OER-based Online Micro-courses: Supporting UNESCO Strategic Development Goal 4: Education for All

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Abstract

The OER Universitas (OERu) is a consortium of more than 30 higher education institutions on five continents. It was founded in 2011 to provide learners everywhere with learning opportunities and pathways to official recognition or credit. The OERu maintains a very economical base with very low expenses. It supports a sustainable learning environment with incremental increases in infrastructural capacity as and when it is needed. The OERu's global digital infrastructure has been created to facilitate learner access to micro-courses on the internet from any geographical location. This Next Generation Digital Learning Environment (NGDLE) is based entirely on free and open source software (FOSS). The OERu has established a working model for transnational micro-credentialling for approved university qualifications. To date it has supported more than 200,000 learners in over 100 countries. The OERu is based on a scalable, FOSS NGDLE which has dramatically reduced the cost of providing learning opportunities to anyone, anywhere, on the web.

Keywords: OER; FOSS; learning environment

Introduction

The OER universitas (OERu) was established in 2011 with a UNESCO grant from the OER Foundation (a former subsidiary of Otago Polytechnic, and now Te Pūkenga in New Zealand) following an international meeting that was convened in Dunedin with funding support from UNESCO. The Open Education Resource Foundation, based in New Zealand, is an "independent, not-for-profit organisation that provides international networking and support for educational institutions, educators and learners to achieve their strategic objectives through Open Education" (OER Foundation, n. d., About). The Foundation is an active participant in the UNESCO OER Dynamic Coalition, hosts the WikiEducator community, co-ordinates the New Zealand Centre for Open Education Practice, and hosts New Zealand's UNESCO Chair in Open Educational Resources (OER). According to UNESCO, OER "are learning, teaching and research materials in any format and medium that reside in the public domain or are under copyright that have been released under an open license, that permit no-cost access, re-use, re-purpose, adaptation and redistribution by others" (UNESCO, 2019).

The OERu has been designed to facilitate access to open online courses for all learners as a sustainable means of achieving the UNESCO Millennium Strategic Development Goal 4: Education for all; as well as SDG 17: Partnerships (UNESCO, n. d.). It consists of an international network of more than 30 institutions and organisations in developing countries across five continents (OERu, n. d., OERu partners). The OERu Outreach Partnership Programme supports institutions in the developing world by providing free membership. The

partners collaborate to develop or adapt freely accessible, high quality, accredited online courses that are designed for independent study, and that use OER.

The OERu was the first international programme to offer courses based solely on OER, so learners do not need to buy expensive textbooks or other materials. OERu aims to open free pathways to learning and accreditation on the web using OER. Micro-courses have been developed to allow learners who are excluded from the formal system to access learning content free of charge and gain recognised credentials at reasonable cost. It focuses especially on learners in developing countries who otherwise would not have access. The OERu does not confer degrees, but works with accredited international partner institutions who provide assessment and credentialing services on a cost-recovery, fee-for-service basis. The OERu relies on the ability to reuse and re-purpose OER and other open access content available on the web.

At this time, many people are learning from digital content available on the open web. However, there is no easy way for these learners to have their knowledge and skills assessed and accredited by recognised institutions. In addressing this problem, the OERu grants free access to high quality courses that are designed for independent study using OER. A collaborative learning environment supports and encourages peer learning and the participation of volunteers. Selected OERu partners provide assessment for a fee, so learners can gain credible credentials.

It started small, with only 200 learners from more than 50 countries, but in in 2022 the OERu had more than 200,000 learners in over 100 countries accessing micro-courses at a first-year level. Now more than 30 higher education institutions, on five continents, have partnered with the OERu to use open courses and provide pathways to accreditation for international learners.

Many countries lack the resources to build the conventional universities necessary to meet the growing demand for higher education. To address this problem, the OERu has developed a sustainable and scalable digital learning ecosystem that links to the formal education sector—it's a parallel learning environment based solely on OER. This has been accomplished with only two full-time staff members. The OERu maintains a very economical base with very low expenses, and supports a sustainable learning environment with incremental increases in the infrastructure capacity, as and when it is needed. The annual budget for digital infrastructure is less than US$10,000, which is equivalent to less than US$0.05 per learner/per year in 2022. Because the OERu environment is scalable to millions of learners, the cost per learner could drop even further.

