



COMMONWEALTH of LEARNING



Guide to Developing Open Textbooks

Andrew Moore and Neil Butcher

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**Andrew Moore and
Neil Butcher**



COMMONWEALTH *of* LEARNING

The Commonwealth of Learning (COL) is an intergovernmental organisation created by Commonwealth Heads of Government to promote the development and sharing of open learning and distance education knowledge, resources and technologies.



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Guide to Developing Open Textbooks

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Introduction

The recent availability of quality open educational resources (OER) means that students and educators have many choices when identifying materials to support teaching and learning. Previously, selecting resources other than those found in a purchased course textbook meant taking liberties with copyright law and hiding behind vague “fair use” clauses. The presence and growth of OER has thus freed educators and students to reuse, revise, remix and redistribute copyrighted materials available under open licences.

Due to the relatively recent origin and rapid growth of the open movement, structures and tools to support students and educators either do not exist or, where they do, are not fully formed or sufficiently comprehensive. For example, there is no single repository or search facility for users to find open materials. Resources are dispersed across the Internet, and a multitude of search techniques are needed to find them. Furthermore, tools required to adapt OER are scarce, yet these are essential; for teachers, locating a resource is only the first step in repurposing a resource so that it can address a lesson’s objectives.

Thus, while the value proposition of OER is clear, there is a barrier to adoption because of poor accessibility and the lack of tools to adapt the resources to new needs. With this in mind, the present *Guide to Developing Open Textbooks* was conceived to (i) reduce the need to spend hours identifying useful resources and (ii) provide the tools to enhance and adapt these original resources.

This manual provides a number of different technological solutions for the effective location and use of existing OER to develop an open textbook platform.

1.1 Objectives

The *Guide to Developing Open Textbooks* has been developed to assist teachers, teaching support personnel and educational technology administrators to:

1. understand the value of open education, OER and open textbooks for teaching and learning;

2. appreciate the potential value of developing an open textbook platform;
3. select appropriate technology to build an open textbook platform, using either existing services offered free on the Internet or open-source tools, based on local needs and resources; and
4. build, manage and maintain an open textbook platform.

1.2 Use of the Guide

1.2.1 Teachers and Teaching Support Personnel

In some countries, there is a dearth of learning materials or textbooks to allow all students in a class to access the prescribed text. In such instances, an open textbook could be developed to improve access to quality resources. In other contexts, teachers may not be satisfied with prescribed traditional textbooks and may wish to develop materials and content more closely aligned with the needs of their particular classes.

Within this group of potential open textbook developers and users we also include those who champion and support the integration of information and communication technology (ICT) into teaching and learning generally. They will enjoy the guide's mix of theory and practical approaches on how to leverage advantage from the use of ICT, OER and free and open-source tools.

Section 4: Developing Open Textbooks is written particularly with this audience in mind. It outlines a non-technical approach to creating an open textbook using existing, straightforward technologies. It provides teachers and students with a step-by-step approach to sourcing content and developing a platform. There is also a segment in Section 4 aimed at good practice when using the open textbook in class.

1.2.2 Developers and Platform Administrators

Technical teams that often work in the background — installing, setting up, maintaining and upgrading education technologies — will find Section 5: Setting Up an Open Textbook Platform useful. This section provides technical solutions for developing an institutional or organisational open textbook platform or repository. Building one's own platform offers a more sophisticated way of storing and organising OER and provides a customised user interface, which many organisations may prefer (compared to the “ready-made” solutions identified in Section 4). The manual describes one particular solution but also outlines other open-source software that can be customised to achieve the same end. This section also looks at the ideal hardware setup to support an open textbook platform/repository.

Open Education and Open Educational Resources

2.1 Traditional Models of Education

Innovative education thinkers, including Freire, Illich, Chomsky, Giroux and, more recently, Robinson,¹ have been critical of the model of education that prevails across the globe. They criticise the predominance of didactic approaches that have reduced education to simple rote learning and the memorisation of facts. Students have become passive learners rather than active learners using higher-order thinking skills and demonstrating creativity and innovation.

Some critics go as far as to say that schools and schooling are not in line with the demands of today's socio-economic needs, reflecting instead the values of 19th-century Europe. Their argument posits that in the 1800s, the requirements for emerging industrialisation and nationalism shaped the education model of that time. It promoted values such as uniformity, punctuality and efficiency, as well as high levels of compliance — suited to factory work. Some have pointed out the similarities that exist in both contemporary schools and traditional factories, such as ringing bells, separate facilities for girls and boys, the separation of subjects, and students organised into batches based on their date of birth rather than their abilities and needs.²

The current model of brick-and-mortar schools, however, is inherently expensive and labour intensive and has proven inefficient in providing universal education to large populations. This has become especially apparent in developing world contexts where the increased demand for education, driven in part by the Millennium Development Goals, has outstripped the state's ability to deliver both well-resourced

1 See pp. 23–37 in Neil Butcher and Associates. (2014). *Harnessing OER to drive systemic educational change in secondary schooling*. Available at https://nbassociates-my.sharepoint.com/personal/andryn_nba_co_za/_layouts/15/guestaccess.aspx?guestaccesstoken=12bTZbzo0cy%2b4KbmHewSxT3h2MT8i8aohbZzh3ABYU%3d&docid=1cc160e324b8a43a08e6ab0057bd46ce0.

2 See Ken Robinson's RSA talk *Changing education paradigms* at TED: http://www.ted.com/talks/ken_robinson_changing_education_paradigms (beginning at 6 minutes 35 seconds).

schools and trained teachers. Many new teachers simply learn on the job, and most emulate the styles and methods they were exposed to as learners, perpetuating previous teaching methods and approaches to learning. Many state schools in developing world contexts also face a dearth of quality resources required for teaching and learning.

While the developing world is grappling with identifying effective methods for using education to build a trained and professional class to support economic growth, the developed world has also found the current model of education expensive, as more citizens see access to university education as crucial for their advancement in today's economy. This is especially true in higher education, where student debt in countries such as the USA has hit alarming levels.³ An interesting indicator of the rising costs confronting students are the funds required to purchase textbooks: these have risen 812% over the last 30 years in comparison with 210% inflation in the consumer price index.⁴

Costs aside, other critics argue that our current education model does not embrace the 21st-century skills required by today's learners and sought after in the workplace: collaboration, communication, self-regulation, innovation and creativity, rather than uniformity and compliance. Learners today also need “soft skills,” such as the ability to use computers and software and be savvy when working online. Most of our schools, however, still encourage teacher-led instruction, passive — often rote — learning, standardised testing, and batching students according to age rather than ability and need:⁵ a one-size-fits-all model.

So, is there not an alternative education model that can elicit the values and skills required by today's learners and that is affordable for all?

2.2 What is Open Education?

Open education is a collective term to describe institutional practices and programmatic initiatives that broaden access to the learning and training traditionally offered through formal education systems. The qualifier “open” of open education refers to the elimination of barriers that can preclude both opportunities and recognition for participation

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- 3 See Online College's *State of student debt in the US*, at <http://www.onlinecolleges.net/student-debt-in-the-u-s-part-1-declines-in-state-spending-lead-to-soaring-student-debt/> (part 1) and <http://www.onlinecolleges.net/student-debt-in-the-u-s-part-2-a-brief-history-of-student-debt-in-the-united-states/> (part 2).
 - 4 See T. Kingkade. (2014, 4 January). College textbook prices increasing faster than tuition and inflation. *Huffington Post*. Available at http://www.huffingtonpost.com/2013/01/04/college-textbook-prices-increase_n_2409153.html.
 - 5 Association for Career and Technical Education. (2010). *Up to the challenge: The role of career and technical education and 21st century skills in college and career readiness*. Available at http://www.p21.org/storage/documents/CTE_Oct2010.pdf.

*in institution-based learning. One aspect of openness in or “opening up” education is the development and adoption of open educational resources.*⁶

Open education is a learning environment accessible to anyone. In this regard a number of countries have established open schools and open universities, of which The Open University (UK)⁷ is a good example. These institutions offer subsidised, inexpensive and occasionally free courses to students.

It is possible, however, to take open education concepts further. Some of these additional characteristics, often cited by advocates of open education, include the following:

- ◆ Courses are available from anywhere rather than bound by geography. This means they are available digitally and distributed using the Internet.
- ◆ Courses are available 24/7 and not bound by office hours. Hence, courses are offered asynchronously rather than only when the class is present.
- ◆ Courses are self-paced rather than dictated by semester length, allowing students to study as and when opportunities present themselves.
- ◆ Courses can be tried out by students before enrolment.
- ◆ Ideally courses and their materials are made available through a “knowledge commons.”
- ◆ Course materials can be shared and reorganised by others for use in different contexts.⁸

If we analyse this list, we can appreciate that students need to operate differently in such an education setting. It is clear that responsibility for learning is placed squarely on the students. They need to self-regulate their studies: identify when to study, make informed decisions about course selection, and have access to and feel comfortable with technology.

The operative word is “open,” and ideally open education attempts to remove barriers so that everyone has the opportunity to study further. The William and Flora Hewlett Foundation has stated that open education “is the simple and powerful idea that the world’s knowledge is a public good and that technology in general and the World Wide Web in particular provide an extraordinary opportunity for everyone to share, use, and reuse knowledge.”⁹

Open schools and colleges, however, have interpreted openness in different ways, and there is much discussion about the extent to which each has embraced openness. Some purists even contest whether it is possible to really open up education when traditional models are so entrenched.

6 Open education. (2016). *Wikipedia*. Available at https://en.wikipedia.org/wiki/Open_education.

7 See <http://www.open.ac.uk/>.

8 See J. Neil. (2013). *Openness & flexibility*. Available at https://en.wikiversity.org/wiki/Openness_and_flexibility.

9 The William & Flora Hewlett Foundation. (n.d.). *The promise of open educational resources*. Available at <http://www.hewlett.org/uploads/files/ChangeArticle.pdf>.

However, a key component of open education (and one that permits many institutions and organisations to set up open learning environments) is access to free, quality teaching and learning resources. These resources go some way to reducing the cost of creating courses, and when they are pooled, they also exemplify the idea of a knowledge commons: a collectively owned pool of shared resources that encourages the repurposing of materials for new contexts. These education materials are open educational resources (OER).

2.3 What are Open Educational Resources?

OER are teaching and learning materials and can include worksheets, tests, class notes and sometimes full programmes. In fact, OER range from simple digital assets — such as a photograph, chart or page of text — to full courses that bundle together associated lectures, reference materials, exams and marking memos. These courses are often referred to as open courseware (OCW) and can be considered a subset of OER.¹⁰ OER are usually sourced from the Internet and consequently are predominately digital in format. As defined by UNESCO in its 2012 *Paris OER Declaration*, OER are:

teaching, learning and research materials in any medium, digital or otherwise, that reside in the public domain or have been released under an open license that permits no-cost access, use, adaptation and redistribution by others with no or limited restrictions. Open licensing is built within the existing framework of intellectual property rights as defined by relevant international conventions and respects the authorship of the work.¹¹

In fact, it was the advent of the Internet that allowed the OER movement to flourish. The World Wide Web proved a fertile environment for the storage and easy sharing of these resources. Sadly, while collectively these resources do constitute a knowledge commons, there is no one place on the Internet where one can search for and find all available OER. Instead, OER are housed in numerous different repositories, hosted by different institutions or organisations, making the identification of appropriate OER for a particular purpose sometimes difficult.

In all cases, though, these education resources either have been released into the public domain or have an open licence permitting users to copy and distribute without asking for permission. They are always free of charge. In some instances, the open licence also permits the resource to be “repurposed.” This means it can be adapted, changed or reworked to better suit new and different educational contexts. Again, no permission is required to do this.

¹⁰ See the Open Consortium for lists of institutions who release their courses as OCW: <http://www.oeconsortium.org/>.

¹¹ See http://iite.unesco.org/files/news/639202/Paris%20OER%20Declaration_01.pdf.





Open licences are added on to traditional copyright laws, which strictly monitor the copying and distribution of licensed materials. Under full copyright, often represented by the © symbol, all rights are reserved by the author and/or publisher. This means that other than reading or viewing the resource, any other use needs to be approved by the copyright holder, which usually includes negotiating a fee. Contravening these rights can lead to litigation whereby the copyright holders attempt to recoup lost income.

The alternative traditionally was to release materials into the public domain, where the author surrendered all rights to the materials. These two positions — “All rights reserved” or “No rights reserved” — was seen as extreme by many who simply wanted to share their resources (rather than sell them) and be acknowledged as the originators.

Taking up a place between full copyright and public domain, Creative Commons (CC)¹² is a licensing system that offers authors flexibility in how they release and share their materials to the public. The CC system provides authors with the option of reserving *some* rights, including the right of “Attribution,” or acknowledgement by the user should they use or adapt a resource. Another condition is “NonCommercial,” which prohibits users from profiting financially from the use of the open resource. A third condition, known as “NoDerivatives,” does not allow the resource to be changed or adapted. The fourth condition, “ShareAlike,” is used to lock in the original licence on all new derivatives and keep the resource in the open community. The four conditions are components (Table 2.1) of the Creative Commons licensing system. The creator/author or copyright holder of a work can use a combination of these conditions to share their materials with others. These four conditions in combination result in six types of licences, as listed in Table 2.2.







12 For more details on Creative Commons, visit their website at <https://creativecommons.org/>.

Table 2.1. The Creative Commons “rights” or conditions¹³

CONDITION	SYMBOL	EXPLANATION
Attribution		All CC licences require that others who use your work in any way must attribute it – i.e., must reference the work, giving you credit for it – the way you request, but not in a way that suggests you endorse them or their use of the work. If they want to use your work without giving you credit or for endorsement purposes, they must get your permission first.
NonCommercial		You let others copy, distribute, display, perform and (unless you have chosen NoDerivatives) modify and use your work for any purpose other than commercially. If they want to use your work commercially, they must get your permission first.
NoDerivatives		You let others copy, distribute, display and perform only original copies of your work. If they want to modify your work, they must get your permission first.
ShareAlike		You let others copy, distribute, display, perform and modify your work, as long as they distribute any modified work on the same terms. If they want to distribute modified works under other terms, they must get your permission first.

