

HELPDESK RESPONSE 20

Open Educational Resources in Africa

A Curated Resource List

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Contents

Introduction	4
1.1. Document purpose	4
1.2. Open education resources defined	4
1.3. Background to open licensing	5
2. OER within the sub-Saharan African context	8
2.1. OER for curricula and platforms	8
2.1.1. Open Learning Exchange (OLE) and OLE Ghana	9
Table 1. OLE Ghana: At a glance	9
2.1.2. Leh Wi Lan	11
Table 2. Leh Wi Lan: At a glance	11
2.1.3. CK-12 Foundation	12
Table 3. CK-12: At a glance	12
2.1.4. Siyavula	14
Table 4. Siyavula: At a glance	14
2.1.5. Commonwealth of Learning — Open / Innovative Schooling	15
Table 5. Commonwealth of Learning: At a glance	15
2.1.6. Rumie	17
Table 6. Rumie: At a glance	17
2.1.7. GeoGebra	19
Table 7. GeoGebra: At a glance	19
2.2. OER for teacher education	21
2.2.1. Transforming Teacher Education and Learning (T-TEL)	21
Table 8. T-TEL: At a glance	21
2.2.2. OER4Schools	22
Table 9. OER4Schools: At a glance	22
2.2.3. Teacher education through school-based support, TESS-India	24

Table 10. TESS-India: At a glance	24
2.2.4. Teacher education in sub-Saharan Africa, TESSA	25
Table 11. TESSA: At a glance	25
2.3. OER modes of delivery: digital, radio, and television	26
2.3.1. Using television to support out-of-school learning: Ubongo Kids	27
Table 12. Ubongo Kids: At a glance	27
2.3.2. Using radio to support out-of-school learning: Rising Academies	29
Table 13. Rising Academies: At a glance	29
2.4. OER libraries and search engines	30
Table 14. OER Africa: At a glance	30
2.4.2. Kolibri	31
Table 15. Kolibri: At a glance	31
2.4.3. Kiwix	33
Table 16. Kiwix: At a glance	33
2.4.4. Global Digital Library (GDL)	34
Table 17. GDL: At a glance	34
2.4.5. OER Commons	37
Table 18. OER Commons: At a glance	37
2.4.6. OER World Map	38
Table 19. OER World Map: At a glance	38
2.4.7. Creative Commons (CC) search	39
Table 20. CC search: At a glance	39
2.4.8. Google Search (Creative Commons)	40
Table 21. Google Search: At a glance	40
2.4.9. Flickr (Creative Commons)	41
Table 22. Flickr: At a glance	41
3. References	42

1. Introduction

In response to the Covid-19 pandemic, Open Education Resources (OER) represent a crucial means to support the continuation of learning in both formal and informal settings ([↑UNESCO, 2020](#)).

1.1. Document purpose

This curated list defines open educational resources, offers background on open-source licensing, and provides a review of OER that can be used in the sub-Saharan African context. This document does not intend to set out a comprehensive list of OER used by teachers, students, parents or other stakeholders; rather, this document will identify exemplars of OER that focus on:

- reaching marginalised learners through offline or online content;
- reaching marginalised learners through mass media;
- using OER for teacher education;
- providing further useful information around implementing OER.

1.2. Open education resources defined

OER can take the form of any medium including text, images, audio, video, software, and so forth. OER are defined in this brief as educational content which is legally, technologically, and socially free ([↑Haßler & Mays, 2015](#)).

- ‘Legal freedom’ refers to resources which have a Creative Commons licence. This provides everyone with free and perpetual permission to combine resources without modification. The majority of licences allow content to be retained, revised, remixed, reused and redistributed (further illustrated in Section 1.2.).
- ‘Technological freedom’ refers to resources that are designed in such a way that they can be accessed and downloaded without restriction in multiple formats.
- ‘Social freedom’ is more nuanced and refers to equitable resources which minimise gendered, linguistic, cultural, and educational barriers to access.

1.3. Background to open licensing

The Creative Commons was founded in 2001 and set in motion a transformation for shared and published licensing. With the Creative Commons licensing model, any person, entity or organisation has both the means and opportunity to distribute and protect, to a lesser or greater degree, original and adapted works.

Even though most OER are created and shared digitally, hard copies, print, and other media continue to remain popular resource types. In the case where teachers, students, and parents or caregivers are living in contexts where access to the internet, devices, or data services may be limited, print versions of OER are an essential component of ensuring equity of access to teaching and learning materials.

With 1.6 billion free and open searchable resources, the Creative Commons supports a large and growing repository of shared content. As a start, consider exploring the OER resources available through the Creative Commons website itself.¹ From there, branch out to a general web search, being sure to include 'OER' or 'Open Educational Resources' in the search parameters. Further details around searching for OER are listed in Section 3 of this document.

The Creative Commons licensing model provides the opportunity to identify, adapt, create, and share OER across the globe.

The Creative Commons (CC) licensing model provides creators and authors with a wide range of licensing options. The following list of CC licence variants² provide details of each licence and how they may be used together to create a range of licensing options:



'Public Domain' (CC0): The CC0 licence provides the widest range of use and adaptation by others, wherein the creator gives up their copyright in full, placing the work into the public domain.

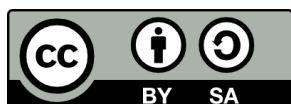
¹ To access the Creative Commons website, visit: <https://creativecommons.org/>

² This list was sourced from [T-TEL Professional Development Programme's \(2016\)](#) guide to OER. To explore, understand, and access logos to support the use of CC licence variants and how they may be used in combination to create a range of licensing options see <https://creativecommons.org/about/downloads/>

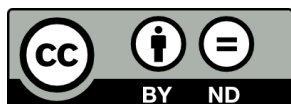


‘Attribution’ (BY): CC BY allows users to copy, redistribute, remix, or transform the content in any medium or format, including for commercial use. Users must give appropriate credit to the author and provide a link to the licence.

The ‘attribution’ requirement is common to the remaining variations of the Creative Commons licences.

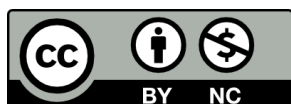


‘Attribution Share-Alike’ (SA): CC BY-SA allows users to copy, distribute, display, perform, and modify work, as long as they distribute the work and any modified work on the same terms. If users want to distribute modified works under other terms, they must get the author’s permission first.



‘Attribution NoDerivatives’ (ND): CC BY-ND allows users to copy, distribute, display, and perform only original copies of work. If users want to modify or adapt work, they must get the author’s permission first.

All of the three above licences can be combined with the ‘Non-Commercial’ condition, restricting the licences further by prohibiting commercial use.



‘Attribution Non-Commercial’ (NC): For example, CC BY-NC combines the ‘BY’ requirement for attribution with the ‘NC’ requirement prohibiting commercial use. That said, we focus here on educational content, which should be free from commercial constraints.

Creative Commons licensing is the most widely recognised open licensing system for content, such as text, images, audio, and video. There are other licensing types that apply to other media (such as data or software). For example, the MIT Licence of the Open Source Initiative,³ founded in 1998, is one of the earliest and widely recognised licensing rubrics for software development and associated services in the open-source community (↑[Lakhan & Jhunjhunwala, 2008](#)).

³ For more information, visit: <https://opensource.org/licenses/MIT>. A complete description of the Open Source Initiative licensing and their applications in OER can be found here <https://opensource.org/licenses>.

With a long and well-supported foundation and history reaching many aspects of content, data, and software, open licensing provides a robust foundation upon which both direct end-users and educational institutions can rely.

2. OER within the sub-Saharan African context

The type and extent to which OER are used in any given setting or country are unique, reflecting in part the in-school and governmental knowledge and perceptions regarding OER. Additionally, the availability and compatibility of OER both as online resources, in offline or other modes, including print, are often considered essential criteria in the process of selecting contextually-appropriate OER which can be scaled effectively.

In this section we review examples of OER that are relevant to the sub-Saharan African context, including a summary of materials, licensing, format, and other key features. This curated list provides examples of three categories of OER, namely:

- OER for curricula and platforms
- OER for teacher education
- OER modes of delivery.

This list by no means reflects the full scope or focus of OER across the region. Each example includes a summary table, a link to the resource, and a brief description.

2.1. OER for curricula and platforms

OER are frequently used as curriculum or learning platforms. These OER can support learning for students and teachers that either aligns with existing national curricula or offers alternative subject content.