Technology

Every free and open source software (FOSS) application has been thoroughly tested at scale, is concurrently serving many tens or hundreds of thousands of users, and has already evolved technically to meet the challenges of achieving "internet scale". There has been no increase in overall Next Generation Digital Learning Environment (NGDLE) infrastructure capacity or cost, and no impact on performance, while providing services to up to 200,000 learners per year. In addition, the OERu currently works with hosting providers on different continents, without using any of their proprietary services or features, so they can easily shift to other cloud service providers if needed. This also provides commodity FOSS cloud nodes with minimal cost or disruption. The OERu costs are therefore fixed and predictable—the OERu environment does not exceed flat-rate data storage and transfer allotments.

Intentionally, the OERu does not use a learning management system to deliver courses. Content is developed or adapted collaboratively in WikiEducator, an instance of the FOSS MediaWiki platform that also powers Wikipedia and provides detailed version control for multiple remix scenarios by many collaborators. A collection of wiki pages constituting a micro-course are

automatically published in minutes to any instance of the WordPress content management system on which an educator has administrative control via an OERu-developed scripted process—thus enabling any institution that wishes to host their own instances of OERu courses at minimal cost. The NGDLE component-based ecosystem comprises the "best of breed" FOSS interaction technologies (forums, social media, annotation, commenting, etc.). Learner or educator posts or other content on these open solutions are aggregated from these distributed technologies into a single course "feed" by the OERu-developed WEnotes aggregator system. The discussion interactions from sites and services located around the world are periodically "recruited" via automated OERu-run systems into a comprehensive Twitter-like feed of learner "mentions". This feed, in turn, can be filtered to show only those mentions that specifically reference tags or "hashtags" relevant to specific OERu courses. These course feeds, which update in real time as new mentions are recruited from around the web, are integrated into the course websites, providing a relatively immediate source of learner interaction and feedback. This provides a powerful example of a unique global collaboration that would be difficult to replicate using closed solutions (Lane & Goode, 2021).

Many of the services from which mentions are recruited are also run by the OERu—these are part of a new family of technologies called the "Fediverse", which exist in parallel with better known, highly marketed social media such as Twitter, Facebook, Instagram, YouTube, Twitch, Medium, and Reddit. In contrast with these household-name media services, Fediverse-equivalent platforms (Mastodon, Diaspora, PixelFed, PeerTube, OwnCast, WriteFreely, and Lemmy) are tied together via the ActivityPub open standard that allows them all to interoperate or "federate". Each platform is a network of independently run instances of the relevant software. All are FOSS, each with its own global developer community constantly improving each platform for the benefit of participants in all the communities' running instances. All are not-for-profit, and are run by communities, not corporations. Their power comes from the diversity of their communities, and the inability for commercial interests to capture them. The OERu runs instances of all these Fediverse platforms and more. They are amenable to "recruiting mentions", enrich the OERu's own community of open educators, and are philosophically aligned with the OERu's ethos of sharing, inclusion, and collaboration within a diverse global community (Lane, 2023).

Pedagogical infrastructure

Free and open access to OERu courses is possible because of the implementation and maintenance of the FOSS NGDLE, its low cost, and the partnerships among institutions and organisations around the world. The costs of course development and adaptation are shared among the participating partners and the cost of ongoing software maintenance is shared by the international FOSS community, which focuses on continuous improvement.

OERu micro-courses are designed for independent self-study. As a small non-profit organisation, the OER Foundation does not have the financial resources to provide tutor support. However, Anderson's Interaction Equivalency Theorem underpins the design by providing robust student–content interaction and courses that are designed for high levels of peer learning support (See Fig. 1). The theorem posits that meaningful learning can be achieved provided one of three types of interaction (learner–content, learner–teacher, or learner–learner) is present at a high level (Anderson, 2003). The courses are also informed by Holmberg's theory of guided didactic conversion using simulated lecturer–student conversations, which are embedded in the course material (Holmberg, 2020). To answer specific questions about the NGDLE and the nuts and bolts of its courses, OERu has created a dedicated student support site that provides help, including screen-cast videos on how to study using the OERu online platform.

