaire - Round 1

### Introduction

This questionnaire aims at gathering the opinion of OER experts on the main OER funding models actually used within universities and to reach a consensus (through a Delphi method) on the most promising models to sustain OER production and adoption. The questionnaire is part of a research run by the SMART Learning Institute of the University of Beijing (main contact: Ahmed Tlili) and by the Universidad Internacional de la Rioja (main contact: Daniel Burgos).

### Part 1: Personal Information

Full name:
Institution:
Country:
Teaching experience (in years):
Teaching subjects:
Familiarity with OER (on a scale of 1 to 5, where 1 is not familiar and 5 very familiar):

### Part 2: OER funding Models

We have identified the following funding models for OER

1. **Institutional:** universities cover the costs of OER as part of their mission/mandate
2. **Government:** OER are funded through public support by national or local public funding
3. **Endowment:** the funding for OER is provided by charities or foundations
4. **Membership:** the university pays to be part of larger OER consortium that handles the creation and delivery of OER, as in the case of the OER Universitas consortium
5. **Donations:** OER are funded through public and/or private donations, as in the case of Wikipedia
6. **Freemium:** OER are funded by converting a number of users into paying customers
7. **Creator-pay:** the creators of the OER pay for their development and dissemination
8. **Sponsorship:** the cost of OER is borne by sponsors in return for advertising and promotion
9. **Selling learning-related data:** the cost of OER is covered by selling data and analytics about learners' activities
10. **Community-based model:** the university relies on a community whose members bear the cost of producing OER

**Question 1: can you identify other funding models?**

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**Question 2: Based on your experience, please rate these models according to their frequency of being used within universities.**

	Not used	Rarely used	Used	Frequently used
<b>Institutional</b>				
<b>Government</b>				
<b>Endowment</b>				
<b>Membership</b>				
<b>Donations</b>				
<b>Freemium</b>				
<b>Creator-pay</b>				
<b>Sponsorship</b>				

**Question 3 (optional): For the models that you have rated as Used or Frequently used, can you please provide some examples of institutions adopting these models?**

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**Question 4: What are in your view the most appropriate models that university should adopt?**

	Not appropriate	Somehow Appropriate	Appropriate	Very appropriate
<b>Institutional</b>				
<b>Government</b>				
<b>Endowment</b>				
<b>Membership</b>				
<b>Donations</b>				
<b>Freemium</b>				
<b>Creator-pay</b>				
<b>Sponsorship</b>				

**Question 5 (optional): For the models that you have rated as Appropriate or Very Appropriate, can you please provide let us what is the reason for your choice?**

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## APPENDIX II

### Delphi Questionnaire - Round 2

#### HOW DO UNIVERSITIES FUND THE CREATION, DELIVERY AND DISSEMINATION OF OER?

Dear experts,

the ten sustainability models below are the result of your inputs during the first Delphi round. For the second round, please let us know if you agree with the models and the way they are defined. Otherwise, please provide your comments in the box below. Also, please fill the “Maturity of the model” column (please rate from 1 to 4, where: 1: established model; 2: emergent model; 3: future potential model; 4: inapplicable model), provide some examples and list the main challenges for the models. Thank you.

Model	Maturity of the model	Examples	Main challenges
<b>1. Through internal funding</b> (e.g. OER support programme): the university covers the costs of creating, delivering and disseminating OER as part of their annual budget.			
<b>2. By participating in an OER network:</b> the university pays to be part of a larger consortium that handles the creation, delivery and dissemination of OER, or that collects funds and financially supports individual OER providers.			
<b>3. Through public funding:</b> OER are funded through international, national or local public funding, also through grants and funded projects			
<b>4. Through endowments/donations:</b> the funding for OER is provided by charities/foundations or collected through private donations (including crowdfunding)			
<b>5. Through sponsorship /advertisement:</b> the cost of OER is supported by sponsors in return for a specific service or good, such as advertising and promotion			
<b>6. By offering services to learners:</b> the cost of OER is covered by offering services to learners, such as OER customization, tutoring, recognition, including through Freemium models and micro-payments such as using tokenized services			
<b>7. By offering learning-related data to companies:</b> the cost of OER is addressed by			

selling data and analytics about learners' activities.			
<b>8. By producing OER on-demand:</b> the institution is producing OER on behalf of other actors (training centres, companies, students organisations, etc) that pay to release the OER under their brand and conditions.			
<b>9. By relying on OER authors:</b> the time to produce OER is offered by the individual authors, either from the corporate or public sector.			
<b>10. Community-based model:</b> the university relies on a community whose members bear the cost of producing OER, as a combination of any of the previous models.			

**Please write down your comments (if you have any) about the models in the table.**