2.1.1. Open Learning Exchange (OLE) and OLE Ghana

Table 1. OLE Ghana: At a glance

Materials	✓ Materials for students
	✓ Materials for lessons and lesson preparation
	✓ Materials for teacher education
Licence	The Planet Learning platform is licensed under the GNU Affero General Public Licence v3.0 ⁴
Format	E-books and e-readers via Basic e-Learning Library (BeLL)
Access	Online and Offline
Accessibility	No clear accessibility statement or policy
Language	English
Available from	Open Learning Exchange: https://www.ole.org/ https://archive.org/details/bell_literature?&sort=-downloads&page=2 ⁵ Basic e-Learning Library (BeLL): Free Texts: Free Download, Borrow and Streaming: Internet Archive: https://archive.org/details/bell

The Open Learning Exchange (OLE) aims to address three challenges:

- a lack of quality learning materials;
- a lack of effective teachers;

⁴ For more information on the GNU Affero General Public Licence v3.0 see: <https://www.gnu.org/licenses/agpl-3.0.en.html>

⁵ Content provided via the Planet Learning system is not easily accessible via OLE Ghana's website or a web search.

- a lack of meaningful interconnectedness between students, teachers, and school administrators.

Planet Learning is OLE's platform. It is a free, open access, and public domain content repository; it consists of an online, cloud-based repository and a community server which delivers learning materials to a local area network.⁶ The Planet Learning system uses devices which link to an offline digital library housed on a Raspberry Pi.⁷ Planet Learning will run on any operating system, including Linux, Apple OS X, and Windows. It is licensed under the GNU Affero General Public Licence v3.0, which allows for commercial use, modification, distribution, patent use, and private use.⁸

OLE has a number of country-specific branches, which often have developed significant programming, such as OLE Ghana⁹ and OLE Nepal.¹⁰ OLE Ghana uses interactive, curriculum-aligned content which employs low-cost technology via the generic learning system Planet Learning. OLE Ghana has worked on several initiatives with the Ghana Ministry of Education, with programmes implemented across 50 rural elementary schools in 8 of Ghana's 16 regions, serving 6,000 students.

Programmes undertaken by OLE Ghana include TeacherMate¹¹ which assists teachers with handheld devices and differentiated learning systems to improve pupils' basic literacy levels; and Ghana Reads,¹² an approach to student literacy-building which emphasises self-paced, student-centred learning. Ghana Reads utilises a learning management system to enable interaction between teachers and students, with tablets and Raspberry Pi supporting learning. Part of the Ghana Reads programme is the Basic e-Learning Library (BeLL), an offline digital library. The BeLL consists of computer servers loaded with OER. The servers are connected to a projector, laser printer, speakers, and monitors to support large-group lesson delivery

⁶ For more information on the Planet Learning system, see:

<https://www.ole.org/our-platform/>

⁷ For more information on Raspberry Pi, see: <https://www.raspberrypi.org/>

⁸ For more information on Open Learning Exchange's licensing, see:

<https://github.com/open-learning-exchange/planet/blob/master/LICENSE>

⁹ <https://www.oleghana.org/>

¹⁰ <http://www.olenepal.org/>

¹¹ For more information on TeacherMate, see:

http://www.oleghana.org/index.php?option=com_sppagebuilder&view=page&id=20&Itemid=694

¹² For more information on Ghana Reads, see:

http://www.oleghana.org/index.php?option=com_sppagebuilder&view=page&id=21&Itemid=693

and individual use on monitors. Additional resources can be added to the BeLL via a flash drive or created and added locally using a keyboard and video camera. The BeLL operates offline, but internet connectivity can provide access to additional resources (†[Center for Education Innovations, no date](#)). OLE Ghana's programmes use solar-powered technology, making them accessible in environments with limited access to power. However, obtaining the requisite devices incurs costs; a 1GB Raspberry Pi server costs \$35, and tablets and keyboards cost \$60 each. The existing scale of OLE Ghana's work is significant; considerable lessons can be learned from this work, which can be adapted, reused, and recycled in future programmes.

2.1.2. Leh Wi Lan

Table 2. Leh Wi Lan: At a glance

Materials	✔ Materials for students
	✔ Materials for lessons and lesson preparation
	✘ Materials for teacher education
Licence	CC BY
Format	PDF, Word
Access	Download; printable
Accessibility	No clear accessibility statement or policy.
Language	English
Available from	Ministry of Basic and Senior Secondary Education: Sierra Leone: https://mbsse.gov.sl/leh-wi-lan/ EdTech Hub: https://edtechhub.org/coronavirus/oer/ Open Development and Education: https://docs.opendeved.net/lib/?featured=BKQMIMBQ&sort=date_desc

Leh Wi Lan is an intervention which aims to improve pupil learning outcomes in English and mathematics in Sierra Leonean secondary schools. The programme aims to make schools safe for girls, improve learning conditions in schools for boys and girls, strengthen central and district capacity to oversee educational reform, and improve monitoring and learning. Impact is measured through performance tracking against existing school certificate assessments. Furthermore, these resources are linked to the West Africa regional secondary school examinations.

The programme supports both teaching and learning through a range of resources (lesson plans, pupil handbooks and other materials). All resources are made publicly available on the Leh Wi Lan website and can be downloaded in PDF format. Guidance notes are provided for teachers and pupils alike to remove educational barriers, in an attempt to make the content as accessible as possible to all. All resources are licensed under Creative Commons Attribution.

2.1.3. CK-12 Foundation

Table 3. CK-12: At a glance

Materials	✓ Materials for students
	✓ Materials for lessons and lesson preparation
	✗ Materials for teacher education
License	Creative Commons Attribution-NonCommercial 3.0 Unported Licence
Format	Digital textbooks
Access	Textbooks can be read online and downloaded
Accessibility	Multi-modal to suit different learner needs
Language	Available in multiple languages, including English, Spanish, Korean, German, Chinese, Greek, Polish

**Available
from**

CK-12 Foundation. Free Online Textbooks, Flashcards, Adaptive Practice, Real-World Examples, Simulations:
<https://www.ck12.org/student/>

CK-12 provides digital textbooks, coupling scaffolded content with technology to support students, teachers, and parents throughout the learning process. The resource is multi-modal to suit differentiated learning styles and provides an online interactive learning platform directed by students and teachers. It serves more than 134 million users. The content is written in several languages, including English and Spanish, and provides instruction on numerous subjects — with a heavy focus on science, technology, engineering, and maths (STEM) subjects.

CK-12 resources are free and integrated with a variety of Single Sign-On (SSO) and Learning Management System (LMS) partners, including Google Classroom, Edmodo, and Blackboard. Curriculum developers have the capacity to use, edit, and repurpose existing CK-12 materials. As such, CK-12 content can be localised to ensure the subject matter is culturally and linguistically relevant. The site has an in-built function for machine translation with Google Translate. Educators can create their own textbooks or customise CK-12's existing materials.¹³ Its focus on supporting parental and community engagement in the learning process is significant. However, connectivity is required for additional features such as videos and quizzes. CK-12 content is licensed under a Creative Commons Attribution-NonCommercial 3.0 Unported Licence.¹⁴

¹³ To see an example of localised content, visit this page to see CK-12 content made available in Georgian through the joint initiative and efforts of the CK-12 Foundation, the Education Coalition and the United Nations Children's Fund.
<https://www.ck12.org/pages/georgia/>

¹⁴ For more information on Creative Commons Attribution-NonCommercial 3.0 Unported licence, see: <https://creativecommons.org/licenses/by-nc/3.0/>

2.1.4. Siyavula

Table 4. Siyavula: At a glance

Materials	✓ Materials for students
	✓ Materials for lessons and lesson preparation
	✗ Materials for teacher education
Licence	Openly licensed ¹⁵
Format	Content available online and can be downloaded and printed
Access	Textbooks can be read online and downloaded
Accessibility	No clear accessibility statement or policy
Language	English
Available from	Siyavula. Open Textbooks: https://www.siyavulaeducation.com/work-oer.html#BOOKS

Siyavula Education aims to help South African learners improve their performance in mathematics and science. It uses digital textbooks to provide adaptive and targeted practice for mathematics, physics, and chemistry for primary and high school levels. The programme is aligned to the South African curriculum.