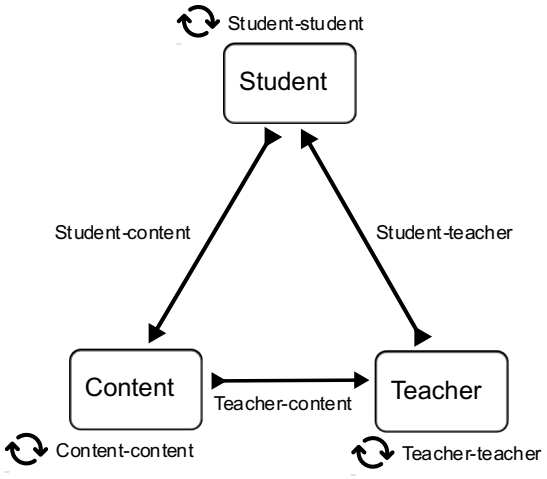

Figure 1 Anderson's Interaction Equivalency Theorem (2003)

Using the NGDLE, learner interactions are distributed across the web using the most appropriate FOSS technologies. These distributed interactions are aggregated into the live course feed introduced above.

The micro-courses are designed to build capability for participants to learn on the internet rather than learning in a classroom or within the cloistered context of a single software application such as a learning management system. These micro-courses incorporate a wide range of media and typically include video "signposts" for each learning pathway, while at the same time ensuring that learners can succeed in the course without watching the videos (in recognition of the cost of bandwidth in many parts of the developing world). Interactive content has been embedded in the courses, providing a wide variety of activities (readings, case studies, reflections, course comments, discussion forums, social media posts, etc.), and interactive quizzes that have immediate feedback on correct and incorrect answers. A key feature in the courses is the adoption of a "pedagogy of discovery' in which learners identify, evaluate, and share open-access resources in pursuit of their own learning interests for designated activities.

Transnational qualifications

The OERu has developed a functioning model for the transnational recognition of micro-credentials as part of its commitment to develop an international system for course credit articulation. This model is based on an adaptation of the Transnational Qualifications Framework for the Virtual University for Small States of the Commonwealth (Transnational Qualifications Framework Management Committee, 2015). The framework defines standard levels of learning and corresponding learning effort for post-secondary qualifications to facilitate articulation within national accreditation and qualification systems. This OERu-defined micro-credential qualifications framework is based on the concept of "notional learning hours", which refers to the length of time a student would typically take to achieve a stated learning outcome. This could include contact time with an instructor; time spent studying, completing assignments or specified tasks; and time spent on assessment. Ten notional hours equals one credit.

The OERu standardised on 40 notional learning hours for each micro-course to ensure sufficient learning for meaningful assessment, and to accommodate international differences in the size of degree courses. Consequently, three OERu micro-courses is equivalent to a standard three-credit course in North America, while four micro-courses are equivalent to a standard undergraduate course in Australia and New Zealand, and five micro-courses equates to a module of 200

notional learning hours in the United Kingdom. This framework approach has facilitated reuse of OERu micro-courses at different institutions and enables a system of transnational micro-credit transfer that is recognised by credentialling authorities.

OERu micro-courses

The OERu course site hosts an innovative, capacity-building package of micro-courses, namely "Learning in a Digital Age" (LiDA). The underpinning pedagogy includes embracing active learning and open educational practices. The pedagogy itself is designed to promote innovation using digital literacy skills and OER capacity, offering learners both a pathway towards independent learning through the internet and encouragement to create their own openly licensed digital media. The LiDA course package focuses on building capability for online learning and associated digital literacies in context. Relevant digital skills are embedded in context—so, for example, learners can master how to annotate webpages using hypothes.is, while researching the differences between digital skills and digital literacies.

Learners can opt in to receive course instructions for each session via email. These personalised email communications are automated with the FOSS Mautic marketing automation software hosted by the OERu. The OERu also provides a dedicated social media site (mastodon.oeru.org) and support forums for all its courses (forums.oeru.org). Learners help their peers, and volunteers from the open academic community offer support to learners.

