Modernization and internationalization of Iranian HEIs via collaboration in TEL-based curriculum development in engineering and STEM

UNITEL E-COURSE

LECTURE NOTES

M2: Student-centered learning in practice and in STEM

Unit 2-6 Open Educational Resources (OER) and MOOCs in online-oriented STEM teaching

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Introduction

This topic will present Open Educational Resources (OER) and MOOCs in online-oriented STEM teaching and has the following objectives:

Objective 1: to recognise the different movements promoting openness in science research, innovation and education and identify synergies and interconnections between them

Objective 2: to characterize Open Educational Resources (OERs) and identify its typical features and contexts of use

Objective 3: to distinguish MOOCs according to different design patterns and select the most appropriate to each given learning need

Objective 4: to search, find and assess OERs and MOOCs for STEM teaching and learning situations

Objective 5: to implement Open Educational Practices in STEM teaching and learning

1.The open science ecosystem: opening up sources, access, data and education

1.1.History of OER

“It is commonly referred that the main milestone in the Open Education movement is the foundation of the United Kingdom Open University in 1969. But the emergence of openness in education can be tracked in history long before this important event, in several movements, discourses and approaches that do not always indicate the term open.” (Teixeira et al., 2017, p. 4).

Peter & Deimman (2013) make an historical reconstruction to the concept of openness in Education pinpointing some of its beginnings before the XX century, as can be seen in Figure 1.

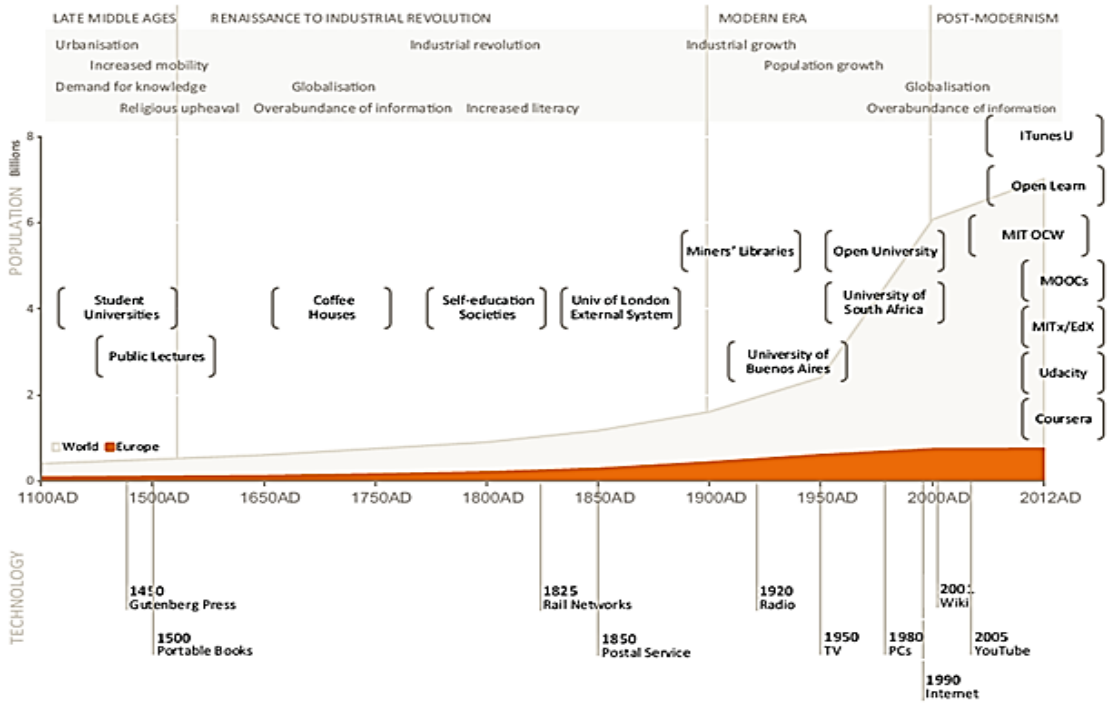

Figure 1 – Role of openness in education: a historical reconstruction (Peter & Deimann, 2013)

The MIT OpenCourseWare project is seen as the first recognised OER project, though the open education movement predates this event with roots in open source, open and distance learning and open knowledge. David Wiley coined the term open content in 1998 and OER was first used at UNESCO's 2002 Forum on the Impact of Open Courseware for Higher Education in Developing Countries. In September 2007 a meeting in Cape Town led to the Cape Town Open Education Declaration release on 22 January 2008.

