Mapping OER Movements in the Field of Mathematics

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Abstract

The purpose of the paper is to compile a list of initiatives featuring OER developers' work in Austria, Estonia, Portugal, Romania, and Spain, aiming to improve awareness, accessibility, and fostering cooperation in the landscape of OERs in mathematics.

The results reveal diverse approaches to OER in mathematics across the selected European countries. Austria initiated OER in 2002, fostering collaborative efforts. Estonia emphasizes MOOCs and national strategies, being the only one of the analyzed countries that does not have an OER repository in higher education. Portugal boasts user-friendly OER repositories. Romania actively integrates OER, and Spain encourages OER through institutional repositories and national initiatives.

Collaboration, technological platforms, and governmental support play pivotal roles in fostering the adoption and integration of OER in mathematics. These findings contribute to the broader understanding of such OER dynamics, emphasizing the need for continued collaboration, support, and innovation in OER across Europe.

Keywords: International collaboration; OER development; OER repositories; mathematics education.

1. Introduction

Research has indicated that courses incorporating OER materials yield either superior or equivalent outcomes compared to courses that do not utilize OER. These studies underscore the positive impact of OER on educational effectiveness and student performance within the realm of mathematics (Khoule et al., 2021). The OER movement aims to foster collaboration among educators and institutions while offering free or affordable alternatives to educational materials, thereby reducing education costs (Clements et al., 2015).

The Gate2Math project aims to create a smart library of open and multilingual educational resources in the field of mathematics (Gate2Math Project, 2024). The paper seeks to contribute to the OER movement by compiling a comprehensive list of sites where OER developers' work in mathematics can be found in partner countries Austria, Estonia, Portugal, Romania, and Spain. By doing so, the authors hope to further enhance the accessibility and collaborative spirit that define the OER landscape.

2. Background

Notable organizations such as COL, UNESCO, Creative Commons, OpenLearn, OER Africa, and several other credible proponents and pioneers of OER have played a pivotal role in establishing fundamental guidelines, benchmarks, frameworks, and professional development modules for OER, a trajectory that should be sustained (UNESCO-COL, 2011). In 2021, more than 6000 higher education institutions, companies, repositories, government agencies, services, events, and individuals took initiatives and projects in the field of OER in Europe (ENCORE+, 2021). The development of digital education and training takes place within the framework of the European Commission's action Digital Education Action Plan (2021-2027). This action supports the "investment in high-quality, accessible, inclusive, and secure digital education and training" (European Commission, 2023, p. 6). Numerous projects and resources within the OER movement incorporate cutting-edge open content utilizing simulations, mobile apps, virtual reality (VR), and augmented reality (AR). Furthermore, some dedicated repositories and platforms exclusively provide OER materials for mathematics courses at either no cost or low cost for higher education. Some notable examples include MyOpenMath, Khan Academy Collection, Ximera open-source platform, Paul's Online Math Notes, and Desmos Classroom Activity.

3. Methodology

This scoping review follows the methodology outlined by Peters et al. (2015). The search strategy includes using variants of "Open Educational Resources" (e.g., OER, open textbooks) as search terms across academic databases (e.g., Web of Science, ERIC), institutional

repositories, Google Scholar, institutional websites (e.g., UNESCO, OER Commons), and relevant government websites. Inclusion criteria involve initiatives directly related to OER from Austria, Estonia, Portugal, Romania, and Spain, in any language, while exclusion criteria pertain to irrelevant initiatives and unavailable sources. A protocol with metadata by sources is used to document the search and selection process. The results are presented in a table summarizing the key information obtained from the identified initiatives. This methodology provides a systematic and transparent analysis process, facilitating the comprehensive identification and mapping of OER initiatives.

4. Results of the literature review

4.1. OER developers' work in Austria

Austria's OER movement began in 2002 with Geogebra software. Projects like the European Open eLearning Content Observatory Services and Catrobat further boosted OER development. The Open Education Austria platform, alongside initiatives like "Open Education Austria Advanced," facilitated OER repository creation and tools like the OERhub search engine, promoting OER adoption in Austrian higher education institutions (see Table 1).