The LiDA course development constitutes a component of several significant milestones within the global OER movement. It is part of the world's first OER-based programme implementing transnational micro-credentialling, with pathways to achieving formal academic course credit towards university-level qualifications in four countries. The LiDA micro-credential, comprising four micro-courses, has been evaluated for equivalency by the New Zealand Qualifications Authority on the New Zealand Qualifications Framework (New Zealand Government, 2016). Using bilateral articulation agreements, LiDA was approved for credit transfer at OERu partner institutions in the USA, Canada, and the United Kingdom.

In the United Kingdom, the OERu network established the world's first university-level exit qualification that is based entirely on OER open online courses. LiDA also qualified for the Certificate of General Studies, conferred by Thompson Rivers University in Canada (Thompson Rivers University, n. d.).

LiDA implementation challenges

The LiDA micro-course originated as a short course entitled "Open Content Licensing for Educators" (OCL4Ed), which was developed collaboratively with funding support from the UNESCO Office for the Pacific States in 2011. OCL4Ed was originally developed as a wiki-based course to support collaborative authoring enabled by the version control of the Mediawiki software environment. However, several shortcomings in course delivery were discovered in the initial iteration of the course. Many learners were not familiar with navigating wiki-based courses. Replicating the course for re-use by institutions was cumbersome. In addition, initially, there were no assessment or credential options for formal academic credit. Moreover, as a standalone micro-course equating to 40 notional learning hours, the first micro-courses were not of sufficient scope to qualify for full course credit.

In 2015, the OERu international network commenced development of the "Learning in a Digital Age" online course, encompassing OCL4Ed and other aspects of digital literacy required for 21st century innovation, learning, and teaching. An international network of experts and professional educators worked together to investigate course outlines from similar university courses and to

identify the foundational requirements for the LiDA curriculum. This included an open crowd-sourcing activity inviting educators to submit comments and concepts for inclusion.

This work resulted in the creation of a collection of four openly licensed micro-courses:

1. Digital literacies for online learning (LiDA101)
2. Digital citizenship (LiDA102)
3. Open education, copyright and open licensing in a digital world (LiDA103)
4. Critical media literacies and associated digital skills (LIDA104).

The OERu developed a scripting solution to publish a collection of wiki pages constituting a course to publish a "snapshot" of the materials to the WordPress content management system, for which the OERu has also developed a "mobile-first" course "theme' which offers an adaptive layout for content so that it is easy to use on both low-cost mobile devices and desktop computers. This solution has enabled version control for collaborative authoring, while providing the ability for any institution to host their own instances of responsive open online courses for learners regardless of the internet-connected devices to which they have access. This technical approach has facilitated remix and reuse of OERu courses. For example, North West University in South Africa remixed sections from the OERu's "Introduction to Entrepreneurship" series of micro-courses to offer a customised micro-course for inclusion in their course, "Introduction to Business Management" (BMAN111). Students were required to work through this micro-course hosted by OERu and complete a series of quizzes which contributed towards their continuous assessment mark for the course.

The OER Foundation also collaborated with UNESCO and the International Council for Open and Distance Education to develop a culturally appropriate French instance of the LiDA micro-course on "Open Education, Copyright and Open Licensing", in partnership with the French Ministry of Education, the French Thematic University, and the virtual universities of Francophone Africa. The course was published on the OERu open technology infrastructure for re-use by any institution.

LiDA reception

As of October 2022, LiDA micro-courses have been offered to more than 8400 registered learners from over 100 different countries. The ages of OERu learners ranged from 18 to 68 years, and nearly half the learners were not native-English speakers. Sixty-four percent of learners were female and 66% were in full-time paid employment. The majority (50%) of learners indicated that their primary purpose for participating was professional development, 17% indicated reskilling for a new career, and another 17% listed personal development as their main motivation.

There is an online course evaluation survey for each micro-course to review effectiveness of the design and to inform continuous refinement of that course and future courses. The OERu administers an optional "OERu new participant survey" where demographic information and data is collected on learner experiences with online learning, and their reasons for studying with the OERu. This helps them to not only progress but also inform the design of the courses and support the development of future courses. Staff also monitor anonymous website analytics to evaluate how OERu course sites are used by learners. This analysis complies with the privacy requirements of the European General Data Protection Regulation (GDPR) (European Union, n. d.).