The OER movement is comprised of four main categories (from SPARC site):

- **OpenCouseWare (OCW):** OpenCourseWare is the digital publication of high quality educational materials that are freely and openly licensed, and are available online to anyone, anytime. They frequently include course planning and evaluation tools along with thematic content. OpenCourseWare initiatives range in scope from mirroring traditional classroom sized endeavors to the emerging MOOC (massive open online course) model, which enables large-scale participation by anyone with Internet access.

- **OER Publishers**: The rapid rise in the cost of textbooks, combined with the high demand for affordable alternatives, has led to the emergence of new open publishing efforts for textbooks and other OER. This category also includes initiatives geared toward developing specific collections of OER, such as the Khan Academy and Saylor Foundation.

- **OER Repositories**: Digital repositories have evolved into a convenient place to find, share and remix OER from a variety of sources. They range in scope from portals and gateways that provide access to information on OER and aggregated content resources to institutional repositories with source content and tools to develop OER.

- **Publicly-Funded Initiatives**: Increasingly, policymakers on the local, state and national levels are developing policies that encourage the creation and adoption of OER. Approaches vary from directly funding the creation of OER to conditioning federal or state research dollars to require that any Education Resources produced because of that funding be made openly accessible. (See POERUP and OER Policy in Europe)

It is important to acknowledge the **advantages and disadvantages in the adoption and use of OER**, depending on the point of view. These are summarized in Table 1, along with arguments from both points of view.

Advantages of OER	***Disadvantages of OER***
Freedom of access, both for yourself and others	Varying degrees of time commitment
Freedom from proprietary systems and corporations	Teachers sometimes not rewarded by the system for their efforts
Encourages pedagogical innovation	Starting large projects can be difficult
Lowers costs to students	Some projects require startup resources
Potential publicity	Quality varies
Contribution to a community	May not meet accessibility requirements for persons with disabilities
Method of collaboration	Need to check accuracy before use
Helpful to future educators	May need a high degree of customisation (called localisation in the OER community)
Potentially beneficial to developing nations	Technical requirements vary and some require you to use a particular software
Avoids 'vendor lock-in' or a situation in which you have to use one company's products	Requires varying degrees of continual financial support
	Some institutions may be concerned about 'giving it away'

Table 1- Advantages versus Disadvantages (WikiEducator's OER Handbook for Educators)

1.2.The three generations of OER

There have been several OER initiatives all over the world in the past decades, with corresponding variety of approaches of how OER are designed and used. Teixeira (2012) identifies three different generations of OER, each with its specific focus on quality, displayed in Table 2.

1st Generation	Open Courseware	Free access to materials produced by high-profile education institutions in order to support face-to-face teaching
2nd Generation	Open Content Resources	Free access to materials produced by single or network education institutions or editors in order to support autonomous independent learning in the context of open learning, distance learning or e-learning
3rd Generation	User Generated Content	Free access by expert individuals or organizations to materials produced for independent learning for use and redesign

Table 2: Three different generations of OER (Teixeira, 2012)

Open Courseware, "refers to educational material organised as courses and typically distributed as PDF files, as well as smaller chunks of learning, often referred to as learning objects. The content may involve websites, simulations, text files, images, sound or videos in digital format, some only for use and others open also for adaptation and reuse" (Teixeira et al., 2017, p. 17).

Open Content Resources refers to materials developed by educations institutions or people. These may admit degrees of openness because of the requirements and restrictions in open licenses.