Siyavula provides learners with open, curriculum-aligned content that can be accessed via multiple modalities, such as basic-feature phones or internet-enabled devices. There is also a specific offline access focus; thus, content is also downloadable and made available to print. The software is developed in line with open web standards, maximising innovation potential while minimising the risk of platforms becoming defunct. Siyavula can be

¹⁵ For more information on Siyavula's licensing, see:
<https://www.siyavulaeducation.com/technology-licensing.html>

adapted by teachers based on learners' progress. While much of Siyavula's content is made freely available, some content sits behind a paywall.¹⁶

We note that there are several other open textbook initiatives, such as OpenUpResources¹⁷ and African Storybook,¹⁸ which may also be of interest.

2.1.5. Commonwealth of Learning — Open / Innovative Schooling

Table 5. Commonwealth of Learning: At a glance

Materials	✓ Materials for students
	✓ Materials for lessons and lesson preparation
	✓ Materials for teacher education
Licence	Various Creative Commons Licenses
Format	PDF
Access	Learning materials can be downloaded for offline access and read or viewed online
Accessibility	CoL's website has assistive technology to support enhanced reading accessibility (↑CoL, no date); though operational in several countries, the language of instruction employed in each country is not clear
Available from	CoL: https://www.col.org/programmes/open-schooling OER for Open Schooling (OER4OS): https://www.col.org/programmes/open-schooling/oer-open-schooling-oer4os OAsis Home: http://oasis.col.org/

The Commonwealth of Learning (CoL) focuses on enhancing learning as a means to foster economic growth, social inclusion, and environmental conservation. Its Open / Innovative Schools Initiative targets out-of-school primary and secondary learners. The model focuses on a variety of areas, such as teacher professional development in eLearning courses and in the use of

¹⁶ For more information on Siyavula pricing, see: <https://www.siyavula.com/pricing>

¹⁷ <https://openupresources.org/>

¹⁸ <https://www.africanstorybook.org/>

OER, improving administration of open schools, and supporting the use of appropriate technologies in teaching and learning. The OER for Open Schooling (OER4OS) project, launched in 2012, aimed to provide materials under the Creative Commons licence agreement to support learning in 17 secondary school subjects. These materials have been made accessible for use in six countries: Botswana, India, Lesotho, Namibia, Seychelles, and Trinidad and Tobago. Teachers' guides were also provided to support educators in using OER effectively.

Open Schooling can be integrated within government ministries, universities or through standalone, independent distance education institutions. The Open Schooling initiative's model¹⁹ can be tailored by individual countries. Open schooling resources are developed with Creative Commons licences and the focus on upskilling educators around OER is clear. The initiative also includes an open access repository for reusable and adaptable learning resources and publications.²⁰ Materials are freely available, but — as with all resources — some contextual adaptation might be needed to maximise benefits.

¹⁹ For more information on the Open Schooling model, see: <http://oasis.col.org/handle/11599/2721>

²⁰ For the open access repository, see: <http://oasis.col.org/>

2.1.6. Rumie

Table 6. Rumie: At a glance

Materials	✓ Materials for students
	✓ Materials for lessons and lesson preparation
	✗ Materials for teacher education
Licence	Proprietarily licensed, free to access
Format	Video, App, PDF
Access	Materials can be downloaded and read or viewed online
Accessibility	The LearnCloud tool has an accessibility widget which has a variety of features, including a screen reader, a keyboard navigation tool, functionality to highlight links, a feature to enlarge text, and a 'dyslexia friendly' setting. Language content can be localised.
Language	Materials are available in multiple languages, including Algonquian, Arabic, Cree, English, Farsi, French, German, Hindi, Italian, Khmer, Mandarin, Mohawk, Nepali, Pashto, Portuguese, Russian, Spanish, Swahili, Turkish.
Available from	Rumie LearnCloud: http://learncloud.rumie.org/

Rumie aims to remove barriers to learning by using technology to freely share educational resources. Rumie has a LearnCloud software tool which contains customisable educational content accessible for all. Rumie's LearnCloud is a proprietary online content curation portal (†Kim & Migdal, 2016). Rumie has been rolled out in a number of countries.

Rumie's content is customisable and can be aligned to a specific curriculum through the LearnCloud tool. It is also possible to access Rumie materials

offline. Users can configure their device settings to 'offline' mode where they do not have a reliable internet connection; this enables downloads as .zip files when users do have connectivity ([Janzen & Chugh, 2019](#)). This offline mode extends access to those without reliable internet access and allows individuals to work autonomously and asynchronously. The learning content is free to access. Rumie's content largely targets young people and adults with themes such as career skills, business acumen, and digital literacies.

2.1.7. GeoGebra

Table 7. GeoGebra: At a glance

Materials	✓ Materials for students
	✓ Materials for lessons and lesson preparation
	✓ Materials for teacher education
Licence	Multiple licenses, providing free non-commercial use of software and curriculum materials, subject to Free Software Foundation (FSF), ²¹ Creative Commons, with the Source Code under GNU General Public License, in addition to GeoGebra Non-commercial license terms.
Format	Web-based platform, with the addition of native iOS and Android apps supporting mobile phones
Access	Software and learning can be downloaded and read online and offline
Accessibility	GeoGebra adheres to WCAG 2.0 AA compliance for its software and curriculum authoring tools ²²
Language	Materials are available in 64 languages (from Albanian, Arabic and Armenian to Welsh, Xhosa and Yiddish) supported by an active volunteer translation team responsible for updating and providing new translations of the software.
Available from	https://www.geogebra.org/ including the App and Play stores

²¹ For more information on FSF, visit: <https://www.fsf.org/>

²²WCAG is linked to below in 2.4.1., for further questions regarding GeoGebra's accessibility email support@geogebra.org

GeoGebra is an open-source dynamic mathematics software and curriculum service for all levels of mathematics education, bringing together geometry, algebra, spreadsheets, graphing, statistics and advanced calculus in one platform and set of apps.

Supporting K-12 and Higher Education, GeoGebra is perhaps more often considered in the context of its role in supporting a rapidly expanding community of millions of teachers and students located worldwide, including all countries within the African continent.

African students and teachers can use GeoGebra on their phones, through the iOS and Android apps as well as on any desktop, laptop and tablet. GeoGebra can be downloaded for free from geogebra.org and runs completely offline and in the same way as the online apps. When working offline, students and teachers can save their GeoGebra mathematics (also referred to as constructions) on their devices. These same, saved constructions can then be searched at a later time, retrieved, used, revised and shared with others. When an internet connection is available, students and teachers can use the same app that is installed on their own devices to search millions of GeoGebra constructions on topics related to their own learning needs. These files can be saved and used offline. GeoGebra also provides a free platform for anyone to create and share their GeoGebra constructions from a personal profile page. More than 10 million students and teachers have GeoGebra profiles, where they save and share their constructions with others regionally and worldwide.

GeoGebra.org is a not-for-profit organisation with the vision to ensure every student and teacher has access to the same powerful software that leading researchers and mathematicians also use. At the same time, GeoGebra strives to put its user community at the heart of its activities supporting mathematics education by providing free web services for students and teachers, where they can create, share, use, and copy any of the millions of curriculum materials shared on the platform.

2.2. OER for teacher education

OER can be used to raise the standard of pedagogy by reaching teachers at scale. 'Teacher education' refers to learning for both pre-service and in-service teachers. For more information on effective teacher education in low-connectivity settings, inclusive of more detail on the OER examples listed below, please see this [↑EdTech Hub resource list \(Koomar, et al., 2020\)](#).

2.2.1. Transforming Teacher Education and Learning (T-TEL)

Table 8. T-TEL: At a glance

Materials	✗ Materials for students
	✗ Materials for lessons and lesson preparation
	✓ Materials for teacher education
Licence	Creative Commons Attribution-ShareAlike 4.0 International
Format	PDF and Word
Access	Materials can be downloaded for offline access
Accessibility	T-TEL has a communications guide (↑T-TEL Professional Development Programme, 2016); there is no clear accessibility statement or policy
Language	English
Available from	T-TEL: https://www.t-tel.org/home T-TEL's Learning Hub: https://www.t-tel.org/learning-hub

T-TEL supports innovation, inclusion, good practice, and results to produce high-quality teachers. It is a six-year programme supported by UK aid which aims to strengthen pre-service teacher education in Ghana and to support the implementation of the Bachelor in Education (B.Ed) degree.