The OERu encourages learners to use personal blog sites to publish the outputs of their learning activities. This supports the development of digital literacies but, more importantly, gives learners control over their innovations even after the course has finished. This data has also

contributed to the strategic development of new software. For example, feedback from course evaluations and server data indicated that learners found it difficult to identify and register the correct URL for the RSS feed page of their individual course blogs. This is important because the RSS feed URL is used to integrate blog posts in the live course feed (RSS is a standardised system for distributing machine-readable content on the internet). Staff addressed this challenge by developing new FOSS code to automatically identify the blog feed web address for OERu learners and simplify the process of registering this for recruitment on the course site. This code is available to all.

Conclusion

OERu has established a working model for transnational micro-credentialling for approved university qualifications. Assessment of outcomes for the LiDA courses are purposefully designed as building blocks to motivate and establish confidence for success before learners attempt the optional summative assessment for micro-credentials with pathways to achieving official academic course credits. Each micro-course has a basic knowledge test covering core concepts. Learners who pass the knowledge test can earn a Digital Badge for Participation at no cost (or purchase the "Certificate of Participation" [PDF file] for a nominal fee of NZ$10). These objective assessments are formative and do not qualify for credit. Feedback on correct and incorrect answers is provided for learners. Skill challenges at the end of each learning pathway constitute sub-components of the final summative assessment. Learners can practice their skills by applying their learning while receiving feedback from their peers before they revise and prepare submissions for their final assessment. All summative assessments for the associated micro-credentials for the micro-courses are subject to independent pre-assessment moderation to ensure alignment with the learning outcomes. Rubrics that provide details of the performance criteria are published on the course sites for each summative assessment. Learners who successfully complete the micro-credentials can qualify for credit towards university-level qualifications in Canada, New Zealand, the United Kingdom, and the United States. Moreover, because they are licensed as OER, any institution can reuse the LiDA assessments for credit recognition towards locally approved qualifications without incurring course design or development costs.

Because assessments for formal credit are conducted by individual OERu partners, due to privacy restrictions, the OERu does not have access to the actual performance metrics of individual learners completing courses for formal credit. However, the course evaluation survey provides some insight into learner perceptions. Ninety-five percent of learners agree that they are generally satisfied with their learning experience, and 85% indicate that they would personally recommend the course to others.

There is evidence of positive learning experiences. Before starting the course, 20% of learners rated their knowledge of OER as *sufficient*, and only 15% rated their knowledge as *excellent*. After taking the course, self-evaluation of knowledge had improved—45% of learners rated their knowledge as *sufficient*, and 36% of learners rated their knowledge as *excellent* (OER Foundation, 2021).

OERu futures

Implementation of the OERu strongly suggests that the status quo for IT infrastructure in higher education institutions is neither the only way, nor the best way, to do things. Because the OERu is not bound by historical decisions or conventions, it can pioneer new approaches from an "educational technology expert" perspective. OERu is driven by open principles and very tight resource constraints, but only needs to fulfil the vision: to build a rich, fit-for-purpose

infrastructure for learners and OER collaborators alike, with the potential to scale to facilitate large numbers of global learners, effectively addressing the UNESCO SDG4: Education for all.

Implementing a FOSS-based end-to-end service gives the OERu a unique perspective and experience compared with organisations that implement only the occasional FOSS component in an IT infrastructure dominated by proprietary software that is costly and extremely restrictive. OERu is building (anonymous, GDPR-compliant) monitoring systems into these services to ensure that evidence of success and failure can be collected and measured without impinging on the privacy of learners or collaborators. The insights gained are being shared openly. The OER Foundation's long-standing commitment to openness in all its forms has secured a pathway for context-specific adoption and adaptation. Meanwhile, the process of refining and adapting courses, both pedagogically and technically, continues to develop the capacity, and the passion, of the individuals and institutions involved.

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Dave Lane is the OER Foundation's open source technologist. His role is to build and maintain the computing systems used to make OERu courses available to learners everywhere, using exclusively free and open source software (FOSS). He is a passionate advocate for the use of FOSS in education and by educators. Dave joined the OER Foundation in 2015 after a few years working with Catalyst IT, the company that in 2012 acquired Egressive, the FOSS software development and IT services company he founded in 1998.

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