User Generated Content (UGC) is "any form of content that was created by consumers or end-users of an online system or service and is publically available to other consumers. This UGC can assume various forms such as videos, blogs, audio files, digital images, etc." (Teixeira et al., 2017, p. 19)

The dissemination of OER and its adoption by teachers and academics worldwide has led to the emergence of the concept of **Open Educational Practices**. These are innovative teaching and learning practices supported by the use and reuse of OER. Understandably, the implementation of such practices in higher education institutions requires a strategic approach for opening up education. In Europe, the Joint Research Centre - JRC has developed a supporting framework for that endeavour. It proposes a wide definition of the term **Open Education**, which accommodates different uses, in order to promote transparency and a holistic approach to practice. It goes beyond OER, MOOCs and opens access to embrace 10 dimensions of open education. The framework can be used as a tool by HEI staff to help them think through strategic decisions: pedagogical approaches, collaboration between individuals and institutions, recognition of non-formal learning and different ways of making content available.

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Open education milestones timeline https://timemapper.okfnlabs.org/villaronrubia/open-education-milestones#4

A TedTalk from 2006 by Richard Baraniuk, The birth of the open source learning revolution

Peter, S., & Deimann, M. (2013). On the role of openness in education: A historical reconstruction. *Open Praxis*, 5(1), 7-14. http://www.openpraxis.org/index.php/OpenPraxis/article/view/23

2.Open educational resources (OER): 5Rs framework, open licenses, and major repositories

2.1.Open educational resources (OER)

Open Educational Resources (OER) are "learning, teaching and research materials in any format and medium that reside in the public domain or are under copyright that have been released under an open license, that permit no-cost access, re-use, re-purpose, adaptation and redistribution by others." (UNESCO, 2022).

For a list of more definitions please see this site. That means that, even if under copyright, materials that have released under an open license, e. g., Creative Commons, are OER. Open licenses are licenses "that respects the intellectual property rights of the copyright owner and provides permissions granting the public the rights to access, re-use, re-purpose, adapt and redistribute educational materials." (UNESCO, 2022). The licence should give users the right to retain, reuse, revise, remix, and redistribute the material for educational purposes. These are known as the 5Rs.

The 5Rs of Open Educational Resources	
Retain	The right to make, own, and control a copy of the resource e.g. download and keep your own copy
Revise	The right to edit, adapt, and modify your copy of the resource e.g. translate into another language
Remix	The right to combine your original or revised copy of the resource with other existing material to create something new e.g. make a mashup
Reuse	The right to use your original, revised, or remixed copy of the resource publicly e.g. on a website, in a presentation, in a class
Redistribute	The right to share copies of your original, revised, or remixed copy of the resources with others e.g. post a copy online or give one to a friend

Credits: Text from the 5Rs of Open Education Resources is from *Defining the "Open" in Open Content and Open Educational Resources* written by David Wiley and published under a Creative Commons Attribution 4.0 license. Images from the Noun Project (*Save* by Markus,

Recycle by Miguel C Balandrano, *Edit* by stzuana, *Combine* by vidorn, *Share* by Hasanudin) and are all released under a Creative Commons Attribution 3.0 US license.

There are several **types of licences**. Creative Commons licenses grant the public permission to use their creative work under copyright law. The presence of a Creative Commons license on a copyrighted work answers the question, "What can I do with this work?

These are the 6 license types (CreativeCommons, 2022), listed from most to least permissive:

CC BY: This license allows reusers to distribute, remix, adapt, and build upon the material in any medium or format, so long as attribution is given to the creator. The license allows for commercial use.

CC BY includes the following elements:
BY – Credit must be given to the creator

CC BY-SA: This license allows reusers to distribute, remix, adapt, and build upon the material in any medium or format, so long as attribution is given to the creator. The license allows for commercial use. If you remix, adapt, or build upon the material, you must license the modified material under identical terms.

CC BY-SA includes the following elements:
BY – Credit must be given to the creator
SA – Adaptations must be shared under the same terms

CC BY-NC: This license allows reusers to distribute, remix, adapt, and build upon the material in any medium or format for noncommercial purposes only, and only so long as attribution is given to the creator.

It includes the following elements:
BY – Credit must be given to the creator
NC – Only noncommercial uses of the work are permitted

CC BY-NC-SA: This license allows reusers to distribute, remix, adapt, and build upon the material in any medium or format for noncommercial purposes only, and only so long as attribution is given to the creator. If you remix, adapt, or build upon the material, you must license the modified material under identical terms.

