Do I.T. Academy: Investigating good practices to increase discoverability and guidance for use of OER for a community of practice.

A dissertation submitted to Manchester Metropolitan University in part fulfilment of the requirements for the degree of Master of Science in Computing

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Date of Presentation: September 2014

Abstract

This project identifies and implements good practices surrounding discoverability and guidance for use of OER for a specific community of practice. The pilot group chosen is Community Arts North West and their Do I.T. training programme which delivers workshops on digital skills for Manchester-based artists. The project addresses the need of the Do I.T. programme for a tool to house training resources in an online repository.

The project also addresses an issue shared by many learning providers. While there are many learning resources available free of cost from disparate sources on the Internet, systematic information surrounding how they can be used in an educational context is often lacking. Specific areas of good practice including the use of metadata to describe educational use, design patterns and suitable web-technologies are identified in a review of literature in the area of OER and a review of three high-profile OER repositories.

The innovative technologies of LRMI and schema.org (restricted sets of metadata fields which are marked up using semantic HTML tags) are chosen as the best candidates to maximise discoverability of learning resources by search engines.

Based on this review and the priorities of the pilot group, a tool in the form of a web repository is created. This website is now in use by the pilot group here: http://doitacademy.flossmanuals.net.

Declaration

No part of this dissertation has been submitted in support of an application for any other degree or qualification at this or any other institute of learning. Apart from those parts of the dissertation containing citations to the work of others and apart from the assistance mentioned in the acknowledgements, this dissertation is my own work.

Signed

Acknowledgements

I would like to thank the following members of the pilot group for taking part in this project: Adelle Robinson, Hilary Turley, Leah Olwen, Mahboobeh Rajabi, Phil McDowell, Sara Domville, Joanna Wakeford and Tommy Ollerenshaw.

Thanks also to the guidance and support of my tutor Peter McKenna and course leader Silvester Czanner.

The information provided in the area of OER and specifically LRMI by the following members of Cetis has been invaluable: Lorna Campbell, Phil Barker and Wilbert Kraan.

Finally, I would like to give a retrospective thank you to members of the Transmission.cc metadata team, especially Zoe Young, Simon Worthington, Adnan Hadzi, And Lowentall and Anna Helme.

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1 Overview

1.1 Introduction

Advances in technology have made access to freely available learning resources via the Internet widespread. This project aims to investigate how good practices in the area of Open Educational Resources (OER) can be applied to the smaller scale publishing of learning resources. Specifically, what techniques could a learning community quickly and easily adopt to profit from existing OER eco-systems.

This project adopts the definition of OER created by UNESCO at the Paris conference on OER (UNESCO, 2012).

> “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 Educational Resources (OER) have proliferated in recent years having been both the subject of many funded research and production initiatives. At the same time as these funded initiatives, there has also been an increase in the use of social media to distribute self-published learning materials, for example, YouTube videos and blog posts. The volume and diversity of these contributions is remarkable. They are often reused by educators even if they are not self-described as OER by their authors.

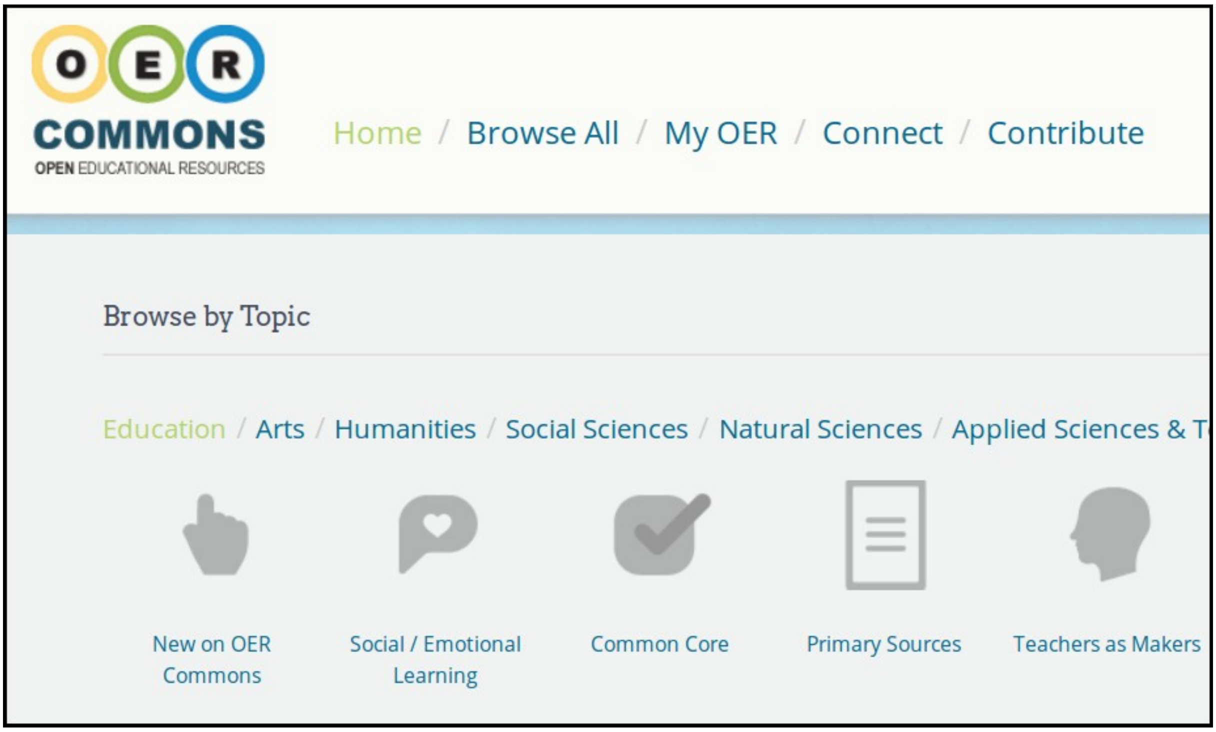


Illustration 1: The front page of the OER Commons web repository – a tool to aid the discovery of OER

There has been extensive work done to identify and overcome barriers to reuse of OER resulting in many recommendations and good practice guides (Groom, 2013). The main areas of good practice that this study addresses are discoverability and guidance for use. Guidance for use in this context signifies educational use, the technical ability to adapt resources and legal issues surrounding reuse.

Effective discoverability is still a major issue for OER and cited by some studies as the most significant barrier to reuse (White and Manton, 2011). Web based repositories which aggregate OER from many sources have been created to address this issue. An example of such a repository is a website called OER Commons (shown in Illustration 1). In this project the term repository is referred to primarily as a website to house and distribute learning resources.

Pedagogical fit has been identified as the most significant factor for tutors when deciding if to reuse a specific resource (White and Manton, 2011). There is, however, often little guidance as to how the material could be structured for specific learning needs at the point of delivery. Educational context is particularly lacking for small scale, self published OER (Weller, 2011, p. 110).