T-TEL has downloadable content openly available on the Learning Hub on its website. T-TEL professional development resources were developed to support teaching in 46 of Ghana's Public Colleges of Education and improve the competency of student teachers. The resources can also be used within schools and communities of practice by in-service teachers. The set of resources are organised into twelve pedagogical themes including questioning, group work, and assessment for learning.

All T-TEL resources are OER, available under a Creative Commons Attribution-Share-Alike licence. Users are free to use and adapt the resources as long as T-TEL is attributed and the same licence is retained ([T-TEL Professional Development Programme, 2016](#)).

2.2.2. OER4Schools

Table 9. OER4Schools: At a glance

Materials	✗ Materials for students
	✓ Materials for lessons and lesson preparation
	✓ Materials for teacher education
Licence	Creative Commons Attribution-Share-Alike or Creative Commons Attribution-NonCommercial
Format	Netbooks, e-book readers, PDF.
Access	Materials can be downloaded for offline access
Accessibility	No clear accessibility statement or policy
Language	English
Available from	OER4Schools Professional Learning Resource: http://oer.educ.cam.ac.uk/wiki/OER4Schools

OER4Schools is an open-access, multimedia programme for school-based teacher professional development. The project aims to develop teachers'

capabilities in interactive pedagogy, integrating technology in teaching and learning where appropriate technology is available (e.g., tablets, netbooks, e-book readers, OER and open-source software). OER4Schools-based TPD programmes have taken place in Zambia, Kenya, Rwanda, and Sierra Leone.

OER4Schools uses open content: resources can be adapted and are customisable. The content is hosted on a wiki²³ and can be collaboratively edited; they are available under a Creative Commons licence. Materials can also be downloaded as a PDF.

A range of research publications is available on OER4Schools,²⁴ including several peer-reviewed journal publications. For example, ↑[Hennessy, et al. \(2016\)](#), conducted in Zambian primary schools. The study found that participating teachers increasingly adapted lessons to the skill level of students and incorporated more practical group work into their classes. Furthermore, the study also found that the programme supported students to actively engage in activities and develop a deeper subject knowledge (↑[ibid.](#)). A follow-up study 18-months after the initial pilot demonstrated that certain teachers sustained these positive changes to their pedagogical practice. In fact, a 'large proportion of the teachers developed a broader range of teaching strategies to draw on, namely dialogue, questioning and group work' (↑[Haßler, et al., 2020](#)). These strategies were all promoted by the programme.

²³ The software used is Mediawiki: <https://www.mediawiki.org/wiki/MediaWiki> the same software that runs Wikipedia: <https://www.wikipedia.org/>

²⁴ See <https://docs.opendeved.net/lib/LJWIPFRA#cites>

2.2.3. Teacher education through school-based support, TESS-India

Table 10. TESS-India: At a glance

Materials	✗ Materials for students
	✓ Materials for lessons and lesson preparation
	✓ Materials for teacher education
Licence	CC BY-SA 4.0
Format	PDF; Video; Word; e-book; e-reader; Zip file; RSS
Access	Materials can be downloaded for offline access
Accessibility	No clear accessibility statement or policy
Language	Materials are available in multiple languages, including English, Hindi, Assamese, Kannada, Odia, Bengali
Available from	TESS-India (Teacher Education through School-based Support): https://www.open.edu/openlearncreate/course/index.php?categoryid=45

TESS-India aims to strengthen and transform professional development and classroom practice in India. The programme particularly focuses on inclusive and participatory child-centred pedagogy. It includes pre- and in-service teacher education reaching more than one million teachers and teacher educators.

Though TESS-India is not a programme which has been implemented on the African continent, there are several lessons that can be learned from this example. For example, TESS-India offers a toolkit of almost 200 freely available OER in multiple languages. The toolkit comprises 105 teacher development units, 20 school leadership units, 10 principles of practice, 55 videos of classroom teaching and a compendium offering sample teaching-learning

pathways through the OER. Teacher educators are supported by a free Massive Open Online Course (MOOC) available in English and Hindi. Users are free to use, adapt and re-use this material as long as the source is credited under the CC BY-SA 4.0 licence.²⁵ The localisation of the resources into multiple languages working across diverse contexts is a significant aspect of TESS-India. The following example follows TESS-India, and focuses on the African context.

2.2.4. Teacher education in sub-Saharan Africa, TESSA

Table 11. TESSA: At a glance

Materials	✗ Materials for students
	✓ Materials for lessons and lesson preparation
	✓ Materials for teacher education
Licence	Creative Commons Attribution-ShareAlike 3.0 Unported (CC BY-SA 3.0)
Format	PDF; Word; Video
Access	Materials can be downloaded for offline access
Accessibility	No clear accessibility statement or policy
Language	Materials are available in multiple languages such as English, French, Arabic, and Swahili
Available from	TESSA: http://www.tessafrica.net/about-us

²⁵ For more information on CC BY-SA 4.0, see: <https://creativecommons.org/licenses/by-sa/4.0/>

TESSA is a network of teachers and teacher educators stretching across sub-Saharan Africa. It provides OER, linked to the school curricula, and is designed to support teachers and teacher educators in developing active approaches to learning. It was created to improve the quality of, and access to, school-based education for teachers.

At the core of the network is a bank of OER, produced in partnership with local African educational experts. These resources are designed to help teachers and teacher educators develop an active approach to learning and to make their teaching more interactive. The resources are available in four languages with ten different country versions. The content ranges from curriculum frameworks, learning modules for both primary and secondary levels, handbooks and toolkits, and more.

The large bank of materials is made available to enhance and improve the quality of, and access to, local, school-based education and training for teachers. The OER are being used by communities located in individual schools and by institutions with a national reach. TESSA content is licensed under a Creative Commons licence.

2.3. OER modes of delivery: digital, radio, and television

While digital media — available via the internet — are often identified as the primary source of OER, radio and television remain important modalities for reaching households in countries where power, internet and mobile connectivity are not universally available or reliable.

For example, in Ghana, approximately 35% of adults own a smartphone ([↑Silver & Johnson, 2018](#)). This is compared to the penetration of radio, reported to be 91 % by [↑Media Ownership Monitor: Ghana \(no date\)](#). According to [↑Watson \(2019\)](#), around 700,000 households own a pay- or subscription-based television in Ghana. This equates to around 10% of the total households, judging from [↑Ghana Statistical Service \(2014\)](#) data. It is expected that this figure will have increased in recent years, following trends of increasing television ownership shown by [↑Watson \(2019\)](#). For more information on radio and television as EdTech modalities, please consult the following EdTech Hub reports: a rapid evidence review on educational television by [↑Watson & McIntyre \(2020\)](#); a rapid evidence review on educational radio by [↑Damani & Mitchell \(2020\)](#); and two Helpdesk responses on radio-based education ([↑McBurnie, 2020a](#); [↑McBurnie, 2020b](#)).

Thus, broadcast media are important media for ensuring equity in access to remote learning. Given the potential of broadcast media as modes of delivery

for remote learning across sub-Saharan Africa, the following section highlights several examples of how OER and broadcast media can be used in tandem (↑Haßler, et al., 2020).

2.3.1. Using television to support out-of-school learning: Ubongo Kids

Table 12. Ubongo Kids: At a glance

Materials	✓ Materials for students
	✓ Materials for lessons and lesson preparation
	✗ Materials for teacher education
Licence	MIT License
Format	Video / TV; Audio / Radio; App; Paper-based
Access	Certain materials can be downloaded offline
Accessibility	The multi-modal approach supports diverse learners' needs (↑Ubongo, 2016)
Language	Content is available in several languages, including Kiswahili, English, French, and Kinyarwanda
Available from	Ubongo Kids: https://ubongokids.com/ Akili and Me: http://akiliandme.com/

Ubongo Kids, run by the NGO Ubongo, has reached more than 17 million viewers in 31 countries through its 'edutainment' programming. Ubongo Kids delivers programming on traditional subjects such as mathematics and science as well as covering broader issues including gender rights and financial literacy. Ubongo Kids is offered through multiple modalities with radio, app-based and paper-based materials supporting the televised and internet-streamed video content. Ubongo Kids has also been translated into five other languages, alongside its original Swahili content.