Table 1. Directories with open resources in Austria

Key Initiative and Website	Description
GeoGebra www.geogerba.org	Dynamic geometry and algebra open-source software now encompass spreadsheets, graphs, statistics, and calculus, offering virtual books with explanations and assignments.
Catrobat https://catrobat.org	Austria's OER project empowers youth with free software, fostering their transition from users to developers through Pocket Code apps and visual programming.
Open Education Austria platform https://www.openeducation.at	Austrian universities pioneer a national OER infrastructure, promoting free educational content through open practices. This effort includes creating the OERhub search engine and merging OER repositories.
iMooX https://imoox.at	Austria's sole MOOC platform, established in December 2013 by the University of Graz and the Graz University of Technology, provides OER materials across multiple fields, including higher mathematics.

Materials across these platforms are freely available under Creative Commons licenses in both German and English, aligning with the Austrian Federal Ministry of Education, Science, and Research's official strategy (Bundesministerium für Bildung, 2022). This strategy stresses the

integration of OER materials into curricula, fostering personalization and supporting teachers, students, and stakeholders.

4.2. OER developers' work in Estonia

Estonia (see Table 2) prioritizes digital education resources through the Ministry of Education and Research (MER), aligning with the Estonian Education Strategy (MER, 2021).

Table 2. Directories with open resources in Estonia

Key Initiative and Website	Description
Koolielu Portal https://web.archive.org/web/201904 18143749/ https://koolielu.ee /waramu/index/ /archived/	Until 2016, it was the primary repository for general education, hosting over 5700 resources, including animations, audio lectures, presentations, exercises, training videos, simulators, content packages, dictionaries, tests, and multimedia lectures/synopses.
e-Koolikott https://e-koolikott.ee	With over 18,700 resources, the portal contains both OER and commercial content and serves as Estonia's main educational materials repository.
KAE School https://www.kae.edu.ee	The platform offers 159 videos (inspired by Khan Academy) and 101 exercises on the practice topic of mathematics and programming, licensed under CC BY-NC-SA.
HITSA Educational Object Repository https://web.archive.org/web/201905 28221650/http://www.e-ope.ee/repositoorium//archived/	Repository in higher and professional education housing over 4,600 resources under Creative Commons licenses, providing educational materials for various subjects and disciplines
LePlanner https://www.leplanner.ee/	An online platform enables teachers to create visual lesson plans and share educational resources, including OER, with students, all under CC BY license.
HEI repositories: ttps://dspace.ut.ee, https://dspace.emu.ee,https://dspace. tktk.ee	Platforms dedicated to holding study materials (some of them are OERs).

OER infrastructure such as repositories, tools and platforms help to share reusable digital resources (Põldoja & Laanpere, 2020). Cooperation with the European Social Fund supports projects for the digitalization of teaching aids. In higher education, since the closure of the HITSA-managed repository in 2020, OER has been stored in universities' institutional repositories.

4.3. OER developers' work in Portugal

In Portugal, several repositories house a wide range of educational materials, including national repositories (Nobre, 2020). These repositories serve as vital resources for educators, researchers, and students, offering access to a variety of scientific and academic documents (see Table 3).

Table 3. Directories with open resources in Portugal

Key Initiative and Website	Description
RCAPP – Open Access Scientific Repository of Portugal http://www.rcaap.pt/	Aggregates Portuguese repositories, acting as a national meta-repository and hosting service, indexing scientific content from educational and research institutions.
R UAb – Open Repository of The Open University https://repositorioaberto.uab.pt	The repository stores, preserves, and provides access to the Open University's intellectual production. Users can search for articles, theses, and other materials by themes, keywords, sources, and dates.
IAVE - Item Bank http://iave.pt/	Under the Ministry of Education, this repository offers educators resources across subjects, including exercises, exams, and assessment criteria, tailored for Portugal's educational context.
Open Repository of the University of Porto https://repositorio-aberto.up.pt/	The University of Porto repository compiles and shares scientific work from its academic community, providing open access to full-text documents. Organized into communities and collections of various document types.

Using these repositories is straightforward, catering to users of all expertise levels in Internet tools. Some repositories also offer extra tools to facilitate creating and sharing OER, promoting open educational practices institutionally.