One particularly promising area is the reuse of OER by communities of practice. This area can be said to occupy a space between the worlds of formal and informal OER production, in other words, between so-called little and big OER (Weller, 2010).

It is the premise of this project that up-to-date tools are needed which support a community-based approach to sharing OER. Specifically, in this case, a web technology which fills the gap between a large institutional repository and self publishing tools used by lone authors.

To give this project a greater focus, I have worked with a pilot group Community Arts North West to create a repository for learning resources used on a course to teach digital skills to artists. The course is called “Do I.T.”. I was a tutor and co-designer of the initial 2013 Do I.T. course. The objectives of the course were based on the need of the participants to develop a web presence to promote their artistic work or practice. Our approach used a mixture of guided instruction, group work with problem based learning and 'real life' media or web production projects.

The choice of CAN as a pilot group for this project is dictated by their need for a tool which matches the remit of the project and their willingness to donate their time to engage with the process.

1.2 Objectives

The concrete goal of this project is to work with a pilot group to create a tool which allows the republishing and organisation of learning materials. The tool should incorporate good practices from the field of OER and digital repositories.

The tool should use up-to-date and durable web technologies and incorporate design techniques to encourage users to enter relevant metadata when republishing resources. Special attention will be paid to include information on guidance for pedagogical use and adaptability of aggregated resources. The tool should adopt suitable measures to increase technical discoverability via search engines.

The end product should mitigate issues of lack of educational context and coherence identified with the use of disparate materials. Resources should be framed within a targeted educational context to encourage user contribution of additional material (Weller, 2011, p. 111).

Together these objectives support a wider aim of creating a resource that can help communities of interest to profit from the wider ecosystem of OER whilst contributing something back to the community through the re-contextualising of disparate resources with educational metadata.

1.3 Research questions

The main research question to be addressed is:

- What elements of good practice in the area of discovery and guidance for use of OER should be prioritised in the creation and design of an OER repository for a community of practice?

The following subsequent questions arise:

- Can a tailored metadata schema for a repository help increase the quality of metadata entered by its users?
- Can a well designed OER repository encourage a community of practice to reuse, adapt and share back adapted OER as part of their teaching practice?

Due to the time constraints of the project it is imagined that these subsequent questions will be addressed through analysis of existing research. The final question, however, will gather data from participants on the impact of the tool in one key area of interest:

- What impact can design have to increase the usability of data entry forms for OER metadata?

1.4 Organisation of project report

Following this introductory section, this report continues with a review of literature in section 2. This section brings to our attention some of the key issues of this project, namely the context, pedagogic theory and technical concerns of OER. The base material of the theoretical framework for the project is uncovered as part of this exploration.

Section 3 draws the research from section 2 together to create a simple representation of the theoretical framework. From this base a methodology for a review of three OER repositories is created.

Section 4 mirrors the structure of this framework when reporting the results of the review of repositories. This review is carried out in great enough detail to identify specific areas of practice and technology. The details selected reflect the objectives of the project outlined in this introductory section thus forming some of the outputs of this project.

The implementation of the coding and design of the repository is described in section 5. The section includes a summary of the user requirements and an overview the most notable areas of technical implementation.

The report then synthesises previous elements of the report in section 6. This conclusion contains a summary of the product created, an exploration of whether the objectives of the project have been met, further reflections on the work and areas of future interest.

2 Literature review

2.1.1 Unravelling different strands of the OER ecosystem

While our project deals with the use of OER at a very local and concrete level, we can contrast this specific context to other strands in the fabric of the OER ecology. To do so, we can begin with a quick description of the genesis of OER.

The 2012 Paris OER declaration contains a wide set of recommendations for member states, including the promotion of the use of open licensing frameworks and the open licensing of educational materials produced with public funds (UNESCO, 2012).

The declaration builds on a decade of progress in this field. Open Educational Resources as a term was decided on at a UNESCO conference in 2002 (Johnstone, 2005) The same year saw the Hewlett Foundation sponsor a high profile release of materials from MIT as part of the Open Courseware programme.

One summary of the aims of Open Education Resources can be found in the review of OER movement sponsored by the Hewlett Foundation (Atkins et al., 2007). The main areas that are identified as part of their logic model are to sponsor high-quality open content, remove barriers to use and the stimulate use of OER. A visual representation of this model is shown in Illustration 2.

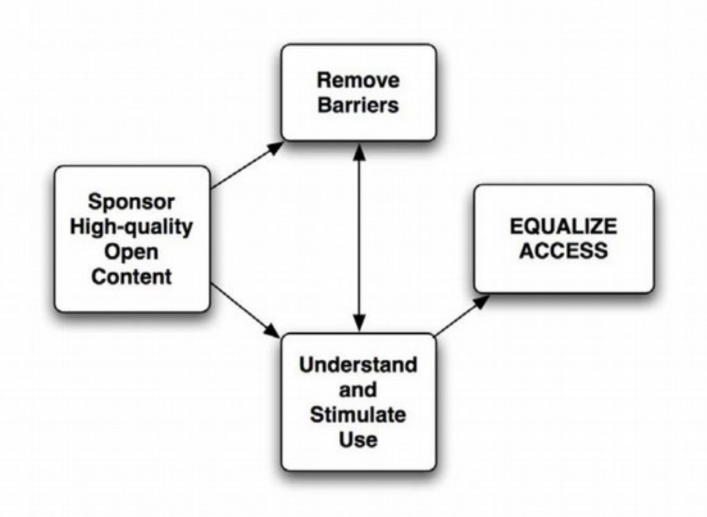


Illustration 2: Hewlett Open Educational Resources Logic Model

The Foundation describes their overall goal for supporting OER as to “equalize access to knowledge for teachers and students around the globe” (Hewlett Foundation, 2010, p. 5).

While large initiatives, often funded by the Hewlett Foundation, have garnered a lot of attention and generated significant outputs, it is vital to acknowledge the diversity of producers and different political strands of the OER movement.

Despite their high quality, an over-reliance and blind replication of materials created by elite US universities can be seen as undesirable. Such a one-size-fits-all approach has engendered a perception of cultural imperialism surrounding such educational resources (Mulder, 2009). This potential underlines the need for the ability to re-contextualise OER through adaptation allowing local differentiation of learning.

In the UK there has been significant research into and championing of OER through many academic initiatives often led or funded by JISC, many as part of the UKOER programme (Groom, 2013). A significant amount of work has been done examining different models of OER and studying their impact on academic staff and learners in higher and further education.

A distinction between little and big OER is useful when examining different strands of OER (Weller, 2010). Big OER are generally complete courses offered by academic institutions and little OER take many forms including video tutorials, blog posts, images or presentations. While, little OER may be available on individual websites, they are often hosted on Web 2.0 services including YouTube, Flickr and Slideshare. Arguably one of the most significant moments in the explosion of little OER was the birth of Wikipedia in 2001.