Impact data from ↑[Borzekowski, et al.'s \(2019\)](#) intervention suggests that children who watched Akili and Me²⁶ (the Rwandan adaptation of Ubongo Kids) had significantly higher scores for counting, number recognition, shape knowledge, letter identification, colour identification, body-part recognition, health knowledge and vocabulary, relative to a comparison group. Experience broadcasting Ubongo Kids in Tanzania suggests per-person, per-year costs are approximately one cent. However, these figures are based solely on developing the content, with costs affiliated with purchasing technology, power or connectivity not included in this estimate (↑[Rapid Evidence Review — TV: Watson & McIntyre, 2020](#)).

Ubongo has worked to develop its own multi-modal approach with resources also developed for radio, mobile use and print in order to reach communities with infrastructural constraints. Future plans include the creation of toolkits for parents, caregivers, and practitioners to support home-based learning during mass school closures. Ubongo Kids is licensed under the MIT Licence which preserves copyright. Licensed works, modifications, and larger works can be distributed under different terms.²⁷

²⁶ To see the Akili and Me website, go to: <http://akiliandme.com/>

²⁷ For more information on the MIT licence, see: <https://github.com/learningequality/sushi-chef-ubongokids/blob/master/LICENSE>

2.3.2. Using radio to support out-of-school learning: Rising Academies

Table 13. Rising Academies: At a glance

Materials	✓ Materials for students
	✓ Materials for lessons and lesson preparation
	✗ Materials for teacher education
Licence	Creative Commons Attribution-NonCommercial 4.0
Format	Audio / Radio; SMS
Access	Scripts can be downloaded.
Accessibility	No clear accessibility statement or policy
Language	Scripts are made available to translate into local languages. Rising's scripts have currently been translated from English into French and Arabic.
Available from	Rising Academies: https://www.risingacademies.com/ Rising On Air: https://www.risingacademies.com/onair

Rising Academies runs a network of 160 schools that serve 50,000 students in Liberia and Sierra Leone. In March 2020, Rising Academies partnered with the governments in these two countries to create an interactive radio instruction (IRI) programme for out-of-school learners. This programme specifically targets students in remote rural areas who cannot access the internet and is estimated to reach 1.4 million children. Rising Academies has also developed Rising On Air, a web portal which enables international partners to download freely available, standardised scripts for IRI lessons. Rising on Air content is available for early years, primary, and secondary-level learners.

When analysing the Liberia Education Advancement Program (LEAP) ↑[Romero & Sandefur \(2019\)](#), found that students in Rising schools progressed

more than twice as fast as children in comparable government control schools.

Rising On Air content allows users to adapt, record and deliver content to students in other contexts. It is licensed under the Creative Commons and is curriculum-aligned. Scripts are available to download for free and can be edited by users. If scripts are edited, audio can be re-recorded by educators.

2.4. OER libraries and search engines

The Google search 'open education resources' returns 3.5 billion results. A clear understanding of the resources required helps to refine the search. However, it still requires scrutiny and discussion to ascertain the quality and goodness-of-fit for given teaching and learning settings. For example, the search 'Ghana open education resources for grade 5 maths' returns this [EdTech Hub \(2020\)](#) blog post which includes OLE Ghana (see 2.1.1. above).²⁸

Between OER resource libraries and search engines, the ecosystem of OER is both available and expansive, providing a solid foundation upon which to build a curriculum and deliver learning. Below we provide information on some commonly-used OER resource libraries and search engines that offer useful starting points for searching for OER appropriate for sub-Saharan African contexts.

Resource libraries are vital facets of OER, acting as freely accessible content repositories. Some of the resources listed in Section 2 of this curated list could also be considered resource libraries, such as CK-12 Foundation and Rumie, for example. The following libraries are but a few of the many hundreds, indeed, thousands of OER libraries that have been assembled and shared.

Search engines are useful tools which help to seek out OER in a targeted manner. The following search engines have been included due to the volume of open resources available and the ease with which users can access these tools. 2.4.1. OER Africa

²⁸ See the blog post here for the link and further information on this:
<https://edtechhub.org/2020/01/22/18-large-scale-edtech-initiatives-on-our-radar-in-2020/>

Table 14. OER Africa: At a glance

Materials	✓ Materials for students
	✓ Materials for lessons and lesson preparation
	✓ Materials for teacher education
Licence	Creative Commons Attribution 4.0 International licence and courseware is also licensed under various CC licences
Format	Word and PDF
Access	Resources can be downloaded and read offline. Downloads can be compressed.
Accessibility	No clear accessibility statement or policy
Language	Resources are available in English
Available from	OER Africa: https://www.oerafrica.org/oer-courseware-research-and-policies

OER Africa aims to raise the profile of OER across the continent, connecting educators, policymakers and academics to promote collaboration. There is a particular focus on teacher education and professional development, where ‘coursewares’ are available, inclusive of teachers’ guides and other units related to educational technology and more. A further focus relates to foundational skills, with courseware on English language and literacy, etc., OER Africa’s final two thematic focuses are agriculture and health. It has established various links with higher education institutions and academics.

OER Africa also provides various toolkits which comprise relevant information, guides, and templates pertaining to OERs. These include guidance on copyright and licensing, course design, and materials to support distance learners. OER Africa courseware is openly licensed and free to download.

2.4.2. Kolibri

Table 15. Kolibri: At a glance

Materials	✓ Materials for students
	✓ Materials for lessons and lesson preparation
	✗ Materials for teacher education
Licence	Creative Commons Attribution 4.0 International licence and further open licenses cover the specific content hosted
Format	Various content is provided through the learning platform such as videos, quizzes, and revision materials
Access	Kolibri is designed for offline access
Accessibility	Web Content Accessibility Guidelines (WCAG) followed during platform design (↑Kirkpatrick, et al., 2018; ↑Matic, 2018)
Language	Available in multiple languages, including, English, Chinyanja, German, Spanish, French, Kiswahili, Portuguese, Yoruba, Arabic, and more
Available from	Kolibri: https://learningequality.org/kolibri/

Kolibri is an offline learning platform that works in communities with limited access to power and connectivity. While Kolibri licensing is CC BY, the license type defines the use of the Kolibri platform itself, not necessarily the curriculum content it delivers or hosts online and offline. As a platform, Kolibri can host content which may be subject to any variation on the CC licence model as described in this document.

Kolibri is available in 23 countries, in dozens of languages for over 6 million users. It is adapted to reach the most remote communities. When exported onto a device, the device can be transported to access local networks to share

installers, updates, and content with other devices. It has been used in non-formal school systems and refugee camps.

Kolibri is designed to provide offline access to a curated and openly licensed educational content library with multiple channels. The focus on offline functionality means that Kolibri has developed processes to extract and compress data, such as videos, for offline use on a device with limited storage capacity. It is hardware-agnostic and runs on numerous devices and operating systems, including Windows, Linux, and OSX. This allows Kolibri to use whatever hardware or devices already exist. The customisable digital curriculum means it can be adapted and tailored where necessary with a content curation system that ensures users have full control over the organisation of educational materials. Co-dependent software components include a targeted tool for curriculum specialists at Ministry-level, school-level, or for NGOs. There is also a tool for school administrators and coaches or educators at the classroom-level.

Kolibri's site has documentation, guidance and demos; the Kolibri toolkit can also be accessed in English, French, Arabic, and Spanish.²⁹

Furthermore, ↑Matic (2018) states that accessibility was a focus for the Kolibri team. Kolibri ensured that proper foreground and background colours provide adequate contrast; all informative graphic elements have alternative textual representation; e-keyboard access is enabled for all interactive page elements; screen-reader use is supported; appropriate captions are provided for video content whenever available.