¹³ Adapted from Saide. (2012). *OER copyright and licensing toolkit*. Available at http://www.oerafrica.org/system/files/9320/oer-copyright-and-licensing-toolkitweb_0.pdf?file=1&type=node&id=9320.

Table 2.2. Six common Creative Commons licences¹⁴

LICENCE NAME / ACRONYM	ICON	DESCRIPTION
Attribution BY		This licence lets others distribute, remix, tweak and build upon your work, even commercially, as long as they credit you for the original creation. This is the most accommodating of licences offered, in terms of what others can do with your works.
Attribution–ShareAlike BY-SA		This licence lets others remix, tweak and build upon your work even for commercial reasons, as long as they credit you and license their new creations under the identical terms. This licence is often compared to open-source software licences. All new works based on yours will carry the same licence, so any derivatives will also allow commercial use.
Attribution–NoDerivatives BY-ND		This licence allows for redistribution, commercial and non-commercial, with credit to the author. The work may not be altered, transformed or built on.
Attribution–NonCommercial BY-NC		This licence lets others remix, tweak and build upon your work non-commercially, and although their new works must also acknowledge you and be non-commercial, they don't have to license their derivative works on the same terms.
Attribution–NonCommercial–Share Alike BY-NC-SA		This licence lets others remix, tweak and build upon your work non-commercially, as long as they credit you and license their new creations under the identical terms. Others can download and redistribute your work, just as under the BY-NC-ND licence, but they can also translate, make remixes and produce new stories based on your work. All new work based on yours will carry the same licence, so any derivatives will also be non-commercial in nature.
Attribution–NonCommercial–NoDerivatives BY-NC-ND		This licence is the most restrictive of the six main CC licences, allowing redistribution only. This licence is often called the “free advertising” licence because it allows others to download your works and share them with others as long as they mention you and link back to you, but they cannot change them in any way or use them commercially.

¹⁴ Adapted from Creative Commons. (n.d.). *About the licenses*. Available at <https://creativecommons.org/licenses/>. Licensed under a [Creative Commons Attribution 4.0 International license](https://creativecommons.org/licenses/by/4.0/).

2.3.1 Potential Benefits of Using OER

So what exactly are the potential benefits of using OER in the creation of a textbook? OER:

- ◆ are free;
- ◆ can be used without the author’s permission;
- ◆ allow the creation of multiple copies for distribution;
- ◆ are predominantly digital and therefore accessible through the Internet, and they can be edited using common software;
- ◆ are not necessarily text, allowing developers to include multimedia formats in a textbook;
- ◆ are not bound geographically, as they can be accessed (if available online) wherever there is connectivity;
- ◆ are often adaptable, allowing others to repurpose them for new uses;
- ◆ if organised properly, can support learning at a student’s own pace; and
- ◆ can be accessed and stored online in OER repositories.

In terms of developing an open textbook platform, OER provide a cost-effective set of teaching resources, and their open nature encourages others to take copies and rework them to suit new contexts. Being digital means that they are accessible from anywhere in the world, and in many instances they can be edited or enhanced using common software editing tools. When OER are organised to achieve a particular curriculum objective inside an open textbook, this gives learners some control over how quickly or methodically they pace their learning.

One method of using OER, pertinent to our task of creating an open textbook, is known as “remix.” Remix means that as long as the CC licences are compatible, developers can use more than one OER and combine them into a new product. The new derivative is in reality an amalgam of multiple OER. This is particularly useful when one is trying to put together a sophisticated course, programme and/or text where the chance of finding one perfect OER is negligible. By remixing OER using compatible smaller components one can assemble something close to what an educator needs. It will become apparent later that this particular benefit is important for the creation of open textbooks.

2.3.2 Challenges of OER

Despite the promising value proposition mentioned above, OER are not always easy to use! Based on our experience, teachers and developers who want to use OER currently face various challenges, such as:

- ◆ *Sourcing appropriate OER*: There is no one-stop shop for OER. They are scattered across the Internet, making searching difficult or at least time-

consuming. Some reside in institutional repositories, others inside social media platforms such as Flickr or YouTube, where open resources are mixed up with fully copyrighted resources. A few websites are dedicated to identifying where OER reside, but none are fully comprehensive.¹⁵ Google’s advanced search does offer a “usage rights” filter, but it is difficult to access, and many are unaware of this functionality.

- ◆ *Understanding open licences:* Not everyone is familiar with different open licences and what they permit. Most teachers are unaware of the different rights, combinations and implications of the licences.
- ◆ *Tackling protective mind-sets:* Many teachers still feel it is “wrong” to use other people’s OER because they fear that doing so may denote a lack of creativity on their part. Conversely, when it comes to allowing others access to their own work, many teachers still attempt to protect, rather than share, their resources.
- ◆ *Adapting OER requires new skills:* To adapt and repurpose OER, the practitioner needs more than basic ICT skills. For example, how do you take a PDF and adapt it if you don’t have the requisite software? Many teachers, especially in developing world contexts, lack the know-how and skills to adapt OER. Also, the practice of remixing resources, especially untangling the CC licences and synthesising resources into a new whole, takes creativity and skill. For some this is a bit daunting, and many teachers say they think it is easier to write from scratch.
- ◆ *Depending on technology and connectivity:* Digital OER is dependent on robust Internet connectivity and good ICT availability for sharing and distribution. However, despite great improvements in access to digital devices and the Internet over the last few years, many teachers and students in developing world contexts still struggle for access or find the cost of connecting exorbitant.
- ◆ *Incentivising innovation at schools and universities:*¹⁶ Educators are confronted with numerous demands in schools and universities. Sadly, demands for innovative, creative lesson design that encourage student-centric approaches are usually not a high priority. Recognition of, or incentives for, the imaginative use of OER to confront issues around learning is often less prioritised than other day-to-day pressures.

Consequently, when developing an open textbook platform, developers need to see whether they can mitigate some of these frustrations for teachers and students. Ideally the design should eliminate the need to spend long hours searching for OER or to have a deep understanding of CC licensing, provide tools to simplify adaptation, provide a mechanism for teachers to share their derivative works

¹⁵ See OER Commons at <https://www.oercommons.org/> and the Creative Commons search function at <https://search.creativecommons.org/> for examples.

¹⁶ Adapted From Commonwealth of Learning. (2015). *Understanding open educational resources*. Available at http://oasis.col.org/bitstream/handle/11599/1013/2015_Butcher_Moore_Understanding-OER.pdf.

easily and offer an offline option for these resources. Finally, the platform should showcase teachers who engage in innovative use of OER.

A free course on “Understanding Open Educational Resources” is available at COL’s Technology-Enabled Learning Lounge.¹⁷ We suggest that readers take this short course to gain a full understanding of copyright and licensing, and of searching for and evaluating OER.

¹⁷ See <http://tell.colvee.org>.

What is an Open Textbook?

3.1 Origins of Open Textbooks

How did the idea for an open textbook originate, and what ideals and principles are central to the platform's design?

For many years, textbooks have been a staple resource for both teachers and students. Traditionally the textbook has provided the class with a standard text that supplemented the teacher's perspective and offered study material and activities for students. In an age where there is a plethora of digital information, a textbook shared by the class still makes sense, as it offers a level of standardisation and makes it easier to set and study for examinations.

However, in recent years the cost of textbooks has steadily risen. For some subjects, the cost of textbooks has become exorbitant, and a teacher or instructor can no longer assume that everyone in the class has access to the text. Some publishers aim to ensure the rapid redundancy of textbooks by releasing new editions that make the older ones less valuable.

A drawback of using a traditional printed textbook is that it is static and fixed. Textbooks also reflect the views, methods and values of the author and rarely reflect all the particular needs of individual classes. A teacher may be happy with parts of the textbook but might take exception to other parts. For example, material included may not be required by the syllabus, or critical material may be omitted. Case studies and examples may be culturally unconnected with the students' local experience, or language may be pitched too high or too low for a particular group of learners. It is also possible that the text needs to be translated into another language. Changing or adapting a traditional text is not an option because of copyright restrictions but also because the printed page is essentially static.

Recently organisations such as CK-12 Foundation,¹⁸ OpenStax¹⁹ and College Open Textbooks²⁰ have begun providing free digital “open” college textbooks. These are generically written texts that cover introductory subjects such as calculus, biology, chemistry, psychology and economics. The digital versions are free and are available in a number of different formats to support different digital reading devices, including PDF, EPUB, and MOBI. However, currently there is a limited number of titles on offer, so educators do not have many alternative titles should the initial offerings be unsuitable for their classes. The open licence does encourage adaptation, but the formats offered don’t encourage users to make any changes. However, prescribing one of these open texts instead of a proprietary resource does tackle cost and access issues.

Traditional textbooks have always provided a definitive subject commentary. Mass-produced and printed on paper, they were a technology solution that suited the needs and education philosophy of the previous century. Today, static texts quickly become outdated, are impossible or expensive to correct and cannot compete with the information-rich, relatively cheap Internet, which allows access to the latest information. So in this digital era, the textbook is ready for a makeover.

The contemporary textbook should support collaborative and co-operative approaches to learning by encouraging the adaption, extension and localisation of meta-narratives, and by prompting and enabling readers to contribute to the knowledge pool. Digital technologies now link our students and educators both together and to global information networks. Information is ubiquitous; in some subjects, changes occur rapidly and thus new information is regularly added. It is time to work the needs of the current age into the services offered by the “textbook.”

3.2 Characteristics of Open Textbooks

3.2.1 An Open Textbook is Adaptable

An open textbook is ideal if a teacher can “repurpose” the textbook so that it better responds to the learning needs of a particular group. In the past there have been attempts to provide platforms that allow the creation and to some extent the manipulation of textbooks.

One such platform was called Connexions, which provided a wiki-based environment that encouraged collaborative writing of educational texts and offered a mechanism for educators to locate these texts as well as to take copies for further adaptation. The platform, however, struggled to assure the quality of

18 See <http://www.ck12.org/>.

19 You can find the latest college open textbooks available via Openstax at <https://openstax.org/>.

20 See the offerings at <http://www.collegeopentextbooks.org/>.

the materials that came out of the system, and searches of the Connexions archive revealed uneven levels of quality, with some resources being comprehensive and others only partially complete. Connexions²¹ subsequently transformed itself into a new platform called OpenStax, providing quality-assured open textbooks.

A similar writing platform is available through OER Commons. Called OpenAuthor,²² it offers teachers the ability to compose, describe, license and publish resources. These resources can be located using a filter in the OER Commons database and opened in the OpenAuthor editing suite to be adapted further.

However, these platforms are predominately text-based and assume words are central to the textbook design. While they do enable authors to insert media, they basically provide a rich text editor. Also, for a resource to be edited, the source material needs to have been developed within the same platform. The editing tools don't work with other formats, and remixes of open PDF documents, YouTube videos, and interactive webpages can only be included via links.

Besides the ability to adapt content, an Open Textbook should also include functionality that allows parts of the content to be reorganised. The teacher or student should be able to resequence the content, delete components and add new content. Teachers should be able to insert multimedia resources and additional tests and assignments to enhance the learning experience. Such a textbook should encourage multiple authors and multiple versions of the same text. For example, such a text could be used as a platform to encourage student interpretations of the content as alternatives to the master version.

3.2.2 An Open Textbook is Structured

Individual OER might in themselves be useful, but to work as content in a text they need to be organised into a learning sequence. The open textbook is, in reality, OER that when assembled in a particular way can help a learner achieve a curriculum statement or objective and, perhaps, a competency. It is therefore recommended that a subject's syllabus be analysed to ascertain exactly what a learner is supposed to achieve by studying that subject; the curriculum structure can then be used to organise the OER. This works especially well if the syllabus has been written using specific objectives. These focused objectives provide the developer with a structure for the open textbook and help with sourcing OER to serve as content. Searching for OER to serve a specific objective is a relatively focused activity and elicits good results.

The sourcing of OER to achieve the syllabus' specific objectives is best done by someone who is familiar with the subject and has a good understanding of both Internet search techniques and the implications of the various Creative Commons

²¹ See <http://cnx.org/>.

²² See <https://www.oercommons.org/authoring/open-author-overview/>.

licences. The latter is especially important, as the OER are to be remixed into a new product. The subject expert’s task is to compile a master set of resources addressing each of the syllabus statements.

Ideally the expert should also add value by providing assessment opportunities — for example, a series of multiple choice questions or a self-marking assignment — to ascertain the student’s mastery of the objective.

This vetted master set of OER is the base level that teachers interact with before embarking on a process of personalisation, adaption and enhancement. Figure 3.1 provides a diagrammatic representation of open textbook structure and possible adaptations.