Big OER can be seen to support traditional education practices with their focus on completeness and quality. Little OER on the other hand are characterised by their piecemeal nature, abundance and variable quality. This variety and the need to recombine materials invites a constructivist approach to learning (ibid).

The motivations of the publishers of little OER are diverse, ranging from a desire to be part of a community or pure subject interest, to a need to increase status through sharing knowledge (Weller, 2011).

An assessment of how widespread the adoption and reuse of OER is varies depending on sources and definitions of OER. One JISC report takes an inclusive definition and is optimistic about rates of reuse (White and Manton, 2011). Another report takes a more limited view of OER including only those intentionally created by educational institutions and asserts that levels of reuse are disappointing (Davis et al., 2010).

There appears to be a general consensus that reuse of OER in the world of HE, FE and Lifelong Learning is happening but that there is still room for improvement. Reuse could be improved by the implementation of good practices, including sharing back, consistent use of open licences and re-contextualising resources. Greater advocacy and the embedding OER into academic programmes may also widen the user base.

OER is often referenced as a 'movement' seemingly without deep reflection on the use of this term. In the production of little OER, there are many characteristics similar to those of social movements. Such characteristics include the use of volunteer time and a great diversity of participants with alliances beyond institutional links.

It is noticeable that there are links between OER and other open practices within education. These include the sharing of learning analysis data and experiments in open accreditation systems like

Mozilla's Open Badges (Thomas et al., 2012). As such, it can be said that these activities could be better expressed as an Open Education movement rather than an OER movement.

2.2 OER and educational theory

Laurillard (2013, p. xvii) reminds us that “Pedagogy is about guiding learning, rather than leaving you to find your own way”. However, it is possible to argue that knowledge of theory is not needed to be a good teacher for teaching is an activity based on experience and reflection. What does it matter if a teacher is not well versed in pedagogical theory, if they have the skills and experience to promote effective learning?

Such an implicit understanding of learning becomes more problematic when it comes to sharing experience on how to teach effectively or to the effective sharing of teaching resources (Masterman, 2013, p. 67). The objective of this project is to help learners and teachers of a community of use to find the resources they need through their effective cataloguing. As such, we must engage with how to describe teaching practice, or in other words, pedagogical theory. To do this different possibilities for framing pedagogical activities will be explored.

2.2.1 Grouping activities by pedagogical perspective

De Freitas and Mayes (2013, p. 17) argue that while blended learning, with its mix of classroom and online activities, may not need new underlying theories of learning, its new opportunities do require us to update existing models of education.

They cite a general agreement on the importance of a constructivist learning approach (Jonassen and Land, 2000). The aim to remove a dependence on traditional instruction-based learning and encourage problem-based learning and social learning is directly relevant to the aims of the pilot group.

De Freitas and Mayes (2013) draw on the work of Greeno et al (1999) to outline an inclusive take on three different schools of learning theory. They argue that the key features of associative, constructive and situative approaches are complementary and thus that the approaches can be used to create a framework to describe learning activities (Table 1).

Associative	**Constructive (individual)**	**Constructive (social)**	**Situative**
Building concepts or competences step by step	Achieving understanding through active discovery	Achieving understanding through dialogue and collaboration	Developing practice in a particular community

Table 1: Framework of different learning theories

This framework can be used by teachers to design and categorise activities to help students to make a transition to self-directed, constructive and situative learning.

While the framework is useful to develop our overall understanding, it seems too broad and overlapping to suit our goal of finding useful ways of categorising learning resources to aid discovery. In comparison another review of e-learning theories by the same authors (2004, p. 15) notes that research on the following areas of constructivist learning has been extensive:

- Problem-based learning
- Anchored instruction
- Cognitive apprenticeships
- Reciprocal teaching
- Goal-based scenarios
- Project-based learning

This list is perhaps a candidate for a taxonomy of learning resources but may again be too broad or skewed towards higher order learning.

The widespread knowledge and durability of Bloom's (revised) taxonomy makes it a viable candidate for categorising OER resources. A visual representation of the taxonomy with descriptions is shown in Illustration 3.