Unless otherwise stated, Kolibri's content is licensed under a Creative Commons Attribution 4.0 International licence.³⁰

²⁹ To access the Kolibri toolkit, see:

<https://drive.google.com/drive/folders/1TNCjAOk24NKZFdK-GYzXSbUhksZ4wuOr>

³⁰ For more information on Creative Commons Attribution 4.0 International license, see: <https://creativecommons.org/licenses/by/4.0/>

2.4.3. Kiwix

Table 16. Kiwix: At a glance

Materials	✓ Materials for students
	✓ Materials for lessons and lesson preparation
	✓ Materials for teacher education
Licence	Multi-licensed under the Creative Commons Attribution-ShareAlike 3.0 Licence (CC-BY-SA) and the GNU Free Documentation Licence (GFDL)
Format	Offline reader
Access	Offline
Accessibility	No clear accessibility statement or policy; however Kiwix draws on Wikipedia's accessibility features (↑Wikipedia, 2020)
Language	Available in multiple languages, including English, Catalan, Danish, Turkish, Italian, Bahasa Indonesia, Polish, Arabic, Russian, and many more
Available from	Kiwix: https://www.kiwix.org/en/

Kiwix is an offline reader which can house highly compressed yet integral copies of Wikipedia, MOOCs, Youtube videos, etc.. The platform focuses on making any educational material available in areas with poor to no connectivity. Kiwix has more than 4 millions users worldwide and runs on mobile phones, desktop computers, as well as inexpensive nano servers (Raspberry Pi) hotspots that can connect up to 25 users at a time.

Kiwix's software is open source and available under the GNU Free Documentation Licence (GFDL3), making it free to use and redistribute.

Wikipedia, TED and every single resource available on the platform are also freely licensed (Creative Commons³² or Public Domain³³).

2.4.4. Global Digital Library (GDL)

Table 17. GDL: At a glance

Materials	✓ Materials for students
	✓ Materials for lessons and lesson preparation
	✓ Materials for teacher education
Licence	Various Creative Commons licences
Format	E-reader; PDF; EPUB; Audio / Radio
Access	Online and Offline
Accessibility	Multi-modal to support learners' needs and has recently launched two sign languages on the Global Digital Library, to support deaf students' access to GDL resources: Kenyan Sign Language , Cambodian Sign Language (↑Global Digital Library, 2020).
Language	There is a focus on minority languages, including readers available in Afaan Oromoo, Afrikaans, Dotyali, Gusii, Hausa, Kinyarwanda, Lingala, Somali, Tigrinya, and many more
Available from	Global Book Alliance.: https://www.globalbookalliance.org Global Digital Library: https://home.digitallibrary.io/about/ African Storybook: https://www.africanstorybook.org/ GDL Radio: https://gdlradio.org/

A flagship project of the Global Book Alliance is the Global Digital Library, developed to increase the availability of high-quality reading resources in 'underserved' languages worldwide. The phrase 'underserved' refers to languages where there is a lack of quality, early grade reading resources

(↑[Global Digital Library](#), no date). The GDL currently offers resources in 43 languages, with a goal to offer resources in 100 languages by the end of 2020.

An example of a GDL project is the African Storybook initiative. It aims to develop, publish, and use contextually-appropriate storybooks that can be read online or offline, downloaded and printed. The African Storybook has been rolled out in 15 African countries to date, reaching 48,303 educators and 1,145,226 children. African Storybooks promotes linguistic appropriateness, preserving mother tongue languages alongside the promotion of bi- and multilingualism.

GDL Radio also offers a library of resources related to IRI and interactive audio instruction (IAI).

The GDL is underpinned by openly-licensed, publicly-available materials published through the Creative Commons. It facilitates translation and localisation into more than 300 languages and opens up its usership to anyone in the education system, from ministries of education to teachers and learners. All the storybooks from the African Storybook initiative are also openly-licensed and free to use.

2.4.5. OER Commons

Table 18. OER Commons: At a glance

Materials	✓ Materials for students
	✓ Materials for lessons and lesson preparation
	✓ Materials for teacher education
Licence	Creative Commons Attribution-NonCommercial-ShareAlike 4.0 Licence
Format	Varied
Access	Online and Offline
Accessibility	A commitment to accessible content (↑Wolfe, 2020)
Available from	OER Commons.: https://www.oercommons.org/about

OER Commons is a public digital library of OER. It allows users to explore and create educational content. OER Commons also has a 'groups' function which enables users to collaborate when working on resources. The library allows users to search, browse, and evaluate over 50,000 OER, such as university courses, open textbooks, and K-12 materials.

OER Commons follows the open principles of OER; resources are freely available to use and reuse at no cost, without needing to ask permission.

2.4.6. OER World Map

Table 19. OER World Map: At a glance

Materials	✓ Materials for students
	✓ Materials for lessons and lesson preparation
	✓ Materials for teacher education
Licence	Creative Commons Licence ³¹
Format	Varied
Access	Online and Offline
Accessibility	The development of the OER World Map ensured a commitment to accessibility (↑North Rhine-Westphalian Library Service Centre, no date; ↑Neumann, 2016)
Language	Available in multiple languages, including English, French, Greek, Swedish, Russian, Afrikaans, Persian, Hindi, Kyrgyz, and more
Available from	OER World Map: https://oerworldmap.org/ Search for resources here: https://oerworldmap.org/resource/ .

The OER World Map allows educators to share information, experiences and ideas related to OER. It aims to facilitate the effective exchange of data, experiences and ideas between different people involved in OER. The OER World Map allows anyone to contribute and / or access the information on the World Map. It is licensed under a Creative Commons Licence.

³¹ For more information regarding OER World Map licensing, see: <https://oerworldmap.org/resource/urn:uuid:1540d063-1a49-4ffd-9bed-0fe0d7b5ebd5?language=de>.

2.4.7. Creative Commons (CC) search

Table 20. CC search: At a glance

Materials	✓ Materials for students
	✓ Materials for lessons and lesson preparation
	✓ Materials for teacher education
Licence	Creative Commons Licences
Format	Images, open texts, audio content
Access	Online
Accessibility	A commitment to accessible content (↑Choudhary, 2020)
Language	English, but with plans to expand access to other languages
Available from	CC Search: https://search.creativecommons.org/

CC search is a tool that allows openly licensed and public domain works to be discovered and used by everyone (↑Creative Commons, no date). Creative Commons, the nonprofit behind CC Search, is the maker of the CC licences, used over 1.4 billion times to help creators share knowledge and creativity online. CC search aggregates results across multiple public repositories into a single catalogue. It also facilitates reuse through features like machine-generated tags and one-click attribution. Currently, CC Search only searches images; but there are plans to add additional media types such as open texts and audio. The ultimate goal is to provide access to all 1.4 billion CC-licensed and public domain works on the web.

CC Search is free to use and is built on openness. Its search function allows users to find content that can either be used commercially or following modification.

2.4.8. Google Search (Creative Commons)

Table 21. Google Search: At a glance

Materials	✓ Materials for students
	✓ Materials for lessons and lesson preparation
	✓ Materials for teacher education
Licence	Creative Commons Licences
Format	Multimedia
Access	Online
Accessibility	Good practice to make Google Images accessible is listed (↑Google, no date)
Language	Available in almost 200 languages.
Available from	Google Images: https://www.google.co.uk/imghp , then follow the instructions listed below

Google offers a function for users who want to filter their results by content which is openly-licensed. To do so, a user can visit the Google Image search (linked above), type in a search term and hit 'enter'. Once the results appear, users can then click on 'Tools' below the search bar, choose 'Usage Rights', and then select 'Creative Commons Licences'.

2.4.9. Flickr (Creative Commons)

Table 22. Flickr: At a glance

Materials	✓ Materials for students
	✓ Materials for lessons and lesson preparation
	✓ Materials for teacher education
Licence	Creative Commons Licences
Format	Images
Access	Online
Accessibility	Flickr has a focus on improving the accessibility of its content (↑Nuh, 2016)
Language	Available in multiple languages, including English, Italian, Portuguese, Bahasa Indonesia, and more
Available from	Flickr: Creative Commons: https://www.flickr.com/creativecommons/

Flickr offers a function for users to filter images by openly-licensed content. The linked website above offers users the chance to browse Flickr by Creative Commons licenses and by each specific Creative Commons licence.

3. References

The references for this report are [available online here](#).