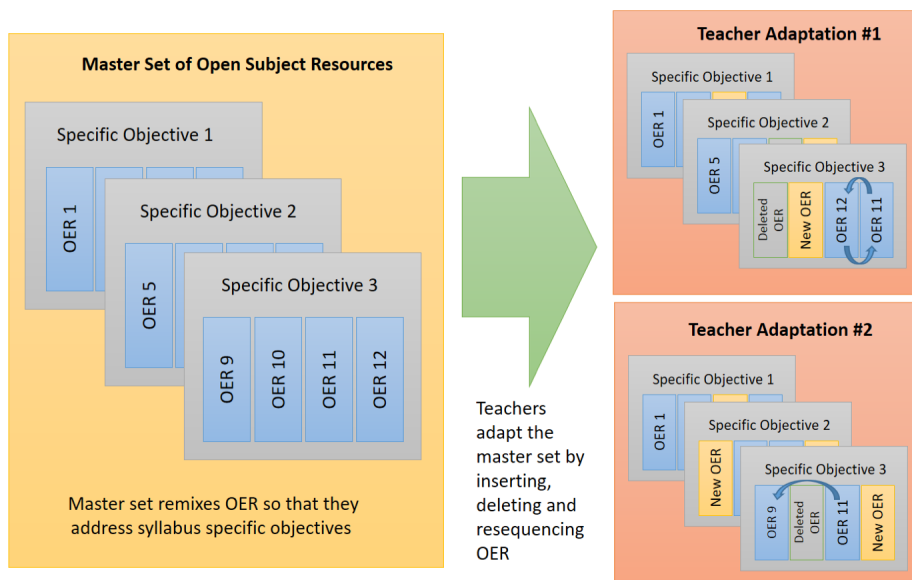


Figure 3.1. The dynamic nature of an open textbook.

3.2.3 An Open Textbook is Shareable

The open textbook should also be easy to share and distribute. This is true in terms of sharing the master set but equally true for the derivatives that are the result of teachers adding value. The open textbook platform should either (i) contain a database or library of the different versions or (ii) offer export options for the new books that can be both shared with and edited by new users. Sharing also needs to consider the devices and software choices of the users to maximise the impact of open textbooks.

3.3 Potential Benefits of Using Open Textbooks

So what is the value proposition for building an open textbook platform? What general benefits can an institution, organisation or ministry realistically expect from building such a tool?

3.3.1 Improved Access to Quality Resources for Educators and Students

Open textbooks will provide free quality teaching and learning resources to teachers and students. These resources will have been sourced and vetted by a team of subject experts and, importantly, aligned to the curriculum.

Open textbooks also negate the need for teachers to spend many hours searching for OER. While they can still search for new or more pertinent OER and add them to the open textbook, the master set contained within the open textbook means the bulk of the search is already complete. Also, by aligning OER to the syllabus, the open textbook provides immediate value to teachers.

3.3.2 Single Repository of Learning and Teaching Resources

Teachers complain that they, and students, can easily get distracted by non-curriculum resources on the Internet, especially when searching for OER. Open textbooks available in a repository will allow access to quality-assured resources and will not require searching for OER on the wider Internet. These same resources can be reconfigured to support different syllabi or curricula.

3.3.3 Potential for Pedagogical Transformation

Because the open textbook is flexible, teachers will feel empowered to create their own versions. It can therefore be used as a catalyst for teachers to reflect on their teaching practice and seek ways to broaden their approaches to learning. For example, teachers might see it as an ideal tool to create “flipped classroom” learning environments, where students access content outside the classroom and use class time to extend their understanding.

Alternatively, while they might initially use the open textbook “as is,” when familiar with the functionality for adaptation they might start to think about how the same tools could be used for student-centric lesson design, and for encouraging students to develop and present components of the syllabus to their peers.

3.3.4 Ease of Use

Earlier we mentioned that teachers often lack the skills to adapt OER. Therefore, editing tools available in the open textbook platform should make it easy to do so. This is often impossible with traditional textbooks and difficult elsewhere on the Web, where specialised skills are frequently required. Ideally platform tools should allow for changes to the words, images and other materials in the actual OER, so we encourage the use of editable digital formats.

3.3.5 Cost-effectiveness

Open textbooks are cost-effective to develop and significantly cheaper to purchase than traditional textbooks. This is partly true because open licences negate the need for subscriptions or purchases. This not to say there is no cost. Teachers will still need to spend time preparing open textbooks. There is also the need for Internet connectivity and access to some type of digital device, but open textbooks nonetheless are considerably cheaper than buying traditional texts.

Another saving is that one person can develop an open textbook for a single subject, or part of a subject, and then share it widely with colleagues. If teachers can work collaboratively and share, then it is possible to build up a library of texts.

3.4 Approaches to Open Textbook Development

There are a number of different approaches to developing an open textbook, and one's circumstances and skill levels will dictate how to go about this.

3.4.1 Prepare Your Own Materials

It is possible to write the open textbook from scratch, where either an individual or a team writes and/or prepares texts and multimedia for the various segments. Lecture capture, video presentations, voice-over presentations, audio podcasts and text, amongst other resources, can be used to compile the content of the open textbook. However, as each component needs to be written or compiled, this approach is no different from a traditional textbook, as the writers don't leverage or adapt existing open content. The compiled content becomes an open textbook only when the team releases the final version with a Creative Commons licence, allowing others to take and adapt it further.

The advantage of this approach is that the open textbook reflects exactly the views of the writing team and suits the original context precisely. Drawbacks include that this approach is both time-consuming and potentially expensive, as all components of the text need to be researched and created.

3.4.2 Adopt Existing Resources

As more and more open textbooks appear, this approach requires the least effort to provide a class with quality materials. A teacher simply identifies an open textbook that is closest to the students' learning requirements and adopts it “as is.”

The advantages are obvious: the resource is free, and the entire class can have access to a standardised text; in addition, teacher preparation is negligible beyond reviewing the open textbook options, and time can therefore instead be spent on supporting learning. A drawback of this approach is that currently there are not a lot of open textbooks to choose from, and the chances of finding an “as is” open textbook ideal for a class's needs are small. For now, the need to customise is a very real possibility.

3.4.3 Adapt Existing Resources

Here lies the crux of the open textbook value proposition: the ability of the user to adapt the text to suit new learning contexts. As mentioned above, the flexibility offered by the open licence to manipulate the textbook content provides teachers with real power to customise the materials to best suit the learning environment. The ability to add, exclude and reorder resources or even revise individual resources allows teachers to create a customised learning experience. Customisation does not necessarily mean that the changes need to be profound. In most cases, these changes will be minor — for example, the addition of the teacher's own notes or the replacement of outdated resources with new ones.

3.4.4 Curate Resources

This approach is an example of a team approach to open textbook development. It assumes that a team of teachers, possibly linked via social networks or through specialised online curation tools, vet resources for inclusion. This way the materials are curated before they are compiled into an open textbook.

This approach ensures the OER used in the textbook development have gone through a process of quality assurance. It also means that there has been some discussion and reflection about the sequencing of the OER to support the acquisition of subject competencies. This consultative process allows those involved to consider multiple perspectives and to identify an optimal configuration for the open textbook.

The drawback of this approach is that the design and building phase of the open textbook takes longer, as it is necessary to encourage consultation.

3.4.5 Mixed Approach

In reality, however, the development models of open textbooks will probably include a combination of the above approaches. Remixing open materials with newly developed resources is a very common strategy. Also, in most team approaches, individuals champion different sections of the textbook, sourcing OER and writing materials to fill in the gaps, then vetting their colleagues' contributions. A combination of team size, individual expertise, time and money will determine the above mix.

4

Developing Open Textbooks

This section is aimed at teachers and teaching support personnel. How can they build an open textbook if they lack technical expertise? We have made an assumption that they do not have access to an existing open textbook to adapt and will therefore need to build one from scratch. We also assume that they do not have advanced computer skills.

A few web-based writing platforms can be used. In this section we will describe just two potential solutions: (i) Gooru²³ and (ii) a combination of OER Commons' OpenAuthor²⁴ and Pressbooks.²⁵

The Gooru platform is a free-to-use learning and teaching platform. It has a database of content, a fair number of which are OER, and over a number of years it has built up many lessons created by the teachers who utilise the site. Visitors can search the Gooru platform for lessons developed by other teachers or for the individual resources from which those lessons have been compiled. Lessons and resources can be copied and then adapted to suit new contexts, and lessons can be enhanced by incorporating tests and assignments. The Gooru platform also offers teachers the ability to enrol students and invite them to their online class to work through the lesson. Student activity is tracked and grades are stored.

Alternatively, teachers can build a lesson from scratch by using resources in the database or by uploading new ones. New resources can be linked to the U.S. Common Core curriculum standards. A Gooru lesson is really a number of sequenced educational resources, such as digital texts, web-based videos or interactive web resources, linked together into a collection. Teachers can sequence the resources, insert bridging comments between them to introduce each resource, and point out what to look for or consider in the resources.

²³ See <http://www.gooru.org/>.

²⁴ See <https://www.oercommons.org/open-author-about>.

²⁵ See <https://pressbooks.com/>.

4.1 How to Create Your Own Open Textbook Using Gooru

4.1.1 Create a Gooru Account (Step 1)

To build learning interventions on the Gooru site, users need to create an account. Follow these steps to do so:

1. Navigate to the Gooru web site at <http://gooru.org> and click the “Sign Up” button.
2. Complete the registration process. There are three panels: the first asks for your contact details, the second your role at school and which country you are from, and the third encourages you to “Create a Classroom.”
3. Click “Create Classroom” and provide the class with a name.
4. A new screen appears, titled “Assign Content to this Classroom.” Identify and click the blue “New Collection” button.
5. Provide the collection with a name. For now it is not too important what you call it, as we will set up the structure in the next session.

4.1.2 Identify Curriculum Statements (Step 2)

Before building anything on the platform, first identify appropriate curriculum statements to act as the open textbook’s structure. Access the website of the relevant ministry of education or national examination authority and locate a digital copy of the syllabus for your subject.

An analysis of this document should reveal two sets of objectives. The first are general objectives which identify desired behaviours, values or broad skills the students should acquire in the subject. The second set are usually specific objectives and tend to be tied to the subject content. Specific objectives state what students should be able to do or demonstrate, upon completion of the course, within a very narrow frame of reference. These are particularly useful, as they can provide structure for the open textbook and search terms for identifying appropriate OER.

SECTION 1 - COMPUTATION

GENERAL OBJECTIVES

On completion of this Section, students should:

1. *demonstrate* an understanding of place value;
2. *demonstrate* computational skills;
3. be aware of the importance of accuracy in computations;
4. appreciate the need for numeracy in everyday life;
5. *demonstrate the ability to make* estimates fit for purpose.

SPECIFIC OBJECTIVES

Students should be able to:

1. perform *computation using* any of the *four* basic operations with real numbers;
2. *convert* among fractions, percentages and decimals;

CONTENT

Addition, multiplication, subtraction and division of whole numbers, fractions and decimals.

Conversion of fractions to decimals and percentages, conversion of decimals to fractions and percentages, conversion of percentages to decimalso and fractions.

Figure 4.1. An example of general and specific objectives, identified in the Caribbean Examinations Council’s Caribbean Secondary Education Certificate Mathematics syllabus.

Select how many of these specific objectives will make up the textbook, to define its scope and size.

4.1.3 Identify and Match OER to Statements (Step 3)

The next stage of development is to find individual OER aligned to the specific objectives. Researchers need to have a good understanding of the subject syllabus content and intentions as well as the Creative Commons licences. Once they have identified a potential OER resource, they need to evaluate it, asking:

- ♦ Does OER help achieve the objective?
- ♦ Is the resource pitched appropriately for the specific student audience?
- ♦ Does the Creative Commons licence permit remixing?
- ♦ Does the document offer only text-based content or is there an interesting mix of media?

- ◆ Is the OER a resource that can be downloaded or does the open textbook need to link to it? This is significant if you want to build an offline version of your open textbook.

The search process needs to identify sufficient OER per objective to ensure that mastery is possible. Alternatively, there should not be too many resources, as that may put students off working through them. Ideally each objective should be supported by approximately four to seven OER.

It is also possible to find additional OER in the Gooru database that might support curriculum statements. All the resources in Gooru have the Creative Commons Zero (CC 0) licence attached to them. Follow these steps to conduct a search:

1. On the Gooru home page, insert a search term in the search field next to the magnifying glass and press “Enter.”
2. Change the filter that by default says “Collections” and instead choose “Resources.”
3. In the new results page is a white and green menu bar that runs below the black menu bar at the top of the screen. Refine your search further by selecting either “Video,” “Webpage,” “Interactive,” “Image,” “Text” or “Audio.”

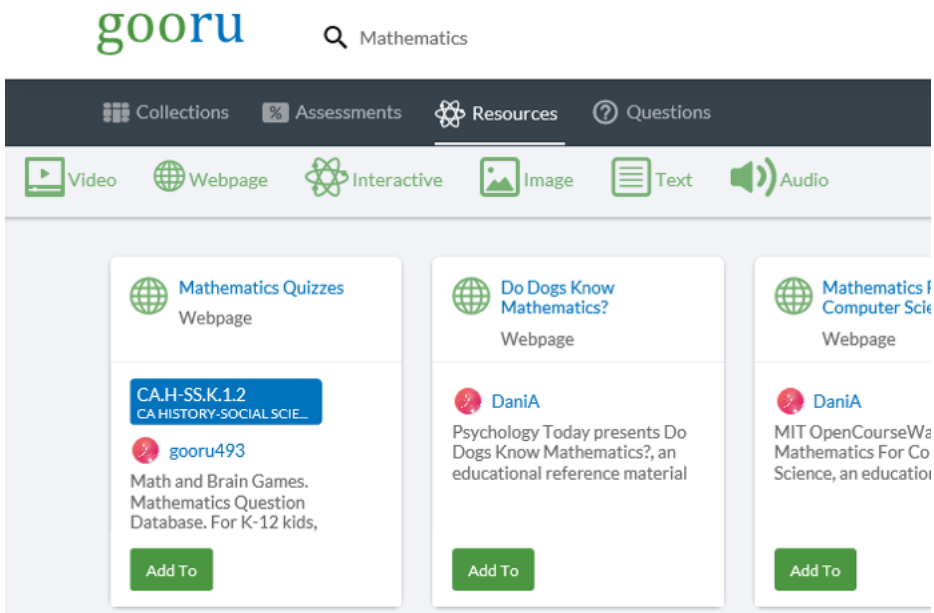


Figure 4.2. The Gooru menu bar with the resource type results filter.