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SA – Adaptations must be shared under the same terms

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CC BY-ND includes the following elements:
BY – Credit must be given to the creator
ND – No derivatives or adaptations of the work are permitted

CC BY-NC-ND: This license allows reusers to copy and distribute the material in any medium or format in unadapted form only, for noncommercial purposes only, and only so long as attribution is given to the creator.

CC BY-NC-ND includes the following elements:
BY – Credit must be given to the creator
NC – Only noncommercial uses of the work are permitted
ND – No derivatives or adaptations of the work are permitted

Credits: https://creativecommons.org/about/cclicenses/

If you want to choose and generate a license for your work, just follow the instructions present in the Creative Commons site.

2.2.Where to find Open Educational Resources

Where to find OERs?

A search engine for free images and audio: https://wordpress.org/openverse/

You may also use Google Advanced Search, filter for License/Usage Rights option. Or the OER Metafinder.

Major Repositories

There are different types of repositories in the world that store open content and hosts collections of OERs. We selected some of them as examples of *Open Educational Resources* Repositories. All of the resources are free and can be used as they are or adapted, remixed, that is: they can be used or re-used.

Name	Site	Origin
Ariadne	http://www.ariadne-eu.org/	European Union
Economics Network Online Learning and Teaching Materials	http://www.economicsnetwork.ac.uk/links/othertl.htm	United Kingdom
FREIburger Multimedia Object Repository	http://freimore.uni-freiburg.de/	Germany
Lab Space	http://labspace.open.ac.uk/	United Kingdom
Merlot	http://www.merlot.org	United States
National Learning Network	http://www.nln.ac.uk/	United Kingdom
OpenLearning	http://www.open.edu/openlearn/	United Kingdom
OER Commons	http://oercommons.org/	United States
OER Online Archive	http://www.archive.org/	Undefined

Table 3-OER Repositories

FURTHER READINGS

https://www.open.edu/openlearncreate/mod/page/view.php?id=138727

https://www.cccoer.org/using-oer/find-oer/

The following curated collections include **Teach Engineering**:

https://www.oercommons.org/curated-collections

3.MOOCs: design types, learning features and major platforms

3.1.MOOC types

An open and massive online course, commonly referred to by the acronym MOOC (*Massive Open Online Course*), is a course offered on a completely virtual basis, designed for a very high and potentially unlimited number of participants, and made available on the Internet without any restriction of access or academic prerequisite, providing a complete learning experience. In this sense, these courses are usually provided with learning objectives, are structured around a list of content, educational activities, and resources, and integrate moments of evaluation that allow to measure the development of skills and/or certain knowledge.

MOOCs may provide a greater or lesser freedom to participants:

1) allowing the participants access to the full contents of the course from the start, enabling the students to adapt their individual learning path to the desired pace.

2) establishing a stricter timetable, only allowing access to resources or resources and activities on predefined dates.

3) defining a weekly pace for the presentation of materials and activities but admitting their conclusion until the end of the course.

As a differentiating characteristic of other online courses, a MOOC is therefore defined as an open and scalable (massive) virtual course.

Being **open** means: unrestricted availability (anyone, anywhere as long as they have an internet connection, can enrol in the course without other prerequisites); free of charge (although some include additional learning certification mechanisms that require payment); use of open resources, licensed for (re)use.

Being **scalable** (massive) means that the course: (i) admits a large number of students maintaining the quality of the educational experience and that (ii) the increase in the number of participants is not directly proportional to the effort required for its monitoring, namely with regard to academic staff, tutoring, evaluation, etc.. (Brouns et

al., 2017, p. 318). Although the categorization of these courses has become increasingly complex, with several taxonomies (Conole, 2014; Pilli & Admiraal, 2016; Pomerol et al., 2015), the three best known design models are the following:

cMOOCs: the first to emerge (2008), they are based on a connectivist pedagogy, which favors interaction between participants, and assume that the interaction dynamics are necessary for learning, which is eminently social; as Conole puts it: "They relied on the benefits of scale though significant interaction with a distributed network of peers. Participants were encouraged to use a variety of technologies; to reflect on their learning and to interact with others. There was no 'right way' through the course; the emphasis was on personalised learning through a personal learning environment." (Conole, 2014, p. 70)