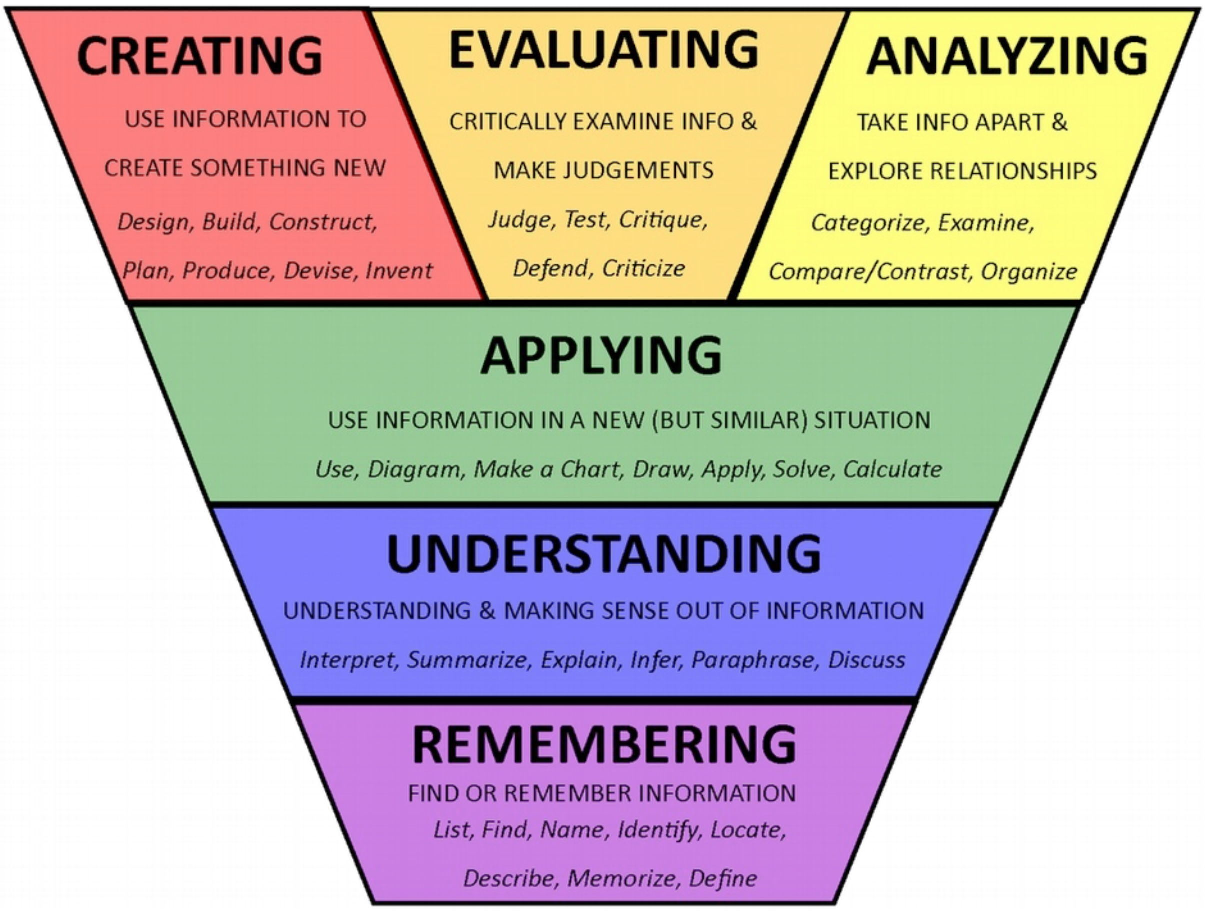


Illustration 3: Visual representation of Bloom's taxonomy

Churches has undertaken work to map the areas of the taxonomy to digital skills and activities (2009).

Beetham has undertaken similar work creating an extensive chart with sample activities within the context of digital literacy (2013, pp. 285–298).

Laurillard's work on the conversational model of education based on activity theory (1997) has implications for how teachers design their lessons using a variety of materials with different goals. More recent work by the same author develops approaches specifically adapted to use Technology Enhanced Learning (TEL) to represent complex practice of teaching in innovative ways (Laurillard et al, 2012). In this work different types of learning are outlined:

- Acquisition
- Discussion
- Investigation

- Practice
- Collaboration

NESTA's report Decoding Learning (Luckin et al, 2012) takes a similar approach in their breakdown of learning types.

- Learning from Experts
- Learning through Inquiry
- Learning with Others
- Learning through Practising
- Learning through Making
- Learning from Assessment
- Learning through Exploring
- Learning in and across Settings

While there is some repetition and vagueness in terms like 'Learning in and across Settings' the breakdown does cover a potentially wide range of resources and is written in accessible language.

One of the most popular pedagogical frameworks is that of learning styles based on work on Kolb (1984). There are many variations of learning style theory. One wide-spread version is VARK (Visual, Auditory, Read-Write and Kinaesthetic) (Fleming and Mills, 1992). The is widely-shared scepticism surrounding the 'intrinsic' nature of such styles in individuals (Rohrer and Pashler, 2012).

The fact that this framework is used widely in the UK education system despite criticisms and lack of research-based evidence may indicate a desire for teachers to find simple frameworks that can be understood easily by peers and students. Beetham (2013, p. 38) sees value in learning styles to promote the use of multi-modal resource production. In other words, the framework could be seen as useful to promote conversations surrounding learning by both teachers and students and to encourage teachers to plan varied lessons.

To view the taxonomy in this way, ie as a representation of good teaching practice, invites us to consider that the decision on which educational taxonomy to use is best made by the pilot group. Indeed, researchers in this area supported a position that the reflective process of deciding such an organisational system is as important as the resulting representation of the pedagogy.

> *The study indicated that a 'one-size-fits-all' approach to modelling pedagogy might not be appropriate, but that offering opportunities to recognise teachers' knowledge and their willingness to engage with adapting and creating representations of their practice was helpful. (De Freitas et al., 2007)*

In summary, this brief review indicates that while the process of applying pedagogy to learning materials has value, no one taxonomy of learning activities is dominant. As such, it seems appropriate to decide a suitable taxonomy collaboratively with the pilot group using this review as a basis.

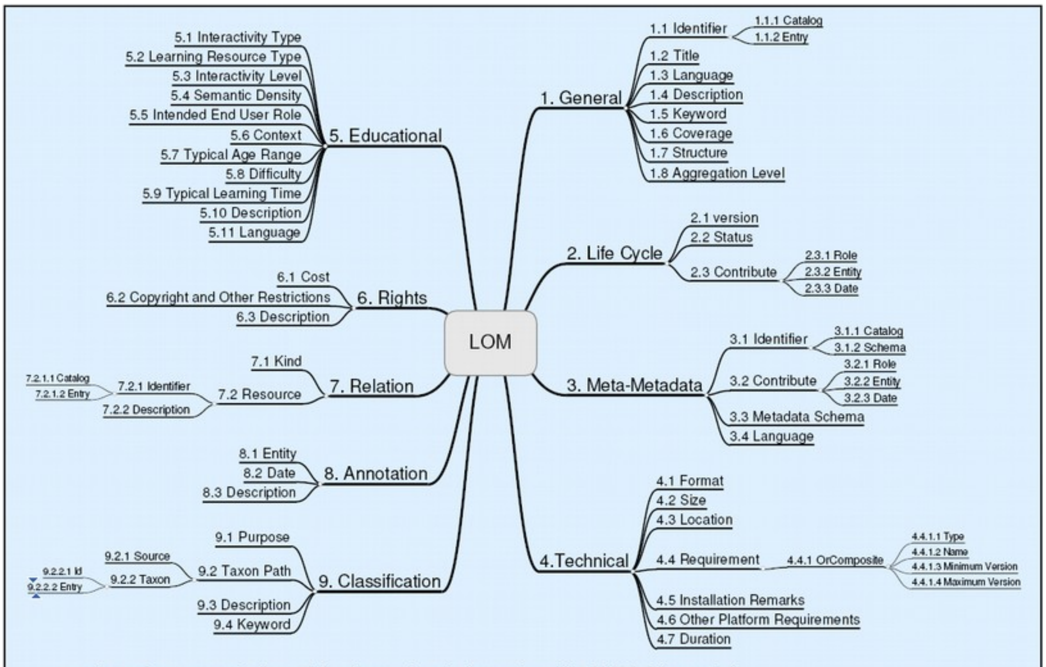
2.3 Technical Literature

To further our understanding of how OER can achieve their potential in our areas of interest, we can examine the effect of technical factors on their creation and dissemination. The ability to be able to describe learning resources in such a way as to maximise discoverability and guidance on educational use relies on choices about metadata. Effective reuse of OER also is greatly affected by issues of licensing and delivery formats.

2.3.1 Metadata

Metadata is data describing other data. In the context of OER, we can think of our core resource as a learning object or asset. This may be a pdf file, a video or a collection of diverse materials. Metadata is used to describe the characteristics of the assets. When you enter a title, description and tags for a YouTube video you are entering metadata about the video. As OER publishers, the importance of entering metadata is primarily based on increasing the ability of consumers to find the resources they need.

OER have an shared heritage with Learning Objects (Weller, 2011, p. 105). The metadata standards which emerged to describe Learning Object were used to aid the portability of learning objects especially between digital repositories. We can take the example of LOM (Learning Object Metadata) standard.



a schematic representation of the hierarchy of elements in the LOM data model

Illustration 4: Visual representation of LOM

Metadata schemas like LOM were designed for storage and archiving and transport between institutional repositories rather than for web-based searching or publishing.