4. Review the resources and select one that you believe will be useful for one of the specific objectives in the textbook. Click the blue “Add To” button.
5. The platform asks you to navigate to and select the appropriate collection into which it should insert the OER. Select the appropriate collection and click the blue “Add” button. Repeat as many times as you need.

4.1.4 Develop the Open Textbook Structure in Gooru (Step 4)

A Gooru account provides tools to allow the user to develop the structure for an open textbook. Gooru offers three levels of categorisation: courses, units and lessons. For an open textbook on, for example, Mathematics, we need to create a course entitled Open Mathematics Textbook. At the unit level we then identify the topics within the textbook, such as Computation, Algebra and Geometry, and within a unit we create lessons that will focus on the specific objective.

Follow these steps to set up the structure of an open textbook:

1. Users need to be logged in. Check by locating the username in the top right corner of the screen. Then click on the username icon.
2. On the right-hand side of the black strip that appears, identify and select the green dropdown menu entitled “Add.”
3. Identify and click “Course.”
4. Provide the course with a name — e.g., “Open Maths Textbook” — and then select the education level that is appropriate for the textbook. Click “Add.”
5. In the “Edit Course” screen, check the details that appear and edit if necessary, but then scroll down to the bottom of the page and click the button entitled “+ Add New Unit.”
6. Provide the new unit with a name and click “Save.” Use a curriculum document to determine what the structure of the textbook should be. For example, in Mathematics the units could be subject topics such as Algebra, Geometry, Number Theory and so forth. Repeat this step and create sufficient additional units so that there is one for each topic within the subject syllabus.
7. Identify a unit and create a category within the unit. The next category level down is called “Lessons in Gooru,” and each lesson should be named to reflect its specific objectives. Click “Add Lesson” to start this process.
8. Repeat step 6 to create the open textbook framework made up of units and their lessons.



Figure 4.3. Screen capture showing Gooru categories and how to align them to a curriculum.

- Once the framework has been constructed (see Figure 4.3), insert a “Collection” for each “Lesson” (Figure 4.4). The collection is in effect the container into which the sourced OER are inserted. When you are inside the red lesson folder, look for the blue button that says “+ Create a Collection.” When you click this button, the platform will create the collection container and ask for the collection’s name; use something like “Algebra Specific Objective 1” and the collection’s learning objective. This information you can draw directly from the syllabus document.

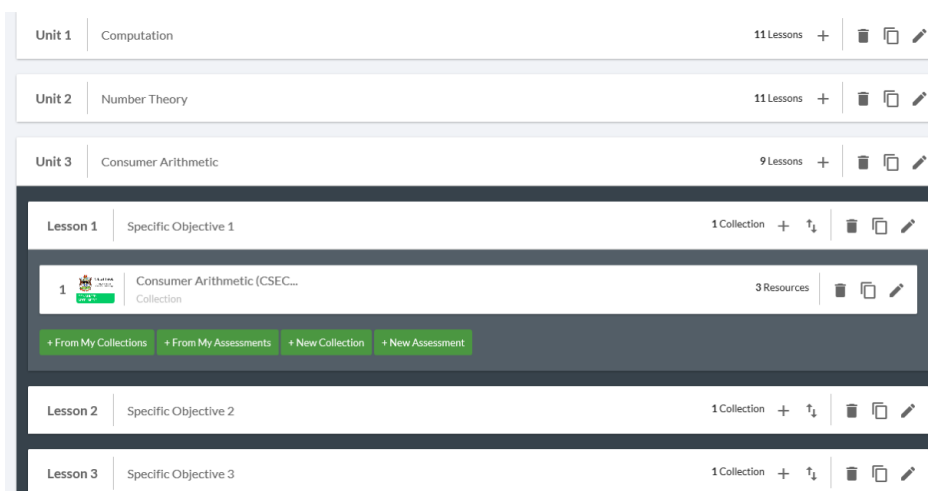


Figure 4.4. Creating the open textbook’s structure in Gooru using the Courses, Units, Lessons and Collections categories.



VIDEO TUTORIAL

Access the video tutorial on “Creating the Structure of an Open Textbook in Gooru” by scanning this QR Code or by accessing it at https://www.youtube.com/watch?v=K_3q_66-qeQ.



4.1.5 Populate the Open Textbook Framework with OER (Step 5)

The next step requires inserting OER into the correct collections. OER selected previously because they could help learners gain mastery of a particular specific objective now need to be placed in the appropriate lesson collection. Follow these steps:

1. Access the collection into which the OER needs to be inserted. The “Edit Collection” screen is displayed. Identify and click “+ New Resource.”
2. From the pop-up window, identify where the OER is and insert the URL.
3. Complete the information fields that locate and describe the resource (see Figure 4.5).

Add New Resource

🔗 Add from URL

Enter URL *

tps://www.youtube.com/watch?v=BNG7ia8cl2s

Resource Title *

Computation

What type of resource is this? *

Webpage Video

Interactive Audio

Image Text

Cancel More Details Add

Figure 4.5. Information fields required by Gooru to add resources to collections.

4. Click the “Add” button that appears at the bottom of the window to finalise the upload details and submit the resource. The OER will now appear as a list item in the collection.
5. Repeat these steps and load in all the OER required for the collection.
6. Once all the OER are loaded, you can edit the collection further. You can resequence the OER or delete any that have been placed in the collection erroneously (see Figure 4.6).

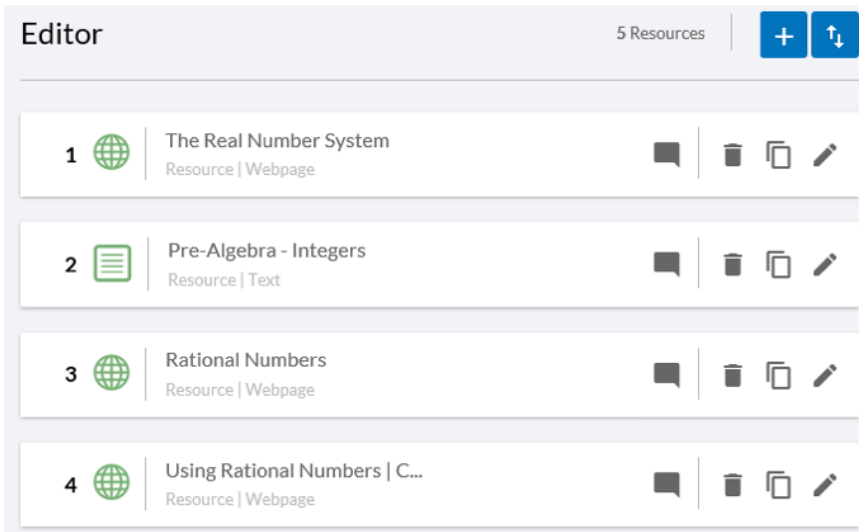




Figure 4.6. Example of a Gooru collection resource list.



VIDEO TUTORIAL

Watch the video tutorial on “Inserting Content into an Open Textbook in Gooru” by scanning this QR Code or accessing the web link at https://www.youtube.com/watch?v=jn_VkQDHZoY.



4.1.6 Assessment Opportunities (Step 6)

Reading through documents and watching videos does not provide teachers with any evidence that a student has acquired a competency or skill, or has even internalised the relevant knowledge. It is therefore a good idea to enhance the open textbook by inserting opportunities for students to test themselves. Gooru does provide this functionality. Follow these steps to add an assessment opportunity to a collection:

1. Access the collection where an assessment opportunity needs to be inserted and click “+ New Question.”
2. A pop-up window appears, offering a number of different question types, including multiple-choice, true-or-false, and fill-in-the-blank. Select one (see Figure 4.7).

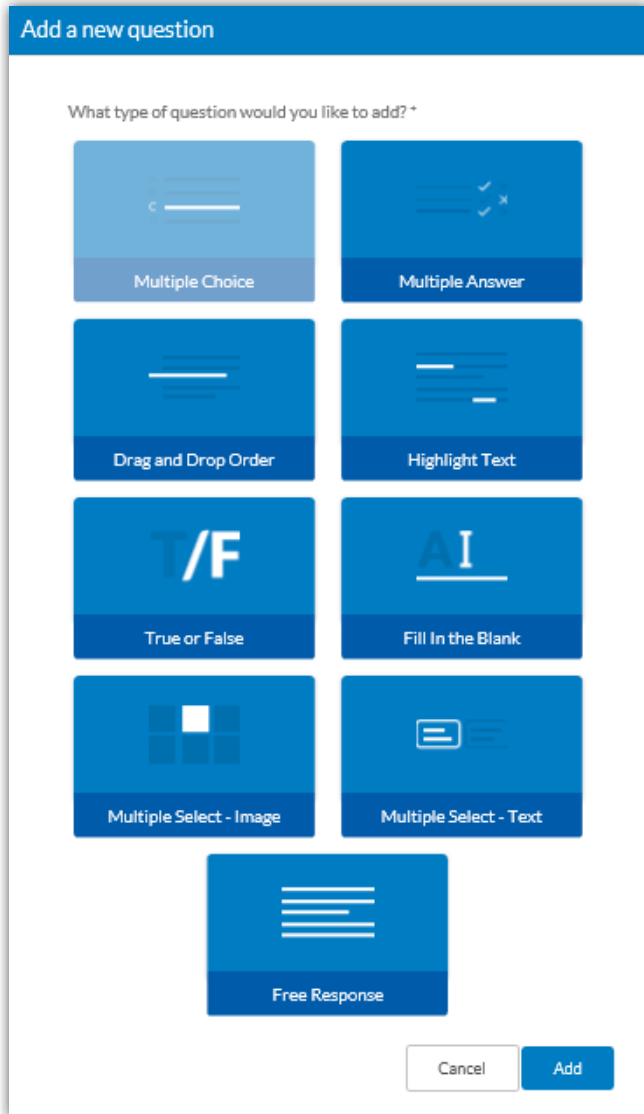


Figure 4.7. The “Add a Question” window.

3. Complete the question fields. One field is for the question, but in the case of multiple-choice questions it is also necessary to provide the options and identify which is the correct answer.
4. Scroll down to the bottom of the window and select “Save.”
5. Add as many questions as you think are necessary for the teacher to determine whether mastery of the objective has been attained.
6. In the Collection List you can reorganise and resequence both the OER and the questions.

It should be noted that any questions inserted within the collection are formative only. Gooru will track student activity but treats questions inside collections as useful for students to apply and practice what they have learnt. It does not report back to the teachers. If you require a test to be summative then you need to build this feature at the lesson level, not the collection level. The steps for creating assessment at the lesson level are as follows:

1. In the Editor view, click on a lesson and look for the “+ New Assessment” link.
2. In the pop-up window, enter the assessment name and click “Add.”
3. Now add information about the audience and the type of test you are to build: “Recall,” “Skill,” “Strategic” or “Extended” thinking.
4. Click “Add Question” and then add the first question type as described above.

Assessments allow you to create questions in exactly the same way as mentioned above, but the assessment container acts as a test space. Teachers can stipulate the order of the questions, the mark allocation and other features. Any activity on the assessment questions by authenticated users (the class) will be tracked and reported to the teacher of the class.

VIDEO TUTORIAL

Watch the video tutorial on “Adding Assessment Opportunities in Gooru” by scanning this QR Code or accessing the web link at <https://www.youtube.com/watch?v=Ffr254kGjI4>.



4.1.7 Creating a Gooru Class (Step 7)

In Step 6 we mentioned that tracking and monitoring student progress is possible. Right at the beginning, Step 1, you created a class. A class is in reality a container that holds information about the people reading the open textbook. Class members need to have their own Gooru account and be identified by the teacher.

One of the nice features is that when a teacher accesses the class, they can see an overview of each class member’s progress through the open textbook. To set up a class with students, follow these steps.

1. Identify the white navigation bar at the top of the screen and click on “Classrooms” in the top right-hand corner.
2. In the pop-down window under “Name your Classroom,” provide a class name.
3. Click the “Create” button.
4. A new screen identifies the class settings. There will be no assigned course content, and a teacher should select the blue button “Choose Course,” then navigate to the prepared course, the open textbook, and select it.
5. To restrict the class to only invited students, look for the classroom’s unique code, which the teacher can distribute to interested parties. It is an alpha-numeric code such as “E3TTU6.” This unique code can be entered by students on Gooru’s home page when they click the “Join a Classroom” button, which will guide them to the class.

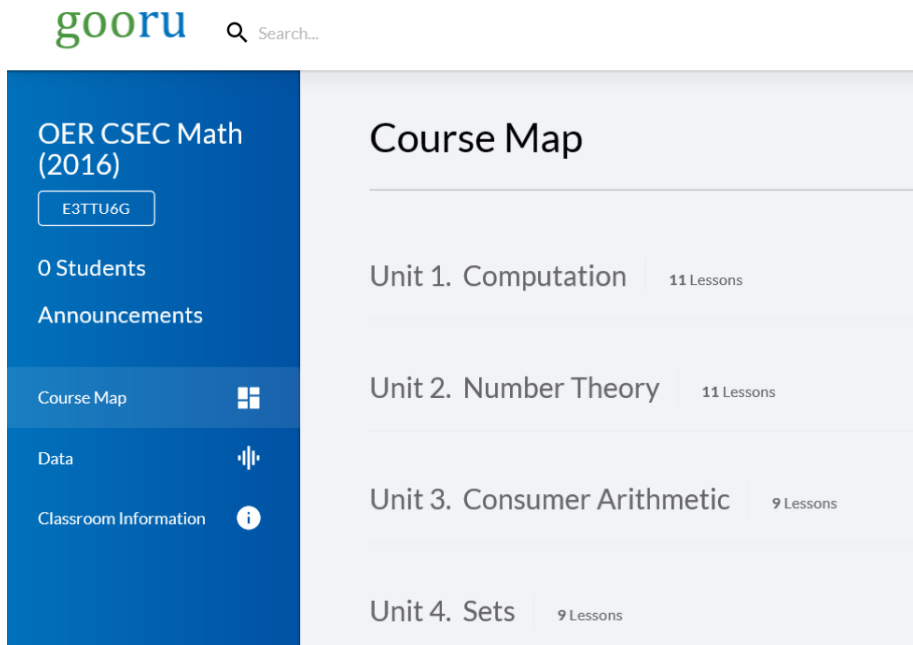


Figure 4.8. Enrolling students using the unique classroom code.