Although there is a central space where course activities are available, the entire learning experience takes place on the network. The participants use various locations on the internet to produce their artefacts and participate in the course activities. In this dynamic, participants interconnect and, consequently, learn from activities and artefact building and from the sharing of other people who are part of their network. Course organization privileges the freedom of time and pace of learning on the part of the participants but includes some time scheduling to enable interaction. Teaching support is distributed among the participants. Assessment is mainly done through peer-review or other assessment mechanisms associated with the characteristics of the artefacts produced. There may be a formal certification, through specific assessment (usually paid).

xMOOCs: emerging later (2011), but more widely known they are based on a more instructivist and cognitivist pedagogy, which privileges the interaction of students with the contents (videos, lectures, texts), suppose that the interaction dynamics is not necessary for the dynamics of learning, which is eminently individual, and teacher led. The X stands for an extension to conventional teaching, and is usually provided by established universities, as a free course, sometimes being directly connected to their formal paid courses.

The courses take place on an online platform, where you can find relevant information. The organization of the course privileges the freedom of time and pace of learning on the part of the participants, and the guidelines are only indicative so that the participant can self-regulate their learning. Learning is based on content and activities that seek to

confirm whether content or behaviours have been acquired or understood. Teaching support may be mainly automatized, but there is usually a team to answer doubts and give assistance. Assessment is mainly individual and automatized. There may be a formal certification, through specific assessment (usually paid).

sMOOCs: developed as a European answer to the American and Canadian MOOC types, and more as a pedagogical framework than a model (Brouns et al., 2017, p. 319), the ECO SMOOC is based on a social-constructivist pedagogy, which privileges the interaction among participants and presupposes that interaction dynamics is necessary for learning, which is eminently social. However, they target the group or community, and not the network, as the social learning structure supporting learning (Dron & Anderson, 2009). The course takes place in an online platform, but sometimes it may use other spaces outside of the platform. Learning is based on contextual activities, that is, activities where participants bring their knowledge and experiences, leading to learning and the construction of knowledge in a social context. There is usually a first individual phase of exploration of the materials, which moves to a second phase of interaction with others where individual reflection is discussed with the other participants, namely in collaborative activities. Teaching support is mainly mediating and facilitating the interactions between the participants. Assessment is carried out through peer- or even self-assessment mechanisms. This assessment focuses on the process (e.g. the quality of a participant's contributions to the group discussion forum) and the final product (e.g. feedback given by one participant to the report submitted by another). There may be a formal certification, through specific assessment (usually paid).

3.2.MOOCS major platforms

Although the most widely known MOOC platforms are the American, like Coursera, EdX, Udacity there is an extensive list of MOOC platforms all over the world, including national MOOC platforms. For an up to date report of the main platforms see ClassCentral (2022).

FURTHER READINGS

Pomerol, J.-C., Epelboin, Y., & Thoury, C. (2015). *MOOCs Design, Use and Business Models*. John Wiley & Sons.

4. From OER and MOOCs to open educational practices (OEP): promoting innovation, flexibility, and personalization in STEM teaching

Societal and technological changes are responsible for a new type of learner, with new learning needs and competencies, that must be matched by alternative educational deliveries, like eLearning. And OEP may have a key role in these new educational deliveries. OEP may be defined as any educational activity involving the creation, use, or dissemination of an adaptive open learning resource (Teixeira, 2012). Here is a list of types of OEP (Teixeira, 2012).

- **1st Level – *Non formal use and reuse***

  Free access materials are used for learning by independent learners, whom can also edit it and change the material's content sharing it with the community;

- **2nd Level – *Formal certification of non-formal use***

  Independent learning done through the use of free materials can be subject to formal certification by an Educational Institution;

- **3rd Level – *Formal use and reuse***

  Institutions and teachers can use and reuse free available materials in its own courses, being material pre-validated by another school or an HEI, or after its own formal validation process.