4.4. OER developers' work in Romania

Romania actively participates in the OER movement through initiatives, projects, and governmental policies (see Table 4). The "Knowledge Economy Project" marked its initial involvement, followed by establishing of the Romanian Coalition for OER in 2013.

Table 4. Directories with open resources in Romania

Key Initiative and Website	Description
Didactic.ro https://didactic.ro	The online hub supports teachers with various materials and tools, like lesson plans, teaching materials, worksheets, games, and interactive activities.
Digitaledu.ro https://digitaledu.ro	This digital education platform, supported by the Institute of Educational Sciences, hosts 11,356 curated educational activities and OERs endorsed by experts.
Virtual Library https://roedulib.ro	OER Digital Platform with materials, mainly for the gymnasium education cycle.
Educatie.inmures.ro https://educatie.inmures.ro	Mureş County Online Educational Community platform contains a collection of didactic materials published to facilitate the work of all education specialists.
Digitaliada https://digitaliada.ro	The program, funded by the Orange Foundation, reaches more than 30000 students in 101 secondary schools in 34 counties in Romania. It comprises over 4,000 OERs, including lessons, tests, exercises, tasks, didactic projects, and video tutorials.
LIVRESQ https://livresq.com	The platform hosts various teaching materials, such as interactive lessons, textbooks, and e-learning courses. By the end of 2023, it contained 20,500 items.

The National Strategy on Digital Agenda for Romania 2020, since February 2015, and subsequent reforms in 2017-2018 further emphasized OER integration, with projects like the CRED project focusing on teacher training and development of OER resources.

4.5. OER developers' work in Spain

There has been a growing interest in OER among universities in Spain, and many institutions have started to develop and share OER (see Table 5).

The strategy of most Spanish universities is to store and distribute OER through institutional repositories (Santos-Hermosa et al., 2020). The Spanish government has also encouraged the use of OER through various initiatives, such as the creation of a national repository for OER and the establishment of a national plan for open science (Marín & Morales, 2018).

Table 5. Directories with open resources in Spain

Key Initiative and Website	Description
Procomún https://procomun.intef.es	MEFP's initiative, the Add Project, offers an educational learning platform for teachers and students to access and download learning objects in various formats.
Universidad Nacional de Educación a Distancia (UNED) https://contenidosdigitales.uned.es/fezUNED/	Repository of OER that includes a wide range of materials, including textbooks, videos, and interactive learning activities.
The Universitat de Barcelona (UB) https://crai.ub.edu/es/recursos-de-informacion/repositorios-digitales#	Institutional repositories that contain open-access digital publications derived from the teaching, research, and institutional activity of the teaching staff, students, and other members of the University of Barcelona.
MDX (Materials Docents en Xarxa, in catalan) https://www.mdx.cat	The Catalan Government's platform hosts OER for educators, students, and the public in Catalan, Spanish, and English, covering textbooks, multimedia, and interactive activities.
UPCommons https://upcommons.upc.edu	An institutional DSpace repository stores university members' academic work, under a CC BY 3.0 license.
Open Education Consortium https://www.oeconsortium.org	Several universities network to promote the use of OER in education.

5. Discussion and conclusions

This comprehensive research illustrates, on the one hand, the joint enormous interest in the educational community for OER development and, on the other hand, the variability in possibilities by the academic necessities and applications, as well as teaching and learning methodologies.

Results in Section 4 are the cornerstone to a) a first inventory of organizations (institutional and academic), working groups, and main agents involved in the transformation towards a shared space of OER creation, and b) facilitate OER development networks in favor of greater homogeneity, efficiency, and sustainability of the resulting resources. In particular, identifying and selecting the most appropriate common features in terms of general policies, standardization and promotion, dissemination, support strategies, platforms, software and development tools, and potential partnership possibilities in consortiums. The Gate2Math project also involves founding a community for creating, receiving reviews and using OERs in mathematics. The creation of a comprehensive OER inventory empowers both students and teachers, promoting greater participation in learning and the development of a global, interconnected OER development network.

Acknowledgments

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