6. Once the students can access the materials, ask them to work through the collections. Their progress will be tracked by the Gooru platform, and you will be able to see from the class page where they are in terms of collections accessed and performance on assessments.

VIDEO TUTORIAL

Watch the video tutorial on “Creating a Class in Gooru” by scanning this QR Code or accessing the web link at <https://www.youtube.com/watch?v=M8dUp7WehK8>.



4.1.8 Sharing and Copying (Step 8)

One of the features of the open textbook mentioned in earlier sections was that it should encourage teachers to take away their own copies of the master set of OER, with an eye to adapting the resources and making them better for the intended audience. Gooru automates and facilitates this process. Teachers do, however, need their own Gooru account and must be logged in before attempting this.

The screenshot shows the Gooru website interface. At the top left is the 'gooru' logo with a search bar. To the right are links for 'Featured Courses' and 'Classrooms'. A user profile for 'andryn2006' is visible. The main content area features a course titled 'Navigate Math'. Below the title are two buttons: 'GD' and 'Remix'. The course description includes 'Grade 7 CCSS MATH' and 'Grade 8 CCSS MATH 1+'. The description text reads: 'Navigate Math is an outcomes-proven course with hundreds of students across Leadership Public Schools' high school campuses growing nearly 3 years in mathematics in 1 school year as measured by NWEA MAP. Navigate Math is an intervention course and approach that accelerates academic growth and empowers students to direct their own learning. Navigate Math helps students develop the foundational knowledge, skills, and thought processes required to be successful in pre-Algebra and Algebra.' On the right side, it says 'Created by AcNumLPS'.

Figure 4.9. The remix button.

1. When logged in, access the course required for copying. On the course opening screen you will notice two buttons.
2. Select “Remix.”
3. Gooru then asks you to rename the course title. Click the blue “Remix” button.
4. It is now available for editing and appears as an extra course in your course folder. All the fields are editable, and the resources can be manipulated (deleted or re-sequenced).

4.2 Pros and Cons of Using the Gooru Platform

While the Gooru platform is very easy to use and offers great functionality, there are a few drawbacks to using it for building an open textbook. The platform has been designed for the U.S. market and offers no international standards for curriculum statements. There is also no way for developers or teachers to add new standards to the system; instead, this task is performed by Gooru developers and requires communication with them to insert standards from different countries. Consequently, finding resources that align with national curricula using the existing standards search facility is not possible.

There is no offline version of the Gooru platform. It operates entirely online, and connectivity is a prerequisite if you want to work with the platform. This is potentially a problem for people in areas where connectivity is not ubiquitous.

There is also a problem associated with Gooru's scale. There are thousands of users, each developing courses and collections; individual teacher contributions therefore struggle to stand out amongst all this activity. As mentioned above, Gooru does supply users with unique class codes and external URLs to guide class members to the appropriate Gooru class. Gooru also offers a degree of customisation, allowing unique banners and logos. However, if the motivation to construct an open textbook is about promoting or highlighting an institution's or organisation's desire to offer open education, then the Gooru platform does not provide strong enough branding opportunities.

4.3 Using OER Commons

Whilst we have outlined in detail how Gooru can be used to create an open textbook, there are a number of other options. The following alternative strategy provides the full functionality of an open textbook and is worth investigating, as the results have different strengths from those achieved using Gooru.

OER Commons²⁶ has a number of creation tools designed to either create OER from scratch or harness existing open content to encourage students to solve specific tasks. As with the Gooru platform, no specific technical skills are required to use this third-party web-based solution.

4.3.1 Open Author

OER Commons already has a collection of thousands of OER, many of which have been linked to the U.S. Common Core standards. This database can be used to search for appropriate resources from which to construct an open textbook.

²⁶ See <https://www.oercommons.org/>.

OER Commons' authoring platform, Open Author,²⁷ can be used either to design and create individual resources or to lay out the structure of an open textbook. However, one does not necessarily need to write from scratch, as it is possible to find OER inside the OER Commons already formatted for use in Open Author. To identify these OER, the search needs to be refined by selecting "Open Author Resources" in the "Content Source" field. Currently, however, this type of resource is not very common, so it is possible that for some subjects, open textbook builders will have to lay out the initial text in the Open Author editor.

Figure 4.10 shows the editing screen and the associated rich text editing tools. Note that the textbook creation process is divided into three parts: "Write," where the content is captured, "Describe," where metadata is used to describe the content, and "Submit," which publishes the document to the OER Commons database. Also note that the structure of the textbook can be laid out using as many sub-units as is necessary.

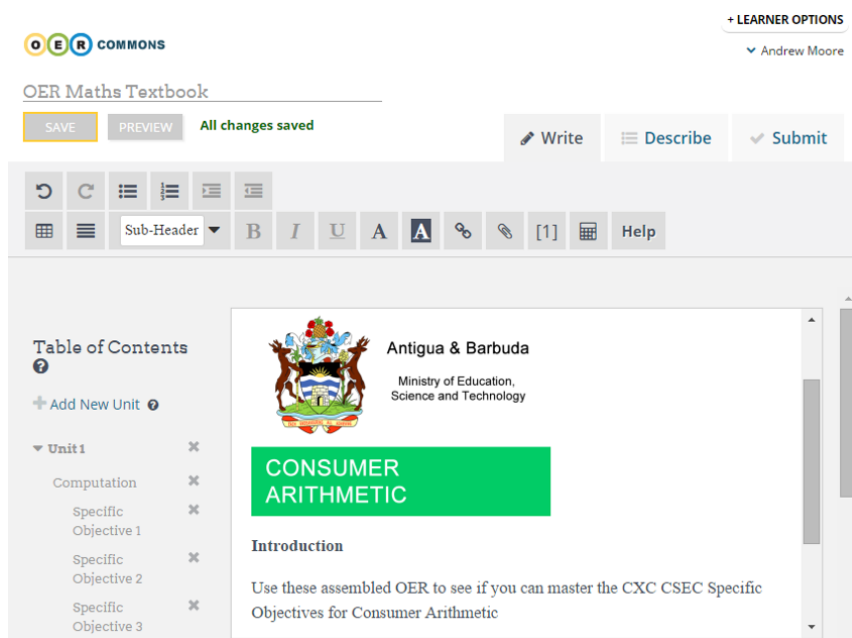


Figure 4.10. Open Author editing screen in OER Commons.

VIDEO TUTORIAL

Access the video tutorial on "Open Textbooks Using OER Commons' Open Author Tool" by scanning this QR Code or by accessing the web link at <https://www.youtube.com/watch?v=0Zf9frXpgGg>.



²⁷ See <https://www.oercommons.org/open-author-about>.

4.3.2 Lesson Builder (for K-12) and Module Builder

There is another set of OER Commons creation tools that can be used to develop an open textbook: the Lesson Builder.²⁸ Instead of writing a textbook from scratch in a rich text editor, as in Open Author, the Lesson Builder’s design gives teachers the tools to provide students with tasks to complete. This approach means teachers can set the specific objectives found in the curriculum statements as the desired outcomes for the task or tasks. The Lesson Builder tool then provides functionality to associate OER — either electronic documents or hyperlinks to web content — with the task. This effectively provides students with the resources required to achieve the specific objective. This approach to open textbook development is not unlike the approach used in the Gooru platform.

An obvious method using the Lesson Builder would be to first task students with studying the associated OER, while subsequent exercises could be created to test the students’ ability to perform the specific objectives. Currently there are no tools in the Lesson Builder to create computer-assisted evaluation, no multiple-choice texts or true-or-false question generators. Consequently, teachers would need to follow up with students to ascertain how they performed on these formative evaluations.

There is, however, the ability for other teachers to “remix” the open textbook. In Figure 4.11, a “Remix” button provides teachers with the ability to take a copy of the lesson. It appears in the “My Items” folders that each authenticated user of OER Commons has in their account. This copy of the open text can then be edited further to ensure the new version responds to local needs and preferences.

A similar interface is provided for those educators who work with post-secondary students. The structure and workflow is the same, but the Module Builder has facilities to provide information for instructors and is not tied directly to U.S. standards such as the Common Core. For developers outside the USA, this tool might be more flexible, as it does not require alignment of standards.



The screenshot shows the Open Author interface for a lesson titled "CSEC Computation - SO1: Compute using Four Basic Operations". The interface includes a search bar, user information (Hello, Andrew Moore | Logout | Help), and navigation links (Discover / Create / Connect / Learn More). The lesson title is displayed prominently, along with a "Lesson Overview" section. On the right side, there are several interactive buttons: "In Class View", "Student View", "Save", "Remix", and "Edit". Below these buttons, there are tabs for "Details" and "Resource Library", and a "Version History" link.

Figure 4.11. The remix function in Open Author.

28 See <https://www.oercommons.org/authoring-overview>.

VIDEO TUTORIAL

See the video tutorial on “Open Textbooks using OER Commons’ Lesson Builder Tool” by scanning this QR Code or by accessing it at <https://youtu.be/jR7Allp2oWM>.



4.3.3 Pros and Cons of Using the OER Commons Creation Tools

Having the open textbook linked directly to one of the best-known OER repositories is a good reason to use this approach. The OER Commons repository provides access to existing OER, making development easier, and it also allows others to find your enhanced product because it is indexed and searchable within OER Commons.

A downside is that the open textbook looks like all the other resources developed using these tools. There is no way to brand or make your resource distinctive. This might be fine for an individual teacher, but an organisation might feel its initiative is lost inside OER Commons, where the look and feel of the open text is uniform with all other contributions.

4.4 Pressbooks

A quite different tool, Pressbooks, has a more professional distribution solution than the OER Commons and Gooru platforms can provide. Popular as a plugin for the WordPress blog/website platform, it also has its own dedicated book-creation platform on the Web that allows authoring directly on their site. There is a free option amongst their many pricing plans.

Pressbooks assumes you will distribute through a dedicated website they build for each book and consequently is very good for distribution over mobiles and tablets. The dedicated Pressbooks website is designed to resize the book content for these custom screens. Via the Pressbooks dedicated web address, the open textbook can be distributed to student tablets, smart phones, laptops and PCs. There is also an option to distribute the textbook in different formats. For example, EPUB files can be read using iBooks, the MOBI format is used in Amazon’s Kindle devices and PDFs can be read on most other devices. See Figure 4.12 for additional options.

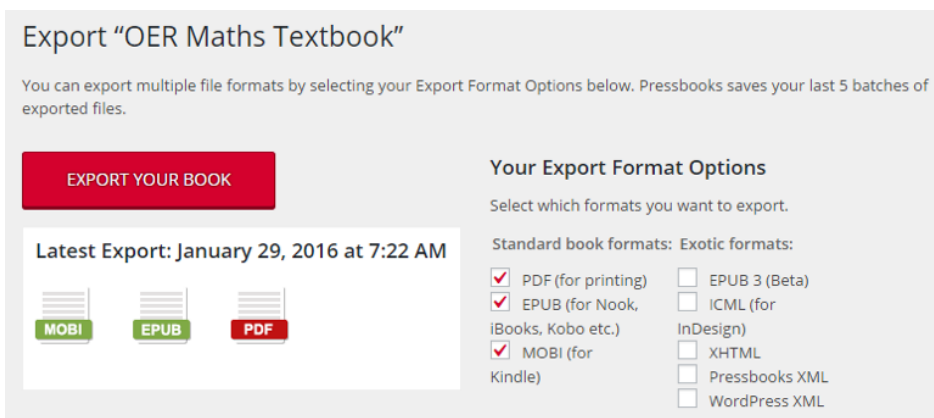


Figure 4.12. Export options inside Pressbooks.

Pressbooks also has its own authoring space, which is more sophisticated than Open Author, offering further tools and options. It is also possible to migrate work developed in Open Author to Pressbooks. Open Author allows content to be exported as an EPUB file. In Pressbooks the EPUB file can be uploaded and opened.

However, Pressbooks does not have an open resource database, so OER to support the open textbook will have to be sourced prior to the book's layout. Developers will therefore need to decide where they would prefer to build the initial open textbook. Open Author allows a developer to draw on the resources in the OER Commons database, while Pressbooks offers enhanced writing features.

Another consideration for developers is the absence of a remix option in Pressbooks. Teachers cannot seek out books in an open database, nor can they copy and adapt as they see fit. They need to first have access to a master file.

Teachers wanting to rework a Pressbooks open textbook need to open their own free Pressbooks account, upload the master EPUB file as the source materials and make the necessary changes to create their customised version (Figure 4.13). They can then distribute their version of the open textbook to their class by providing members with the dedicated web address of the new resource or by handing out the books in the other supported formats.

You can also create a WordPress platform of your own with the Pressbooks plugin to develop open textbooks. The Pressbooks plugin is an open-source book publishing tool on WordPress.