African Storybook. (n.d.). *African Storybook*. Retrieved 21 July 2020, from <https://www.africanstorybook.org/>

Akili and Me. (n.d.). *Akili and Me – Akili and Me Official Site*. Retrieved 21 July 2020, from <http://akiliandme.com/>

Borzekowski, D., Lando, A. L., Olsen, S., & Giffen, L. (2019). The Impact of an Educational Media Intervention to Support Children's Early Learning in Rwanda. *International Journal of Early Childhood*. <https://doi.org/10.1007/s13158-019-00237-4>

Cambridge Education. (n.d.). *Leh wi Lan—Sierra Leone Secondary Education Improvement programme—Camb-Ed*. Retrieved 29 May 2020, from <https://www.camb-ed.com/intdev/article/510/education-at-the-heart-of-sierra-leones-post-recovery-and-march-to-growth>

Center for Education Innovations. (n.d.). *Ghana Reads*. Retrieved 6 November 2020, from <https://www.educationinnovations.org/p/ghana-reads>

Choudhary, A. (2020, July 25). CC search, initial accessibility improvements [CC Open Source]. *CC Open Source Blog*. </blog/entries/cc-search-accessibility-week7-8/>

CK-12 Foundation. (n.d.-a). *Free Online Textbooks, Flashcards, Adaptive Practice, Real-World Examples, Simulations*. Retrieved 21 July 2020, from <https://www.ck12.org/student/>

CK-12 Foundation. (n.d.-b). *Georgia, CK-12 and UNICEF Collaboration |*. Retrieved 27 October 2020, from <https://www.ck12.org/pages/georgia/>

CoL. (n.d.). *Accessibilities | COL*. Retrieved 1 September 2020, from <https://www.col.org/accessibility>

Commonwealth of Learning. (n.d.-a). *Home | COL*. Retrieved 21 July 2020, from <https://www.col.org/>

Commonwealth of Learning. (n.d.-b). *OASIS Home*. Retrieved 21 July 2020, from <http://oasis.col.org/>

- Commonwealth of Learning. (n.d.-c). *OER for Open Schooling (OER4OS)* | COL. Retrieved 21 July 2020, from <https://www.col.org/programmes/open-schooling/oer-open-schooling-oer4os>
- Commonwealth of Learning. (n.d.-d). *Open/Innovative Schooling* | COL. Retrieved 21 July 2020, from <https://www.col.org/programmes/open-schooling>
- Commonwealth of Learning. (2017). *Open Schooling: Addressing the Challenge of Out-of-School Youth*. <http://oasis.col.org/handle/11599/2721>
- Creative Commons. (n.d.-a). CC Search. CC Search. Retrieved 21 July 2020, from <https://search.creativecommons.org/>
- Creative Commons. (n.d.-b). *When we share, everyone wins*. Creative Commons. Retrieved 16 July 2020, from <https://creativecommons.org/>
- Damani, K., & Mitchell, J. (2020). *Radio* (No. 4; EdTech Hub Rapid Evidence Review). <https://edtechhub.org/wp-content/uploads/2020/07/Rapid-Evidence-Review-Radio-1.pdf>
- EdTech Hub. (n.d.). Open educational resources. *The EdTech Hub*. Retrieved 19 August 2020, from <https://edtechhub.org/coronavirus/oer/>
- EdTech Hub. (2020, January 22). 18 large-scale EdTech initiatives on our radar in 2020. *EdTech Hub*. <https://edtechhub.org/2020/01/22/18-large-scale-edtech-initiatives-on-our-radar-in-2020/>
- Eneza Education. (n.d.). *Home*. Eneza Education. Retrieved 1 September 2020, from <https://enezaeducation.com/>
- Eneza Education. (2013, May 10). An Infographic Presentation of Eneza's 2012 Impact Study. *Eneza Education*. <https://enezaeducation.com/an-infographic-presentation-of-enezas-2012-impact-study/>
- Flickr. (n.d.). *Flickr: Creative Commons*. Retrieved 1 September 2020, from <https://www.flickr.com/creativecommons/>
- Free Software Foundation. (n.d.). *Free Software Foundation—Working together for free software*. Retrieved 11 November 2020, from <https://www.fsf.org/>

- GDL Radio. (n.d.). *GDL Radio*. GDL Radio. Retrieved 21 July 2020, from <https://gdlradio.org/>
- GeoGebra. (n.d.). *GeoGebra | Free Math Apps—Used by over 100 Million Students & Teachers Worldwide*. GeoGebra. Retrieved 11 November 2020, from <https://www.geogebra.org/>
- Ghana Statistical Service. (2014). *Ghana Living Standards Survey: Round 6 (GLSS6) [Main Report]*. https://statsghana.gov.gh/gssmain/fileUpload/Living%20conditions/GLSS6_Main%20Report.pdf
- Global Book Alliance. (n.d.). *Global Book Alliance*. Global Book Alliance. Retrieved 21 July 2020, from <https://www.globalbookalliance.org>
- Global Digital Library. (n.d.). *About – Global Digital Library*. Retrieved 21 July 2020, from <https://home.digitallibrary.io/about/>
- Global Digital Library. (2020, April 9). *Launching sign languages on the Global Digital Library – Global Digital Library*. <https://blog.digitallibrary.io/2020/04/09/launching-sign-languages-on-the-global-digital-library/>
- GNU. (n.d.). *Gnu.org*. Retrieved 27 October 2020, from <https://www.gnu.org/licenses/agpl-3.0.en.html>
- Google. (n.d.-a). *Google Image best practices—Search Console Help*. Retrieved 1 September 2020, from <https://support.google.com/webmasters/answer/114016?hl=en>
- Google. (n.d.-b). *Google Images*. Retrieved 1 September 2020, from <https://www.google.co.uk/imghp>
- Haßler, B., Hennessy, S., & Hofmann, R. (2018). Sustaining and Scaling Up Pedagogic Innovation in Sub-Saharan Africa: Grounded Insights For Teacher Professional Development. *Journal of Learning for Development*, 5(1), 58–78.
- Haßler, B., Hennessy, S., & Hofmann, R. (2020). OER4Schools: Outcomes of a Sustained Professional Development Intervention in Sub-Saharan Africa. *Frontiers in Education*, 5. <https://doi.org/10.3389/feduc.2020.00146>

- Haßler, B., Khalayleh, A., & McBurnie, C. (2020). *A five-part education response to the COVID-19 pandemic* (EdTech Hub Helpdesk Response No. 5). <https://doi.org/10.5281/zenodo.3756012>
- Hennessy, S., Haßler, B., & Hofmann, R. (2016). Pedagogic change by Zambian primary school teachers participating in the OER4Schools professional development programme for one year. *Research Papers in Education*, 31(4), 399–427. <https://doi.org/10.1080/02671522.2015.1073343>
- Internet Archive. (n.d.). *Basic e-Learning Library (BeLL): Free Texts: Free Download, Borrow and Streaming: Internet Archive*. Retrieved 15 September 2020, from <https://archive.org/details/bell>
- Janzen, T., & Chugh, M. (2019). *Rumie Management Center (RMC): Product Documentation*. Rumie. <https://rumie-org.atlassian.net/wiki/spaces/PD/pages/217219073/Rumie%2BManagement%2BCenter%2BRMC>
- Kirkpatrick, A., O Connor, J., Campbell, A., & Cooper, M. (2018). *Web Content Accessibility Guidelines (WCAG) 2.1*. W3C. <https://www.w3.org/TR/WCAG21/>
- Kiwix. (n.d.). *Kiwix: Internet content for people without internet access!* Kiwix. Retrieved 21 July 2020, from <https://www.kiwix.org/en/>
- Lakhan, S. E., & Jhunjhunwala, K. (2008). Open Source Software in Education. *EDUCAUSE Quarterly*, 31(2). <https://er.educause.edu/-/media/files/article-downloads/eqm0824.pdf>
- Learning Equality. (n.d.). *Kolibri: A Free, Open Source Education for All | Learning Equality*. Retrieved 21 July 2020, from <https://learningequality.org/kolibri/>
- Matic, R. (2018, December 3). Making Kolibri an All-Around Inclusive EdTech. *Medium*. <https://blog.learningequality.org/kolibri-an-all-around-inclusive-edtech-8601afb4da9>
- McBurnie, C. (2020a). *Using Interactive Radio Instruction to mitigate the educational impact of COVID-19: A curated resource list* (EdTech Hub Helpdesk Response No. 6). <https://doi.org/10.5281/zenodo.3762228>
- McBurnie, C. (2020b). *Expert Consultation: Radio-based Education in the Philippines* (No. 26; EdTech Hub Helpdesk Response).