Currently, in contrast to repository based searching, by far the most popular way for learners or teachers to find and download educational resources is via search engines and openly accessible web-pages (Thomas et al., 2012, p. 61).

The findings of research conducted by OLnet (2010) are particularly significant for the objectives of this project.

- Google and Wikipedia are the two most used search sites for learning resources;
- Most users prefer a simple search strategy (i.e. entering one or two keywords), they don’t care about using metadata until they can’t find what they are searching for;
- Good search tools allow users to continue solving their problem, providing them with some useful content / links that will further their search.

The frustrations of James Dalziel about traditional repositories for Learning Objects lead him to publish nine principles of design which are relevant to the aims of our project (Dalziel, 2013, p. 234). The simplification and change of focus towards the user that these principles reflect is driven by the situation that the publishing, and hence description, of OER is now often done by educators themselves, who are short on time.

One of Dalziel's principles is to abandon structured taxonomies of material in favour of an evolving, community based categorisation using tags. Such a process is often referred to as folksonomy. Another is to promote the free-text searching of resources and the removal of mandatory metadata fields from input forms.

These principles are in line with common practices of Web 2.0 design and are supported by research in the area of open education (Guy and Tonkin, 2006). They reflect a wider emphasis on community-based contributions as shown in communities like the Free Software movement (Raymond, 1999).

A review of the OER repositories undertaken by Shank (2014) from the viewpoint of librarians and academic staff in Higher Education sector showed that repositories of a large size could make material difficult to browse for if subject categories were too restricted. The number of results shown in each category is too high to be useful.

This observation backs up the decision of the project to create a smaller repository but also invites reflection on how to avoid a negative situation of disconnected silos of resources. The area of the semantic web, LRMI and the role of search engines is relevant here. The Learning Resource Metadata Initiative (LRMI) is an extension of the work of schema.org initiative to describe learning resources.

The aim of schema.org is “to help search engines to interpret information on web pages to that it can be used to improve the display of search results making it easier for people to find what they are looking for” (Barker and Campbell, 2014, p. 2).

A overview of the how schema.org fits into the semantic web and of the advantages it can give specialised communities is given by Barker (2012). Barker compares schema.org favourably to other standards, including Dublin Core and metatags. While other standards exist to describe the contents of webpages, it is significant that schema.org is promoted by the major search engines. It is the way they want publishers to include metadata. In the case of LRMI metadata is embedded in the contents of web-pages using a light-weight tagging approach and data should be visible to human readers to be indexed.

The most significant elements of schema.org and LRMI our project are shown included in Table 2 .

LRMI / schema.org element	**Description**	**example**
about	Subject matter	e.g. “Boolean Logic”
keywords	List of keywords	e.g. “Logic, control structures, programming”
licence	A license document that applies to this content, typically indicated by URL.	e.g. “http://creativecommons.org/liceenses/by/4.0/”
learningResourceType	The predominant type or kind characterizing the learning resource.	e.g. “presentation”, “handout”, “video”
EducationalAlignment	Alignment to educational or assessment framework	
EducationalUse	The purpose of the work in the context of education.	e.g. “assignment” e.g. “group work”
EducationalAudience	EducationalRole -	e.g. “teacher”, “student”
InteractivityType	Set to only three types of interactivity	ONLY “active”, “expositive”, “mixed”.
TypicalAgeRange	The typical expected age range,	e.g. “7-9'” “11-”.
TimeRequired	Approximate or typical time it takes to work with or through this learning resource for the typical intended target audience,	e.g. “P30M”, “P1H25M”. wikipedia.org/wiki/ISO_8601#Durations

Table 2: Selected LRMI and schema.org elements

Barker (2014a) uses a concrete example to illustrate the use of LRMI, specifically that of a Google Custom Search. If we imagine a GSCE teacher searching for a learning resource on the Declaration of Arbroath, a simple google search on that term will return tens of thousands of results.

Illustration 5 shows the result of a custom google search where results are filtered so that they only show pages where there exists an elements tagged with the LRMI attribute Educational Alignment with the value GSCE.

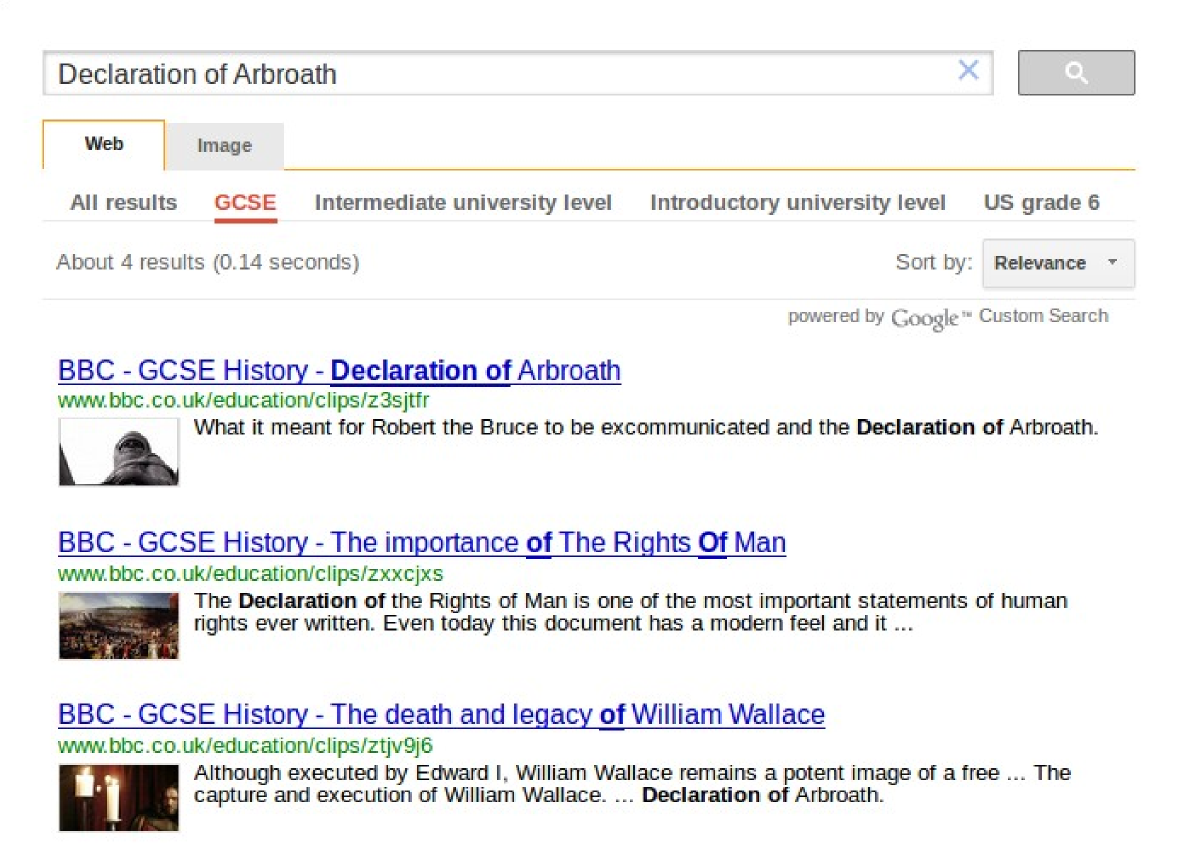


Illustration 5: Google Custom Search with ability to filter by LRMI EducationalAlignmentObject

This demonstration shows the benefits that these advances in the area of the semantic web can bring to educators. However, we are still in a situation where we are unlikely to see many tools using these semantic searches, until more web publishers start incorporating this data into their web resources (Barker and Campbell, 2014).