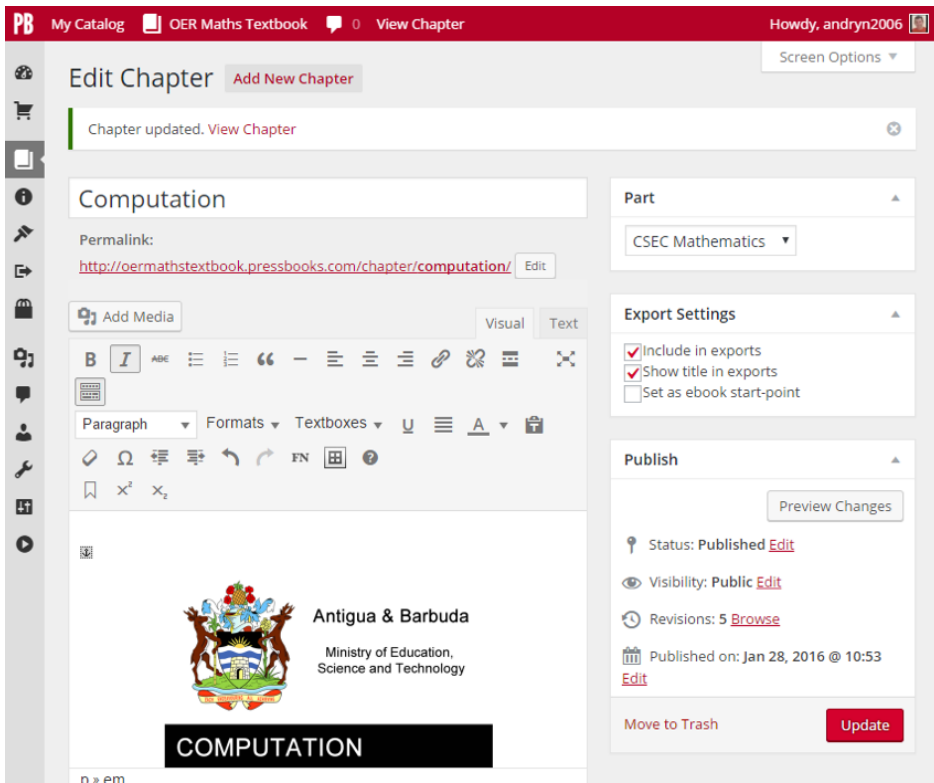


Figure 4.13. Editing tools to adapt the master collection in Pressbooks.

It is worth mentioning that if you have already invested time developing an open textbook using the popular WordPress platform, which provides tools to create blogs and websites, then there is a Pressbooks plugin that has been built to help move the content from WordPress to Pressbooks. The plugin makes this export process seamless and negates the problem mentioned above of exporting and restoring files from one authoring environment into another. WordPress, however, also offers neither a repository of open resources nor the ability to remix.

5

Setting Up an Open Textbook Platform

The previous section described how those with limited technical skills, such as teachers and teaching support personnel, might harness existing web-based platforms to create an open textbook. The drawback of these tools is that they were designed with a different purpose in mind and were not specifically built to support open textbooks. For example, their customisation options are poor or the full functionality desired of an open textbook is missing. Hence, these strategies are, at best, rough approximations of what would be ideal for an open textbook platform.

In this section we offer different technical strategies to build fully operational open textbook platforms using existing open-source technologies — platforms that can house multiple open textbooks, along with their resources and syllabi. These systems also allow for a team approach to the development of open textbooks, including the granting of different permissions for different role-players rather than the development being the preserve of a single author, as was assumed in the previous section. These platforms can be customised to suit any institution's or organisation's specific needs.

This section is therefore of interest to those readers who are proficient in installing and maintaining different server-based programs and technologies. Rather than relying on third parties to provide these technical services, we will identify potential existing open-source tools that can be customised to support an open textbook platform.

A technical solution to create an open textbook platform would typically require the following functionality (see Figure 5.1):

- ◆ A central **database or repository** of OER.
- ◆ A **content management system (CMS)** that allows user to tag OER with metadata linking each to national curriculum statements in order to facilitate their discovery as useful teaching objects.

- ◆ A **learning management system (LMS)** that provides a user interface and tools allowing teachers or students to access curated collections of OER and provide opportunities for assessment. Besides offering a way to interact with the OER, the LMS tools should allow the user the option of customising the database collections further by re-sequencing, deleting or adding resources to the collections.
- ◆ A mechanism to **distribute or share** the revised collection of resources to students or other teachers.

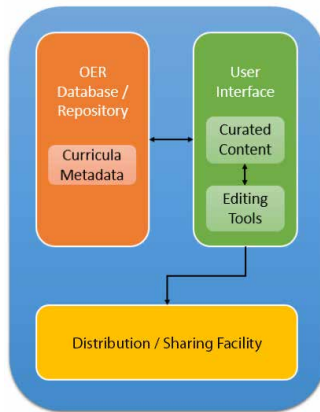


Figure 5.1. Flow diagram of typical open textbook architecture.

We suggest that rather than developing an integrated system from scratch, one can create an open textbook platform by linking a CMS to an LMS or by incorporating an LMS into a CMS. The CMS with its database provides the storage component of the open textbook platform, the repository of open resources, and will also contain the resource metadata, while the LMS acts as the user interface that allows teachers and students to access and customise the resources. Distribution of the resources is possible because both the CMS and the LMS are web based.

These tools and platforms should be installed on a server hosted either locally or perhaps in the cloud. In terms of locally maintained servers, an open-source server operating system is recommended. Another positive of using open software is that such a setup will minimise the cost of developing and hosting the open textbook and its resources.

The following suggested server specification is designed to host 50 simultaneous connections, and it envisages both the CMS and the LMS being hosted on the same server.



SUGGESTED SERVER SPECIFICATIONS AND SOFTWARE*

HARDWARE

- Central Processing Unit (CPU)
- 2 x Intel 6 core 2.6 GHz CPU
- Memory
- 32 GB RAM
- Storage
- 4 x 300 GB SAS 10,000 RPM SAS drives (RAID 10 or equivalent)
- Networking
- Dual or quad Ethernet adapters
- Backups
- Dedicated backup media

SOFTWARE

- Operating System
- Ubuntu 12.04 or other LTS distribution. (The source code is available at <http://www.ubuntu.com/download/server>, and a guide on “How To Compile and Install from Source on Ubuntu” is available at How-To-Geek: <http://www.howtogeek.com/105413/how-to-compile-and-install-from-source-on-ubuntu/>.)
- Server Software
- Apache 2.2. (Apache is part of the Ubuntu repository, so you can install it from inside the operating system. An alternative and somewhat more difficult way is to use <http://www.apache.org/dyn/closer.cgi> to download the source files.)
- Database Software
- PostgreSQL 9.5. (This would support both a Drupal CMS and a Canvas LMS, discussed below. The source code and instructions for installation are available at <http://www.postgresql.org/>.)

* as of February 2016

5.1 Content Management System: Drupal

There are a number of open-source CMSs. The Drupal system, however, has already been used successfully to provide a database for an open textbook platform. Drupal (version 8 at the time of writing) is an open content management software that includes features to facilitate content authoring, guarantee reliable performance and provide security measures to safeguard the repository. It has been designed to ensure that the platform’s functionality can be extended by encouraging developers to create and share modules.

It is possible to use the Drupal system as is for content management or to include a module called OERbit, which provides additional functionality to facilitate the storage of OER. Developed by the University of Michigan, OERbit provides a database environment that is customised for both higher education institutions and the tagging of OER in particular. According to the University of Michigan’s website, OERbit enables:

- ◆ flexible hierarchical organisation of content (e.g., schools and colleges > departments > specialisations etc.);
- ◆ course/resource content types;
- ◆ flexible publishing workflow paired with a revision system;

- ◆ Creative Commons licence integration that goes beyond enabling the CC Drupal module (users can specify a CC licence for each material that is uploaded or each course/resource they create); and
- ◆ Apache SOLR search, which bypasses the generic Drupal search feature.

While OERbit sounds like precisely what is needed for an open textbook, it has sadly not been updated recently and still only supports Drupal 6. It is worth using if you have the older Drupal version, and we recommend that you keep an eye on their website for potential updates.



DRUPAL 8 INSTALLATION ADVICE

Instructions to download the source code and install the Drupal Content Management System version 8 are available at: <https://www.drupal.org/documentation/install>; alternatively, the code can be found at GitHub <https://github.com/drupal/drupal>.

Note: An installation of Drupal 8 will also require PHP 5.4.

5.1.1 The CMS and the Taxonomy

All CMS systems allow for the customisation of the database taxonomy, or the resource classification system. In a CMS this categorisation information is called metadata. When new resources are loaded into the CMS, they are tagged with metadata. Metadata identify the characteristics of an electronic resource, such as title, content, author and format. However, for an open textbook platform the taxonomy must also describe that part of the curriculum or syllabus to which the resource is relevant for teaching and learning. When setting up a CMS to act as an open textbook platform it is necessary to include curriculum statements as part of the taxonomy so that a resource can be linked to the appropriate statement(s). This linking is critical because it aids teachers and students who are searching for relevant resources to support a particular curriculum statement.

A taxonomy is similar in structure to a root system or family tree. There can be multiple levels and therefore numerous relationships between metadata. The beginnings of a simple CMS taxonomy for a mathematics open textbook might look something like Table 5.1.

Table 5.1. Suggested structure of part of a mathematics taxonomy, showing the breakdown of three content areas and their topics and competencies.

LEVEL 1: CONTENT AREA	LEVEL 2: TOPICS	LEVEL 3: STUDENT COMPETENCY
Number Operations and Relations	Whole Numbers	Multiplication of whole numbers
		Order, compare and represent numbers to at least nine digits
		Recognise and represent prime numbers to at least 100
	Exponents	Determine squares to at least 12^2 and their square roots
		Determine cubes to at least 6^3 and their cube roots
		Solve problems in contexts involving numbers in exponential form
	Integers	Add and subtract with integers
		Recognise and use commutative and associative properties of addition and multiplication for integers
		Solve problems in contexts involving addition and subtraction with integers
Patterns, Functions and Algebra	Numeric and Geometric Patterns	Investigate and extend numeric and geometric patterns, looking for relationships between numbers
		Describe and justify the general rules for observed relationships between numbers, in one's own words
	Functions and Relationships	Determine input values, output values and rules for patterns and relationships using flow diagrams, tables and formulae
		Determine, interpret and justify the equivalence of different descriptions of the same relationship or rule presented verbally, in flow diagrams, in tables, by formulae and by number sequences
	Algebraic Equations	Write number sentences to describe problem situations
		Analyse and interpret number sentences that describe a given situation
		Solve and complete number sentences by inspection and by trial and improvement

To illustrate this, let's consider how Drupal was used to construct a prototype open textbook platform for the Antigua & Barbuda Ministry of Education.²⁹ The CMS taxonomy was customised so that it was possible to link resources to the Caribbean Examinations Council's Caribbean Secondary Education Certificate curriculum statements. Searches for resources aligned with specific maths-syllabus-specific objectives were able to identify those resources tagged to the curriculum objective.

²⁹ See the Caribbean OER Textbook Drupal CMS at <http://www.caribbeanoer.org>.

EXAMPLE

Access the Antigua & Barbuda Open Textbook Repository built in Drupal at <http://www.caribbeanoer.org> to see an example of a Drupal repository being used to house an open textbook repository.



Creating a Drupal taxonomy for a particular subject requires an installation of Drupal source code, administrator rights and access to the syllabus that has been used to identify the OER. It is unlikely that the technical team will have been tasked with identifying the subject, its objectives and the appropriate OER, as this would normally be done by a subject expert or team. It is assumed, therefore, that this step in the creation of an open textbook has already been completed, and what is required now is a repository to store and tag these resources. Before uploading or linking these OER, however, it is necessary to develop the taxonomy.

5.1.2 Creating a Curriculum Taxonomy for an Open Textbook

1. Log in to the Drupal CMS as an administrator.
2. Identify the two menu bars running across the top of the screen, one black and the other grey; in the black strip select “Structure.”
3. Scroll down to identify and select “Taxonomy.”
4. Initially there is nothing here, so click on the “+ Add Vocabulary” button.
5. Our first real task is to create a container to hold the curriculum statements. A good name would be “Curriculum.” Fill in the “Name” field. Leave the “Menu Location” as is to ensure that this term appears at the root of the structure. Click the “Add” button at the bottom of the screen.
6. A summary screen is presented, where you can now see “Curriculum” as part of the platform’s structure (see Figure 5.2).

[Show row weights](#)

VOCABULARY NAME	OPERATIONS
+ Curriculum	edit vocabulary list terms add terms batch add terms

Figure 5.2. CMS structure overview.

7. To start building the taxonomy, click “add terms” and in the new screen insert a name and select “Save.” If the CMS is to host more than one open textbook, it is a good idea to insert subject names — Mathematics, Science etc. — at this highest level. Repeat this step as many times as is required.
8. The only difference when creating terms for the second level is the need to identify the new term and its relation to its “Parent.” So if, for example, our new term is “Algebra,” then in the “Relations” box we need to identify that this is a “child” of “Mathematics.” The same is required when creating third-level terms. The term whose name reflects the specific objective “Write any rational number in standard form and in scientific notation” will need to be linked to its second-level parent, “Computation.”
9. It is important that the third-level taxonomy terms be written out in full rather than given a name like “Specific Objective 1.” The reason is that teachers and students when searching according to objective will not be able to distinguish objectives from each other if they share the same name, or to remember what exactly the objective was.
10. Once a structure has been determined, it is possible to see an overview of the taxonomy by selecting “List Terms.” In this screen one can tweak the taxonomy by dragging and dropping terms into the correct sequence. This is useful if the syllabus objectives have a particular order or sequence (see Figure 5.3).