- Media Ownership Monitor: Ghana. (n.d.). *Radio Market in Ghana*. Media Ownership Monitor. Retrieved 15 September 2020, from <https://ghana.mom-rsf.org/en/media/radio/>
- Ministry of Basic and Senior Secondary Education: Sierra Leone. (n.d.). *Leh Wi Lan / MBSSE*. Retrieved 16 July 2020, from <https://mbsse.gov.sl/leh-wi-lan/>
- Mtabe. (n.d.). *Mtabe – Just Ask Too*. Retrieved 21 July 2020, from <https://mtabeapp.com/>
- Neumann, J. (2016). *The OER World Map Project, phase IV (1.2)*. The William and Flora Hewlett Foundation. https://oerworldmap.files.wordpress.com/2016/10/hbz_oerworldmap_proposal_narrative_v12pub.pdf
- North Rhine-Westphalian Library Service Centre. (n.d.). *Launching the Development of an OER World Map: Phase II* [Proposal for Consultation]. The William and Flora Hewlett Foundation. Retrieved 1 September 2020, from https://oerworldmap.files.wordpress.com/2015/01/20141015-oer-map-proposal_hbz_final_v1-2.pdf
- Nuh, Y. (2016, September 29). Improving Accessibility on Flickr. *Flickr Blog*. <https://blog.flickr.net/en/2016/09/29/improving-accessibility-on-flickr/>
- Oates, L., & Hashimi, J. (2016). Localizing OER in Afghanistan: Developing a Multilingual Digital Library for Afghan Teachers. *Open Praxis*, 8(2), 151–161. <https://doi.org/10.5944/openpraxis.8.2.288>
- OER Africa. (n.d.). *OER Courseware, Research and Policies | OER Africa*. Retrieved 20 November 2020, from <https://www.oerafrica.org/oer-courseware-research-and-policies>
- OER Commons. (n.d.). *OER Commons*. OER Commons. Retrieved 21 July 2020, from <https://www.oercommons.org/about>
- OER World Map. (n.d.). *OER World Map*. Retrieved 21 July 2020, from <https://oerworldmap.org/>
- OER4Schools. (n.d.). *The OER4Schools Professional Learning Resource—OER in Education*. Retrieved 28 August 2020, from <http://oer.educ.cam.ac.uk/wiki/OER4Schools>

- OLE. (n.d.). *Open Learning Exchange | Moving from education to learning*. Retrieved 16 July 2020, from <https://www.ole.org/>
- OLE Ghana. (n.d.). *Http://www.oleghana.org/index.php*. Retrieved 16 July 2020, from <http://www.oleghana.org/index.php>
- onebillion. (n.d.-a). *onebillion: One app that delivers reading, writing and numeracy*. Retrieved 21 July 2020, from <https://onebillion.org/>
- onebillion. (n.d.-b). *onebillion: Onecourse – one app for reading and numeracy*. Retrieved 21 July 2020, from <https://onebillion.org/onecourse/app/>
- Outhwaite, L. A., Gulliford, A., & Pitchford, N. J. (2020). Language counts when learning mathematics with interactive apps. *British Journal of Educational Technology*. <https://doi.org/10.1111/bjet.12912>
- Pitchford, N. J., Chigeda, A., & Hubber, P. J. (2019). Interactive apps prevent gender discrepancies in early-grade mathematics in a low-income country in sub-Saharan Africa. *Developmental Science*, 22(5), e12864. <https://doi.org/10.1111/desc.12864>
- Raspberry Pi. (n.d.). *Raspberry Pi Foundation—About Us*. Raspberry Pi. Retrieved 16 July 2020, from <https://www.raspberrypi.org/about/>
- Rising Academies. (n.d.). *Rising Academies*. Retrieved 21 July 2020, from <https://www.risingacademies.com/>
- Rising Academy Network. (n.d.). *Rising Academies—Rising On Air*. Rising Academies. Retrieved 21 July 2020, from <https://www.risingacademies.com/onair>
- Romero, M., & Sandefur, J. (2019). *Beyond Short-Term Learning Gains: The Impact of Outsourcing Schools in Liberia after Three Years* (p. 4) [Preliminary Results Brief]. Instituto Tecnológico Autónomo de México; Center for Global Development.
- Rumie. (n.d.-a). *Rumie Initiative*. Rumie Initiative. Retrieved 21 July 2020, from <https://rumie.org/about-us/>
- Rumie. (n.d.-b). *Rumie LearnCloud*. Retrieved 21 July 2020, from <http://learncloud.rumie.org/>
- Silver, L., & Johnson, C. (2018, October 9). Internet connectivity seen as having positive impact on life in sub-Saharan Africa. *Pew Research Center's Global Attitudes Project*.

<https://www.pewresearch.org/global/2018/10/09/majorities-in-sub-saharan-africa-own-mobile-phones-but-smartphone-adoption-is-modest/>

Siyavula. (n.d.-a). *About us*. Retrieved 21 July 2020, from <https://www.siyavulaeducation.com/about.html>

Siyavula. (n.d.-b). *Our Work: Open Textbooks*. Retrieved 15 September 2020, from <https://www.siyavulaeducation.com/work-oer.html#BOOKS>

Siyavula. (n.d.-c). *Pricing | Siyavula*. Retrieved 21 July 2020, from <https://www.siyavula.com/pricing>

TESSA. (n.d.). *About us | TESSA*. Retrieved 29 July 2020, from <http://www.tessafrica.net/about-us>

TESS-India. (n.d.). *OLCreate: TESS-India (Teacher Education through School-based Support)*. Retrieved 29 July 2020, from <https://www.open.edu/openlearncreate/course/index.php?categoryid=45>

T-TEL. (n.d.-a). *Home—T-TEL*. Retrieved 29 July 2020, from <https://www.t-tel.org/home>

T-TEL. (n.d.-b). *Learning Hub—T-TEL*. Retrieved 29 July 2020, from <https://www.t-tel.org/learning-hub>

T-TEL Professional Development Programme. (2016a). *Open Educational Resources: Guidance for College of Education*. Ministry of Education (Ghana). https://docs.opendeved.net/lib/3B42MMRX/download/BGTEPSML/Ha%C3%9Fler_2016_Open%20Educational%20Resources%20Guide%20for%20Colleges%20of%20Education.pdf

T-TEL Professional Development Programme. (2016b). *T-TEL's Terms, Messages and Communications Guide*. Ministry of Education (Ghana). <http://www.t-tel.org/files/docs/COMMS%20GUIDE%20FINAL.pdf>

T-TEL Professional Development Programme. (2016c). *Theme 5: Teaching and Learning Materials (Professional Development Guide For Student Teachers)*. Ministry of Education (Ghana). <http://www.t-tel.org/files/docs/Learning%20Hub/B.Ed.%20materials,%20resources%20and%20reading/Theme%205%20Teaching%20and%20Learning%20Materialss%20-%20Professional%20Development%20Guide%20for%20Student%20Teachers.pdf>

- Ubongo. (n.d.). *UBONGO KIDS*. Retrieved 21 July 2020, from <https://ubongokids.com/>
- Ubongo. (2016, February 4). New Ubongo Kids Audio Stories. *Ubongo*. <https://www.ubongo.org/new-ubongo-kids-audio-stories/>
- UNESCO. (2020, April 28). *Covid-19 Crisis: UNESCO Call to Support Learning and Knowledge Sharing through Open Educational Resources*. UNESCO. <https://en.unesco.org/news/covid-19-crisis-unesco-call-support-learning-and-knowledge-sharing-through-open-educational>
- Watson, A. (2019, November 13). *Number of pay TV households in Ghana 2014-2023*. Statista. <https://www.statista.com/statistics/756362/ghana-number-pay-tv-housholds/>
- Watson, J., & McIntyre, N. (2020). *Rapid Evidence Review: Television* (EdTech Hub Rapid Evidence Review).
- Wikipedia. (2019). Wikipedia: Text of Creative Commons Attribution-ShareAlike 3.0 Unported License. In *Wikipedia*. https://en.wikipedia.org/w/index.php?title=Wikipedia:Text_of_Creative_Commons_Attribution-ShareAlike_3.0_Unported_License&oldid=880226358
- Wikipedia. (2020). Accessibility. In *Wikipedia*. <https://en.wikipedia.org/w/index.php?title=Accessibility&oldid=984895511>
- Wiley, D. (n.d.). *Defining the 'Open' in Open Content and Open Educational Resources*. Retrieved 29 May 2020, from <http://opencontent.org/definition/>
- Wolfe, A. (2020, August 24). *LibGuides: Accessibility Toolkit for Open Educational Resources (OER): OER Commons-ISKME*. https://guides.cuny.edu/accessibility/OER_Commons_ISKME