Given the tendency for Google to discontinue services if they are not widely used, there is an incentive and certain urgency to adopt LRMI and schema.org and to develop tools to profit from these advances. Investigating a simple but flexible way to do this for emerged as one of the key aims of this project.

2.3.2 Licences

To return to our base definition we can see that the licence chosen for OER materials should be one which "permits no-cost access, use, adaptation and redistribution by others with no or limited restrictions".

Many of the issues surrounding OER and reusability are intertwined with the impact of licences and delivery formats. To explore these elements we can use the four “R”s of openness and the ALMS analysis. (Hilton III et al., 2010)

The four “R”s are:

- Reuse: using all or part of the work for your own purposes
- Redistribute: sharing the work with others
- Revise: adapting, modifying, translating, or changing the form of the work
- Remix: taking two or more existing resources and combining them

Rather than a binary open or closed opposition, the four R's framework encourages a view of openness as a hierarchy or spectrum. This is represented as a diagram in Illustration 6 (Hilton III et al., 2010).

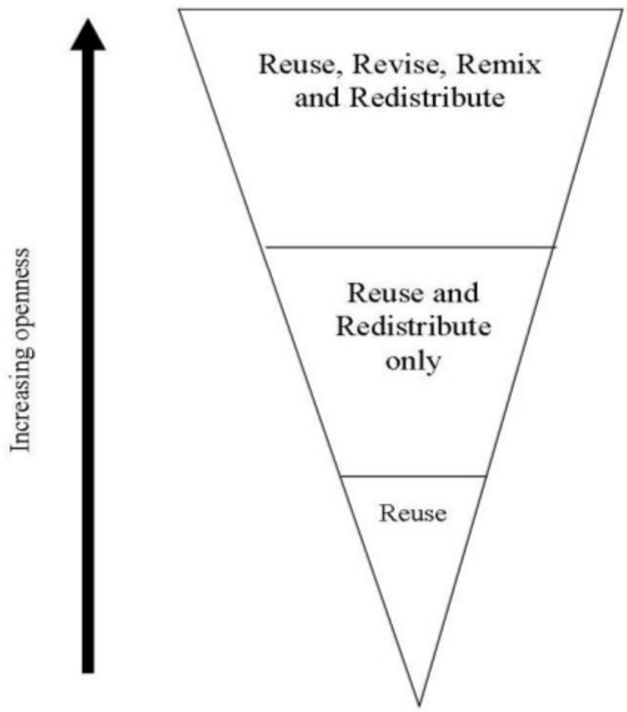


Illustration 6: Four Rs and increasing openness

In 2014 Wiley added a fifth R, “retain”, to this framework to address issues of OER and ownership (Wiley, 2014).

Research has shown that attitudes to reusing resources found on the internet by many educators are pragmatic, bringing to mind in the popular phase, it isn't a crime if you don't get caught (Thomas et al., 2012, p. 17; Littlejohn and Pegler, 2014).

While this under-the-radar approach has its benefits, such an attitude becomes problematic when organisations officially adopt OER as part of their teaching practice and begin re-distributing teaching resources beyond the walls of their own classrooms or VLEs (Littlejohn and Pegler, 2014).

The use of open licences has been simplified by the work surrounding Creative Commons licences. Thomas et al. have made a succinct summary the importance and of impact of this work on the UK OER environment (2012, pp. 47–60). From this work we can understand both the value of a clear and user-friendly mechanism for those publishing OER to control the way their work is reused and re-purposed and the advantages given by of a global set of interoperable licences. These issues are dealt with in a more concrete way in section 4.5.1.

The same authors also cite the importance of machine readable licences as a key area for future work. It appears that work is indeed continuing in this area with the inclusion of a field for “license” in the schema.org specification (Barker, 2014b).

2.3.3 Formats

Wiley's ALMS framework is a way of assessing the impact of delivery and authoring formats on OER, specifically to examine potential barriers to their reuse (Hilton III et al., 2010).

ALMS stands for:

- Access to editing tools?
- Level of expertise required to revise or remix?
- Meaningfully editable?
- Self-sourced / Source-file access?

Access to tools to edit OER without great cost or difficulty is clearly a valid concern for those who agree with the aims of OER. We can take the example of a Keynote presentation which would only be editable to someone with a Mac computer who had purchased the Keynote software. Sharing the file as an odp file or as a pptx file, both of which can be opened using the cross platform free software alternative Libre Office, would be a better solution in this context.

To explore the issue of the level of expertise required to revise or remix a resource, we can imagine many educators would be capable of downloading, opening and changing a word processing document before printing it out for a class. We can compare this relative ease with other formats or applications which would require more work or knowledge. An example would be a specialist learning object designed for transport between repositories, e.g., the SCORM or Common Cartridge formats (zipped packages of XML based documents).

Resources should ideally be meaningfully editable. There is widespread frustration about the difficulty of re-editing pdfs (Hilton III et al., 2010; Atkins et al., 2007). A hand written and scanned document would be even harder to edit. This practical difficulty can be seen as a serious barrier to repurposing of OER.

While the concept of access to the source code of an application can be easily understood, what this means in the context of OER needs clarification. Wiley advocates that the distributed OER file should contain its own source, asking is “the format preferred for consuming the open content the same format preferred for revising or remixing the open content (e.g., HTML)?” (Wiley, n.d.).

Contemporary sharing of OER has seen the gap between big and little OER narrow in terms of the delivery formats used. Some of the big OER providers are adopting or experimenting with web-based authoring platforms and delivery via simpler open formats (Fletcher, 2014).

In the UK, this pattern can be also be seen in the stages of the JISC OER programmes. While earlier stages showed a desire to experiment with OER production platforms and formats, later stages showed a dominance of Web 2.0 services, standard formats and off-the-shelf self-publishing tools including Wordpress (Thomas et al., 2012, pp. 26–27).