NAME	OPERATIONS
Mathematics	edit
+ Vectors and Matrices	edit
+ 1. Explain concepts associated with vectors.	edit
+ 2. Combine vectors.	edit
+ 3. Express a point $P(a,b)$ as a position vector $OP=(a/b)$ where O is the origin $(0,0)$.	edit
+ 4. Determine the magnitude of a vector.	edit
+ 5. Use vectors to solve problems in Geometry.	edit
+ 6. Explain concepts associated with matrices.	edit

Figure 5.3. List Terms view of the taxonomy.

11. To speed up the creation of the taxonomy, it is possible to list all the terms in one field, one under the other, using the bulk operation “batch add terms” (see Figure 5.2). It is possible this way to create each level in one action. Once the first level has been created, enter one term and repeat the process to describe all the terms required within.

It should be noted that in exactly the same way as identified in the steps above, the CMS taxonomy can be expanded to offer metadata tags that describe resources but that are extra to the curriculum. Obvious additional taxonomy terms that would be useful are:

- ◆ contributor (author, institution etc.)
- ◆ copyright (including all the CC licences)
- ◆ keywords
- ◆ publisher
- ◆ format (PDF, web-based, video etc.)

This step is necessary so that users can search for resources using criteria that have nothing to do with the curriculum — for example, author, title, file format and so forth.

VIDEO TUTORIAL

Watch the video tutorial on “Create a Taxonomy within the Drupal CMS” by scanning this QR Code or accessing it at https://youtu.be/bA8qwaKd_EE.



5.1.3 Inserting OER into the Database

Once the taxonomy has been described, the database is ready for OER to be uploaded. Each resource will need to be tagged with metadata drawn from the taxonomy.

1. Identify the two menu bars running across the top of the screen, one black and the other grey. In the grey strip, select “Add Resources.”
2. In the “Create Resources” page, provide the new resource with the following information:
 - ◆ title
 - ◆ keywords
 - ◆ type
 - ◆ format
 - ◆ language

- ◆ audience
- ◆ copyright licence
- ◆ ownership
- ◆ curriculum

It should be noted that if these fields do not exist it is because the taxonomy has not been set up to capture these data. Return to the taxonomy tutorial above and add these terms.

3. In the “Resource Upload” tab (see Figure 5.4) look for the “Choose File” button to upload a digital file or insert the URL where the resource can be found on the Web. When you have identified it, select “Save.”

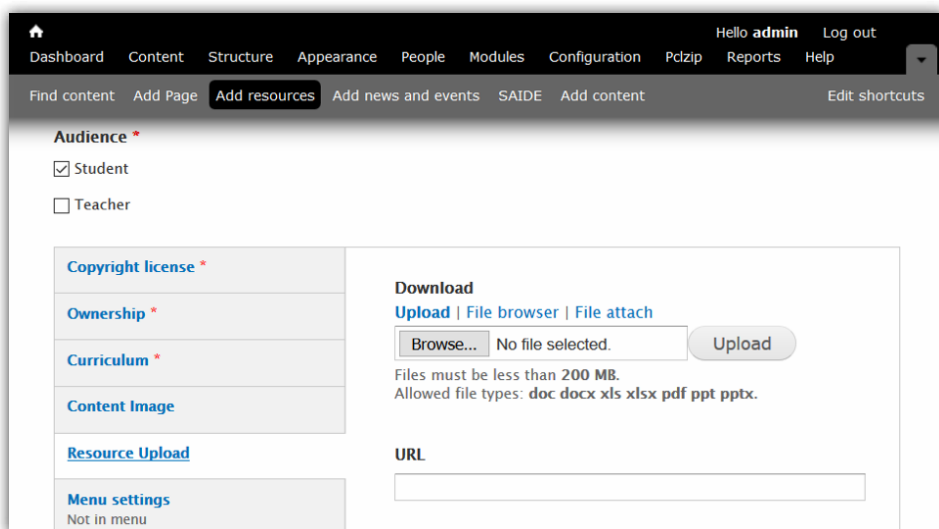


Figure 5.4. Resource upload tab.

4. Repeat this process for each of the OER that need to be saved in the repository.



VIDEO TUTORIAL

Watch the video tutorial on “Upload and Tag OER in the Drupal CMS” by scanning this QR Code or viewing it at <https://youtu.be/9O2JbCgNb-Q>.



5.1.4 Finding Resources by Searching Using the Taxonomy

1. Logout as “admin.” Access the CMS as a normal authenticated user or as a guest.
2. From the CMS home page, look for the search tool. On some installations this is at the bottom of the screen.
3. Use the Keyword search field to find a new resource. Insert a search term and click the magnifying glass icon.
4. Look through the search results, find one that is close to what you are looking for and click on its “title.”
5. All the metadata for that resource are displayed, including the curriculum statements. Click on the statements, and a new set of results will be displayed, showing all resources linked to the same objectives. This is especially useful for finding resources with the same specific objective.

VIDEO TUTORIAL

Watch the video tutorial on “Find Resources within the Drupal CMS” by scanning the QR Code or viewing it at <https://youtu.be/OspNI6Nc6cE>.



The CMS, however, offers only half the solution. To provide users with more of the functionality promised by an open textbook, we need to combine the CMS with an LMS.

5.2 Learning Management System: Canvas

Traditionally an LMS, sometimes referred to as a virtual learning environment (VLE), is used to post course content and activities, provide communication tools for academic classes and track student activity. The LMS is also used to offer assessment opportunities and compile course grades. In the case of the open textbook platform the LMS offers teachers functionality to repurpose, or adapt, “master” collections of OER, aligned to the syllabus. Teachers are given permission to edit these master collections into new versions. For the open textbook platform we specifically use the LMS’s permission system and editing tools.

There are many open-source LMS solutions ideal for this task, including Moodle, Sakai and Canvas. Canvas has an open-source version of their commercial platform that has been utilised for an open textbook platform used in the Caribbean.

Canvas has an interface that allows seamless transition and easy navigation between the open resources of different formats. In Canvas, digital worksheets or textbook pages in PDF or MS Word format can be followed by a streamed YouTube video or an interactive website that contains Java programming. To the user, there is no disruption or deviation from the learning pathway clearly indicated by the LMS navigation tools. However, should a teacher decide to adjust the sequence then this is easy to achieve using the LMS’s drag-and-drop functionality when editing permission has been granted.

Canvas also has good assessment functionality, allowing for the construction and easy adaptation of tests. Another important characteristic offered by Canvas is public access so that users can bypass the login and password screens to allow ease of access to the “textbook.” However, when a teacher or her class wants to manipulate the “textbook,” Canvas offers customisable permissions that can be set up for individual staff and students. Another piece of functionality offered by the LMS that is essential to the model is the ability to deploy copies of a master course (see Figure 5.5) so that different groups have their own version of the textbook to manipulate and develop.

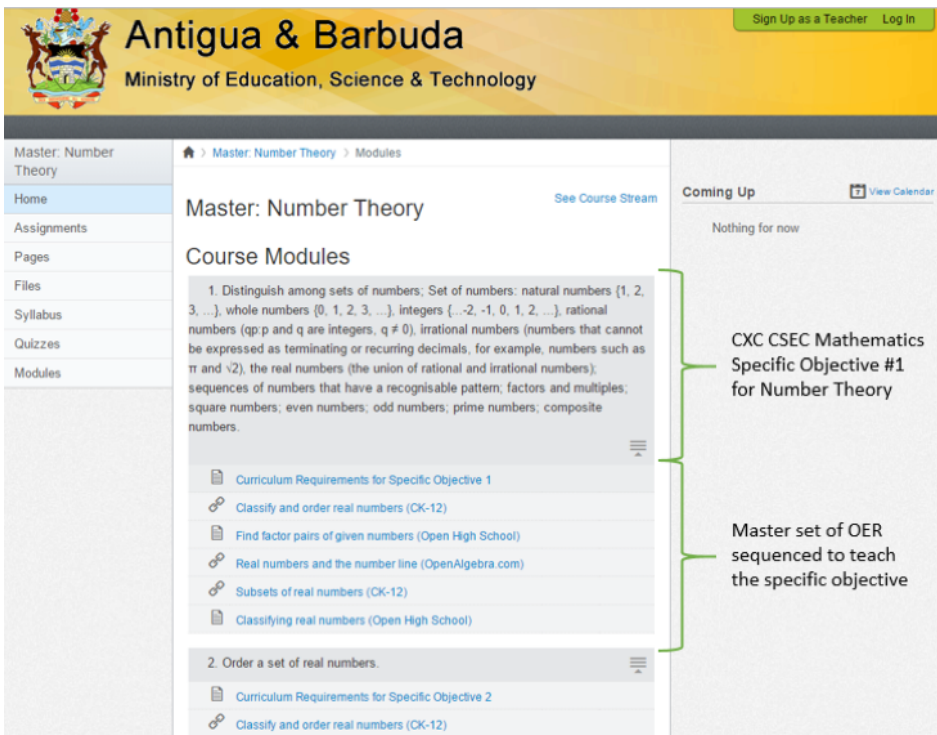


Figure 5.5. Antigua & Barbuda open textbook platform showing master set of OER.

Using Canvas’s permission system it is possible to grant teachers editing rights so that they can adapt the materials. With these permissions it is easy to delete, add and change the sequence of OER. Teachers can easily repurpose the lessons.

The problem, however, is that the “master set” would be changed and there would be no way of keeping the original. To avoid altering the master, the Canvas administrator needs to create copies of the course and then allocate groups of teachers to the copies and grant the appropriate permissions. This strategy creates a bottleneck and means that teachers need to request the creation of a copy of the master set and be granted the appropriate rights, when ideally this process should be automated. This is an instance when customisation of the source code is necessary.



CANVAS OPEN-SOURCE LMS INSTALLATION ADVICE

Instructions to download the source code and install Canvas’s learning management system are available at <https://github.com/instructure/canvas-lms/wiki>.



EXAMPLE

Access the Antigua & Barbuda OER Textbook Learning Management System built in Canvas at <http://lms.caribbeanoer.org> to see an example of a Canvas LMS being used to house an open textbook interface.



After installing the community version of Canvas, it is necessary to set up the LMS so that it reflects the structure of the open textbook. A Canvas course, for example, could be a topic within the subject, while canvas modules could act as the containers for each individual specific objective. What is required at this level is for the technical team to begin to lay out the LMS so that it offers teachers and students a master set of OER resources, with each resource aligned to a specific objective. It is assumed that the technical team will not design the master set but will receive this information and the relevant resources from a content expert. The team’s responsibility will be to load in the resources under the correct module (i.e., for a specific objective). A suggested workflow to create the open textbook structure and link to OER is described below:

1. Navigate and login to the Canvas platform using either the administrator’s permissions or those of a course manager.
2. Create an LMS course. Each course should house a particular subject topic. For example, in Mathematics this might be “Algebra” or “Computation” and so forth.
 - a. Identify and select the “Start a New Course” button on the right-hand side of the screen.
 - b. Provide the course with a “Course Name” and select a Creative Commons licence from the “Content License” drop-down menu.
 - c. Select the blue “Create Course” button.
 - d. Click the “Change Home Page Layout” link.
 - e. In the drop-down box for “When people visit the course page, show them” select “the Course Modules/Sections” and then click “Update Layout.” This ensures that everyone when accessing the open textbook will see the index of contents (see Figure 5.6).

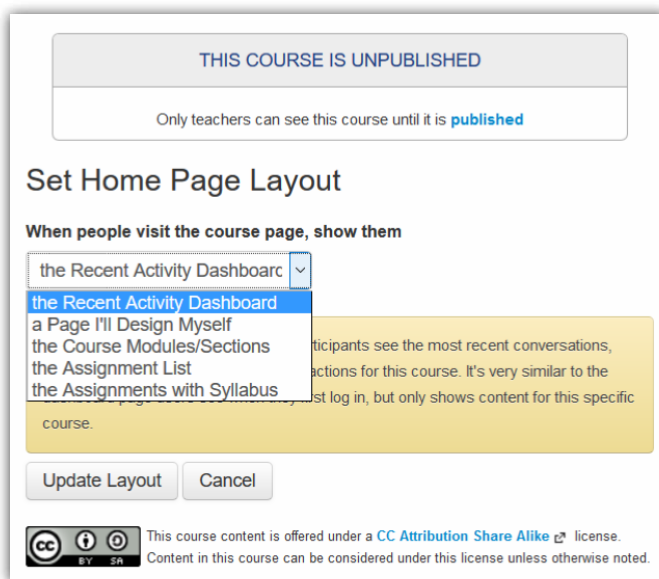


Figure 5.6. Changing the home page settings.

3. Create a course module and a new page.
 - a. Identify and select the blue “Create a Module” button.
 - b. A pop-up box asks you to give the module a “Name.” Modules are in effect category headings and allow you to collect items under a module.

- c. The screen now has a grey bar with tools on the right-hand side. Look for and click a small ▼ arrow next to a ⚙ symbol. From the drop-down menu choose “+ Add Content.”
- d. There is a list of what content tools are available: Assignments, Quiz, File, Content Page, Discussion and Text Header. For this tutorial we will select a “Content Page.”
- e. Click “[New Page]” and insert a name into the new text field that appears, called “Page Name” (see Figure 5.7).

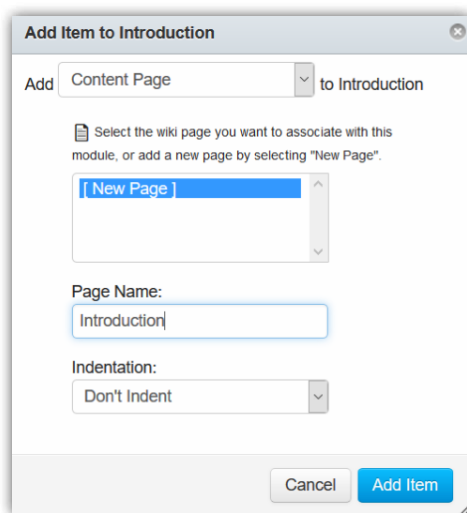


Figure 5.7. Adding a course page.