OERs and MOOCs may be instrumental to the development of OEP as they are part of a wider trend towards opening higher education based on the philosophy that knowledge should be freely available on the internet and without costs to the user (Murphy, 2013). On the other hand, OEP support the (re) use and production of OER in the framework of educational policies that promote innovative pedagogical models, and respect, empower and emancipate learners as co-producers on their lifelong learning process. (Teixeira, 2012). "The emergence of open educational practices (OEPs) resulted precisely from the combination of using OERs and architectures of open learning with the potential to create learning environments in which is given to learners the opportunity to develop independently and self-directed their own learning path. The OEPs can be defined as

practices that sustain the (re)use and production of OERs through institutional policies while promoting the development of innovative pedagogical models and at the same time respect and empower learners as co-producers of their own learning path (Ehlers, 2011; Teixeira, 2012)". (Teixeira et al., 2017, p. 27).

We may adopt OEP by creating and licensing OERs (see Topic 2) and MOOCs or by using OERs and MOOCs, created and shared by others. Regarding the integration of MOOCs in formal Higher Education and STEM courses, Pérez-Sanagustín et al. (2017) propose a hybrid MOOC framework (the H-MOOC framework), presented in Image 2, where the 'x-axis' represents the institutional support needed to implement the initiative, and the 'y-axis' the alignment with the curricular content. The 4 basic models: MOOC as a service, MOOC as replacement, MOOC as driver and MOOC as added value.

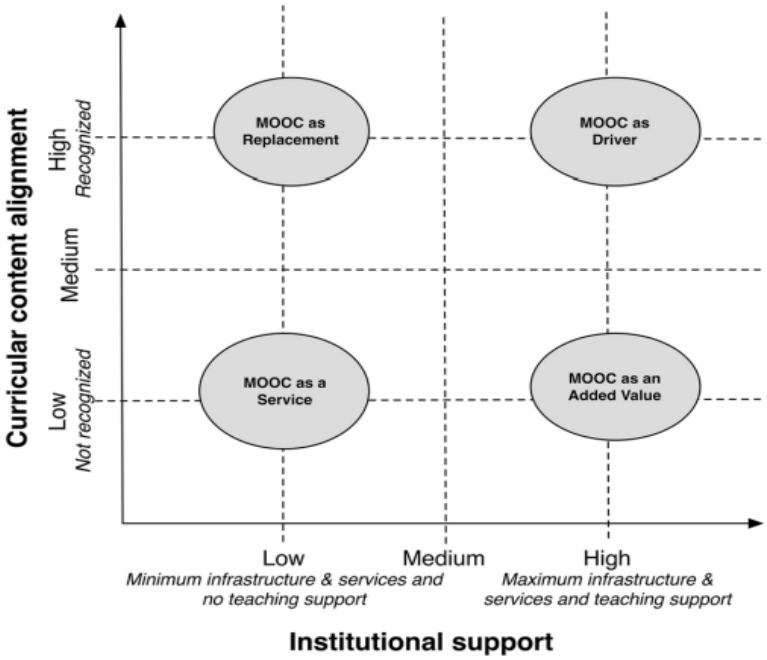

Figure 2 - H-MOOC framework (Pérez-Sanagustín et al., 2017)

Cha & So (2020) review of the literature found three integration approaches are often used in the higher education contexts: (1) integrating MOOCs in blended learning, (2) integrating MOOCs in flipped learning, and (3) integrating MOOCs in non-formal and informal learning. Among others, integrating MOOCs in blended learning has the following benefits: "replacing lectures, augmenting secondary materials, filling gaps in expertise, exposing other types of teaching, reinforcing critical thinking, and improving how to learn online. "(Cha & So, 2020, p. 143). The main benefits of integrating MOOCs in flipped

learning: “First of all, productive in-class time is achieved by making students more actively engaged in discussions, projects, and exercise practices. Students have more opportunities to interact with their peers and/or instructors. Secondly, the role of instructors changed from a knowledge-giver to a knowledge facilitator. Thirdly, MOOCs play an effective role in replacing and supplementing traditional lectures and promoting self-directed learning.”(Cha & So, 2020, p. 147)

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5. Conclusion

In this topic, we addressed the history of OER and the main generations of the development of OER initiatives.

After that we characterized OERs and their different licensing types and provided a list of major OER repositories.

Massive Open courses were defined and established the differences between some of the most well-known types of MOOCs.

Finally, we articulated the relation of OERs and MOOCs to Open Educational Practices and provided some frameworks about the integration of MOOCs with formal Higher Education courses as a way to promote innovation, flexibility and personalization.

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