3 Methodology

3.1 Theoretical Framework

The objective of this section is to synthesise theory into a framework that is adaptable and appropriate to use as a base for analysis of OER repositories. It should be broad enough to encompass both technical detail of a working repository and the professional needs of practising teachers. While, the 4Rs and ALMS frame work provide a solid and well-used technical base, they lack a way of examining other of our key issues surrounding removing barriers to reuse.

We can look to other studies to find inspiration. Hassler provides an inclusive framework in a recent analysis of the ORBIT OER programme which includes issues of “legal freedom; technological freedom (including accessibility); as well as freedom in terms of education and participation” (2014).

Finally, I decided to focus on two main areas of relevant to the success of OER:

- Discoverability
- Guidance for use

These domains contain the following subthemes:

- Searchability
- Browsability
- Adaptability
- Educational Use

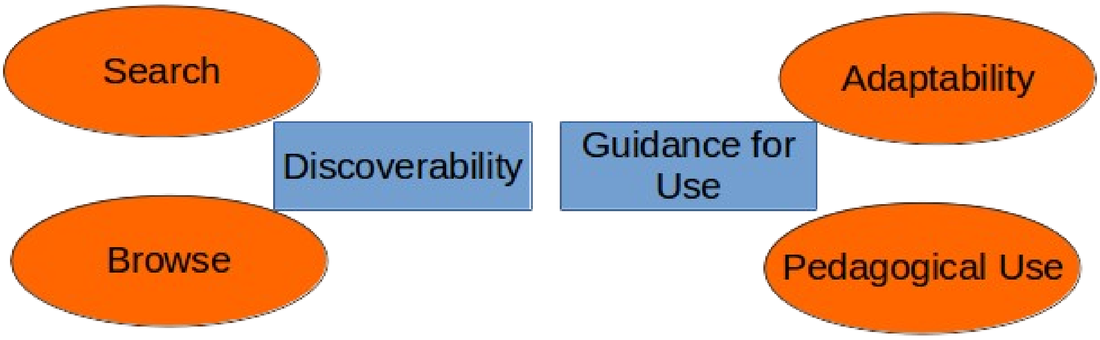


Illustration 7: Visual representation of theoretical framework of this project

The grouping of the main and subthemes of the framework are shown in Illustration 7.

We can see how this framework builds on the analysis of Shank, the 4 Rs and ALMS framework and the work of many researchers in the area of OER and pedagogical guidance as described section 2.2.

3.1.1 Methodology for review of OER repositories

One research approach that was considered was to look at contemporary examples of learning materials using both cognitive theory of multimedia in the domain of learning (Clark, 2008) and theory based on reflective practice (Beetham, 2013) and review their relative effectiveness based on pedagogical theory. The goal was to identify examples of activities which would illustrate different techniques of instruction and learning theory. Early research into this area showed a huge variety of activities and ways of categorising them.

Instead, based on the theoretical framework, I chose to review a restricted set of OER repositories. The task of evaluating individual resources was de-prioritised as I felt that this kind of research was a huge task beyond the remit of this project. Also the final decision of what activities to include and their effectiveness was ultimately a choice of the pilot group.

The following criteria to review selected OER repositories were chosen:

- Usability for contributors

- Discoverability
- Guidance for Use
- Adaptability

While, the issue of usability is relevant to all aspects of the user of OER repositories, it is beyond the remit of this project address usability on such a broad scale. Instead, it is most fruitful to make observations about the ease of use of the different methods used to encourage uploaders to add rich metatadata about learning resources.

Rather than following Shank's approach (2014) of rating the overall performance of repositories in a quantitative way, I chose to analyse and report findings as textual description to give greater flexibility to focus in on areas key to the objectives of the project. Screenshots are used to illustrate particular features. The purpose of this review was to find areas of good practice of design and implementation to inform the creation of the tool for the pilot group.

The following repositories were chosen to be reviewed:

- OER commons
- Connexions
- Curriki

These resources were chosen from a large list of possibilities as they had licencing policies consistent with the aims of OER and provided a diversity of approaches in the areas being reviewed. Rather than comparing each resource in turn, in the following section, I identify and contrast similar and divergent elements and functionality.

4 Review of OER repositories

4.1 Overview of repositories chosen

Of the three repositories reviewed, only one, Open Stax CNX, is directly linked to an academic institution. However, all appear to have a remit to support global learners with a wide range of learning materials.

Open Stax CNX is a wiki based system which also allows content to be exported to epub and pdf formats. It allows importing from word, odt, latex files and promotes the creation of more complete works through the combination of smaller elements. The terminology used to describe this granularity has changed in a recent website update from Modules and Collections to Pages and Books.

OER Commons is both an aggregation tool and an online authoring platform. It is an aggregation tool in the sense that much of the materials that are listed on the website are hosted and originally published elsewhere. It is also possible for anyone to create an account and upload their own resources to the platform.

Curriki works in a similar way to OER Commons. It is possible to use their wiki-based authoring tools to create and collaboratively edit content online. There is also the possibility to upload collections of work and single learning resources.

One of the goals of this review is to identify common elements which can be seen as design patterns for this domain. Terminology is explained in an ongoing fashion, incrementally adding context with examples.

4.2 Discoverability

Shank's study (2014, p. 45) of OER repositories in this area contains a detailed review of searchability and pays special attention to the elements of basic search and advanced search. This review draws on the methodology of his work and gives an analysis of additional innovative areas of design and functionality.

4.2.1 Basic and advanced searching

All three repositories have a search bar as part of their page templates allowing a general search on every page. We can call this approach of searching the whole repository via keywords entered in a single search field a *basic search*. An example of a basic search form is shown in Illustration 8.

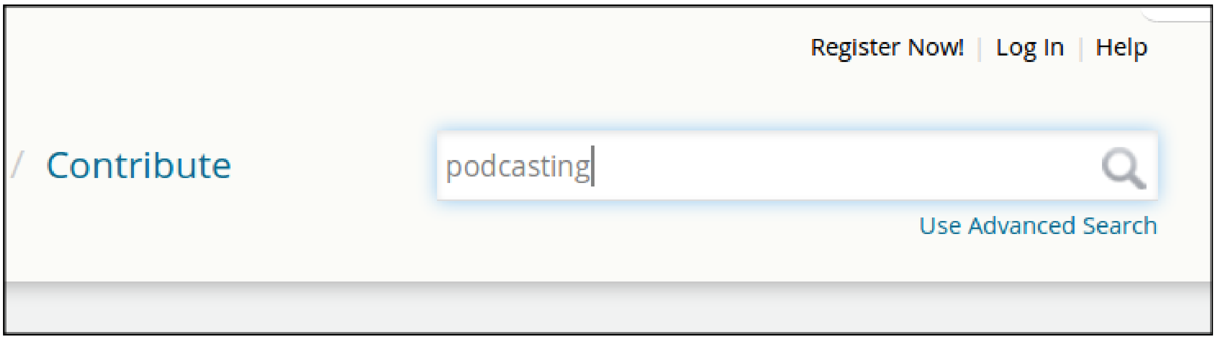


Illustration 8: Example of a basic search (OER Commons)

OER Commons has a prominent simple search bar and a link underneath that bar to an Advanced Search page.