- f. Click the blue “Add Item” button. You will notice that a page icon and the name of the page appear under the grey module bar on the module page.
4. Populate your page.
 - a. Click the page name, which is a hyperlink.
 - b. The page opens but there is nothing to see yet. Seek out and select the grey button on the right-hand side labelled “Edit this Page.”
 - c. This opens a rich text editing box into which you can insert text, images and other media (see Figure 5.8).

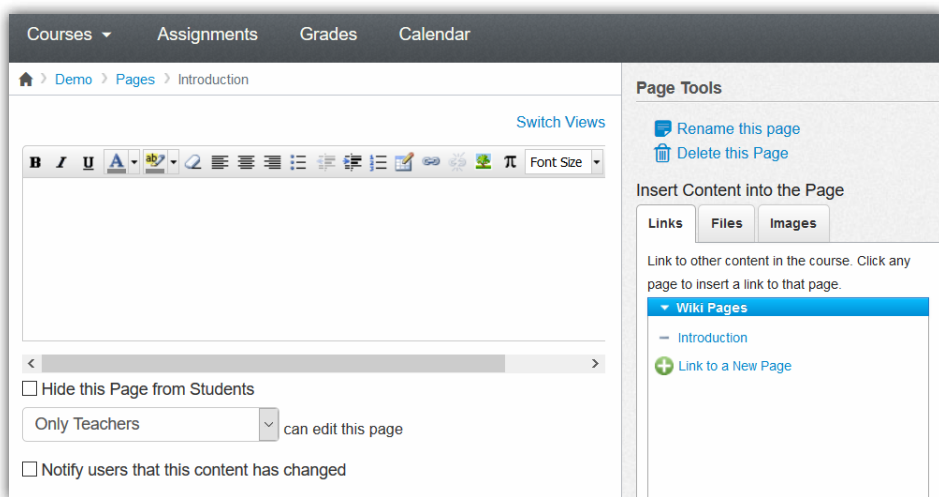


Figure 5.8. Editing a page in Canvas.

Using these tools, it is now necessary to build the content of the open textbook. It is suggested that the module names be the same as the specific outcomes. Within each module there can be an introductory page listing all the OER taken from the database that address that particular specific objective, the service provider and perhaps the particular open licence. See Figure 5.9 for how this might look.

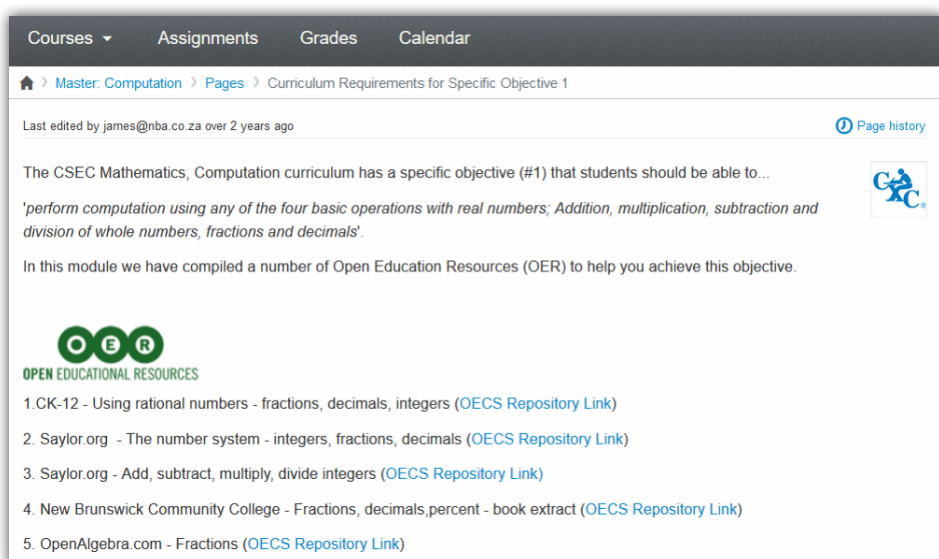


Figure 5.9. Suggested introductory page for a typical module.

The rest of the module is made up of the individual OER. Canvas is very good at linking the OER together no matter what format they might be in. A PDF can easily be followed by a URL. Canvas provides navigation tools that make navigation from one format to the other seamless. Within Canvas each appears to be similar. For example, in Figure 5.10 the icons to the left of the blue resource name identify that this module is made up of “pages,” “web links” and “electronic documents.” Each resource will, however, be downloaded and displayed seamlessly in the Canvas interface. The iconography also identifies “Self-Assessment Activities” that are included in Canvas as one or more built-in quizzes. In this instance, the activity is a multiple-choice test devised by the subject expert to ascertain the student’s mastery of the objectives. These assessment tools can also be built using the Canvas functionality.

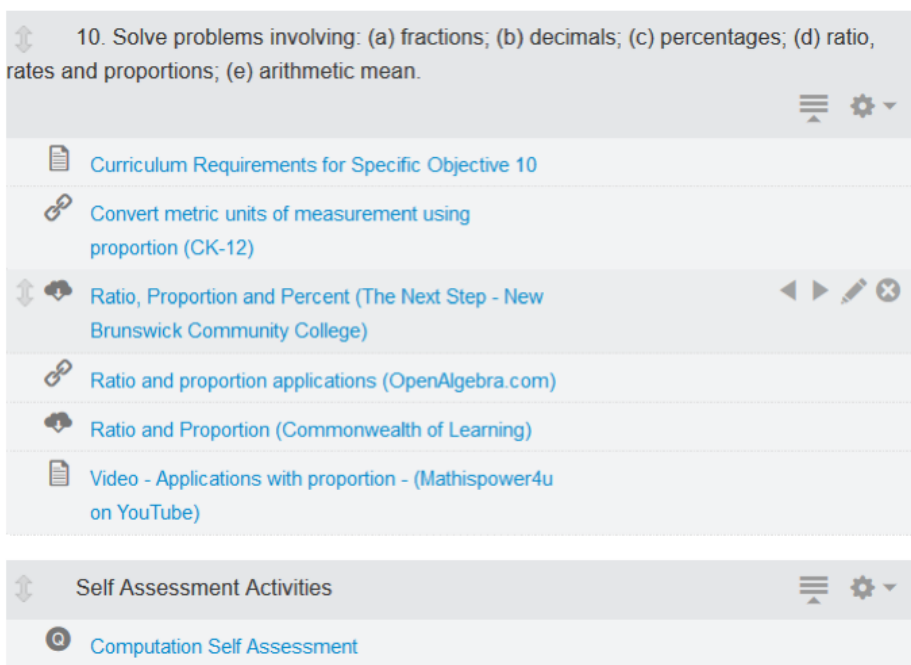


Figure 5.10. Canvas module layout for an open textbook.

5.2.1 Pros and Cons of the Combined CMS and LMS

The CMS and LMS combination described above is not without problems. The way it is described here means that the data need to be captured twice — once in the database and again for the LMS. It is recommended that a relationship, or bridge, be created between the two to stop duplication of effort. This provides an opportunity to customise the source code to improve functionality. The

emergence of Opigno in recent months is encouraging, as this joint relationship between CMS and LMS is built into the technology.

One further issue requiring customisation of the source code is the functionality to duplicate the master set. In the setup described above, teachers do not have permissions to adapt the master set of OER. Instead each school needs to be provided with a copy that includes the appropriate permissions to allow teachers to rework the set. This is technically possible but becomes difficult to sustain as more and more versions are created. This strategy also relies on the interest of an administrator to manually create these copies, and that individual's interest may wane over time. Thus, an automated solution is required.

OPIGNO

Opigno is a Drupal-based LMS. This would suggest that it offers integrated CMS and LMS services. It does allow the development of customised taxonomies, and it also offers functionality to design courses and lessons. However, the standard installation does not include the requirement to tag new resources with any metadata when they are uploaded. Nor is there a mechanism that allows you to search for resources according to metadata. Another problem is that it does not see web-based resources as objects that can be indexed in the system.

However, with a little tweaking by an administrator, some of these issues can easily be incorporated. Opigno currently does seem to offer great promise and is worth investigating further.

Opigno LMS Installation Advice

Instructions to download the source code and install the Opigno LMS are available at https://www.drupal.org/project/opigno_lms, but also visit the Opigno home page for features and user manuals, at <https://www.opigno.org/en>.

5.3 Open Textbook Repository Using DSpace

The DSpace³⁰ open-source database is a customisable database that can be used as a repository for open textbooks resources. It was originally developed by Hewlett Packard and the Massachusetts Institute of Technology and is compatible with both Linux and Windows servers.

Like Drupal, mentioned above, DSpace is a free database option and has much of the same functionality. The DSpace open-source platform is available for free from GitHub, and the code is licensed under the BSD open-source licence, allowing both the use and modification of the code. It is currently used by over 1,000 institutions and organisations,³¹ including educational institutions, hospitals and non-profit organisations. It is easy to install³² and comes with a lot of functionality straight out of the box, negating the need to install additional modules. It provides users

30 See <http://www.dspace.org/>.

31 See <http://registry.duraspace.org/registry/dspace>.

32 See <http://dspace.org/quick-start-guide>.

with the facility to customise many of its features, including to create their own taxonomy and therefore tag resources directly to curriculum statements.

DSpace customised features include:

- ◆ **Customise the theme and the user interface** so that they match the institutional website’s look and feel. This way the open textbook can be branded so that it is perceived to be an initiative of the institution.
- ◆ **Customise the metadata.** Dublin Core is the default metadata format within the DSpace application. However, users can add or change any field to customise it for the open textbook’s needs. DSpace currently supports any non-hierarchical, flat name space.
- ◆ **Configure browse and search.** DSpace administrators can choose what fields they would like to display for browsing, such as author, title, date, etc., and select any metadata fields to be included in the search interface.
- ◆ **Configure the database.** Administrators can choose either PostgreSQL or Oracle for the database where DSpace manages its metadata.
- ◆ **Choose the default language.** The DSpace web application is available in over 20 languages. So if English is not the local language, administrators can customise the language which DSpace uses.

What is potentially useful, over and above its role as an open-source repository, is that the database community has begun to offer online hosting. This means that instead of an institution or organisation having to do the technical support of the database and the servers it resides on, this can be done by a third-party team at “low cost.”³³ This is particularly useful for those institutions who have found that access to quality technical support is both difficult and expensive.

DSpace does support the tagging of resources with a Creative Commons licence. It also displays the appropriate licence when the item is identified. The only drawback with using DSpace straight out the box is that it does not consider web resources as items that can be linked to the database. The database is dedicated to the storage and retrieval of digital files. The DSpace application can recognise and manage the most common formats, such as PDF, Word, JPEG, MPEG, TIFF, etc. DSpace also provides a simple file format registry where administrators can register any unrecognised format, so that it can be identified in the future.

5.3.1 Try the Demo Version of DSpace

DSpace has a demo site that allows you to try out the latest version of the database. This short tutorial will use the demonstration version to set up the metadata structure needed to tag resources with the appropriate curriculum statements:

³³ See <http://dspace.org/>.

1. Navigate to the DSpace website at <http://demo.dspace.org/xmlui/> and click the “Login” button.
2. Use the login e-mail address “dspacedemo+admin@gmail.com” as the username, with the password “dspace.” Click the “Sign In” button.

Before continuing it is important to appreciate that DSpace has a particular architecture. Files, or individual assets, are collected into “Items.” These items are described using metadata. Items, however, are clustered into “Collections,” and multiple collections are housed inside “Communities.”

3. Create a Community to house all the open textbook resources. Search the right-hand panels and identify and select “Context | Create Community.”
4. In the new screen, “Edit Metadata for a New Top-Level Community,” fill in the fields to create a community, such as “Open Maths Textbook.” Also upload a graphic to act as the community logo. Once the fields have been filled in, click “Create.”
5. On the home page identify the new community and open it, then search the panels on the right-hand side and identify “Context.” This time select “Create a Collection.”
6. The new screen, entitled “Enter Metadata for a New Collection of OER Textbooks,” provides fields needed to create a DSpace Collection. Complete and then click “Create.” Repeat this step as many times as the number of collections that are required. For example, you might want collections for Computation, Algebra, Number Theory, etc.
7. Returning to the community, it is now possible to see the list of collections created in the above step. Select one, and look for and click the “Submit a new item to this collection” hyperlink.
8. It is now possible to upload and tag a set of files into the collection. There are four steps to this process: describe the item (such as author, title, date etc.), identify whether there is an embargo on the item, upload the file and provide a Creative Commons licence.

This final step is very important, as it provides the metadata that is used by the search tools within the database to locate and report the existence of the items. What would be required in a database to support an open textbook is curriculum metadata. This customised metadata can be inserted by creating new metadata schemas using the “Registries | Metadata” tool located in the right-hand panel, within the community.



VIDEO TUTORIAL

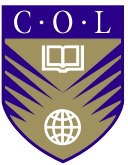
Access the video tutorial on “DSpace as an Alternative Technology to Create an Open Textbook Repository” by scanning the QR Code or accessing it at <https://youtu.be/heDg9FGcamE>.

DSpace is an excellent technology solution to share open textbooks developed by any educational institution. It is used by many to share their teaching, learning and research publications in an organised way to facilitate retrieval on the Web. COL's open access repository — Oasis³⁴ — has been developed using DSpace.

* * *

We hope this guide will encourage readers in educational institutions and governments to take initiative and start open textbook platforms using open-source technologies and free resources on the Internet. Please send us feedback about the usefulness of this guide for developing open textbooks and sharing them using the different options discussed.

³⁴ See <http://oasis.col.org/>.



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