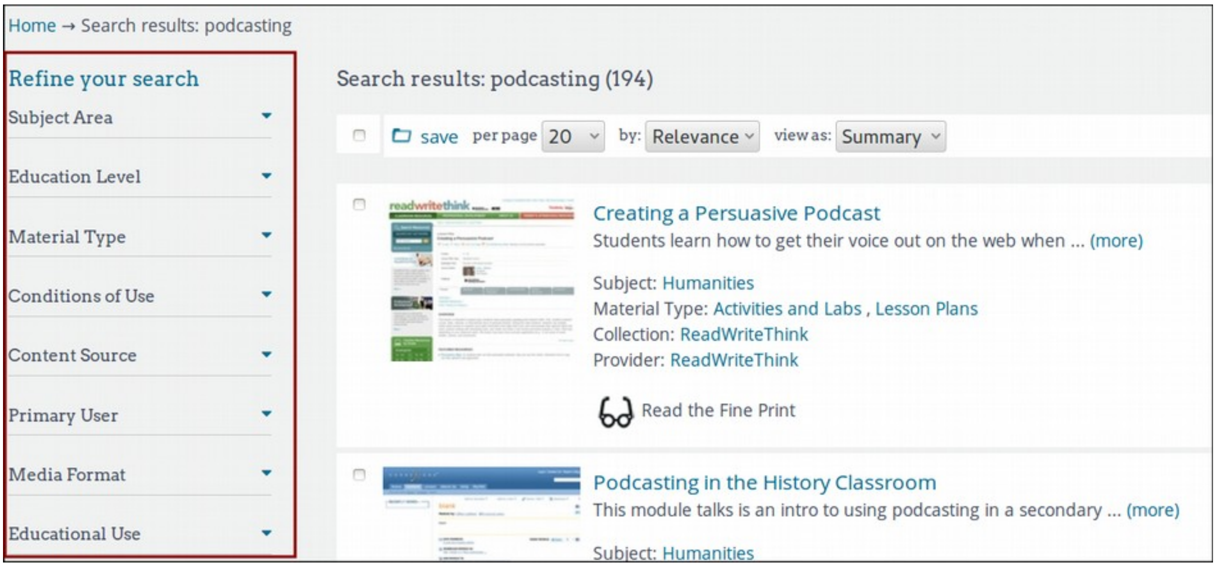


Illustration 9: Refining your search (OER Commons)

Different resources approached more advanced searching in different ways. A search on OER Commons returns a list of results and also features a list of terms that the user can choose to refine their search as shown in the highlighted area in Illustration 9.

Open Stax CNX also offers a similar ability to filter search results. Both OER Commons and

Open Stax CNX offer a separate advanced search page where many options are offered to users who wish to approach searching in a more exact manner.

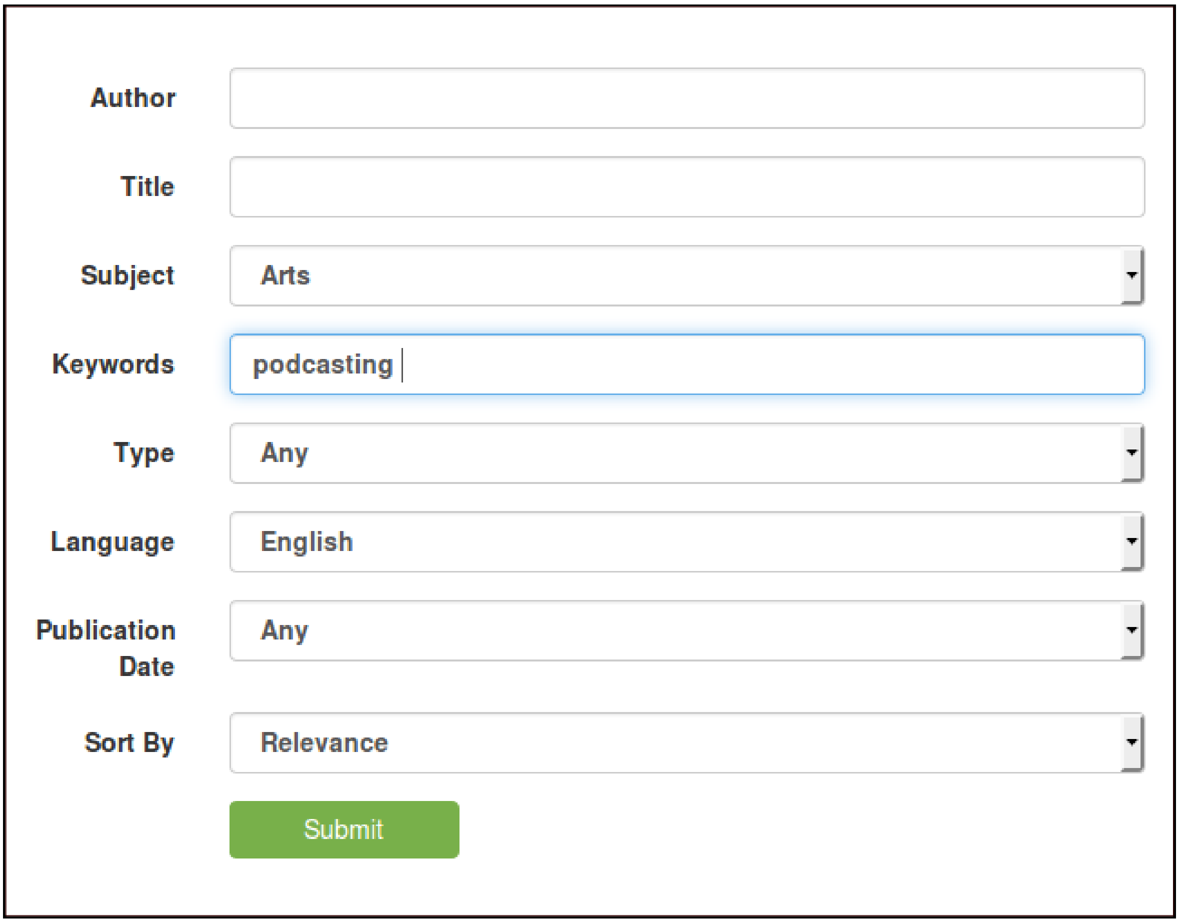


Illustration 10: Advanced search ability (Open Stax CNX)

Curriki offers and promotes the use of the advanced search as a standard way of searching by including an advanced search capability at the head of every list of results as shown in Illustration 11.

Users can further refine search results by selecting additional criteria in various drop-down lists and clicking once more on the *Search* button.

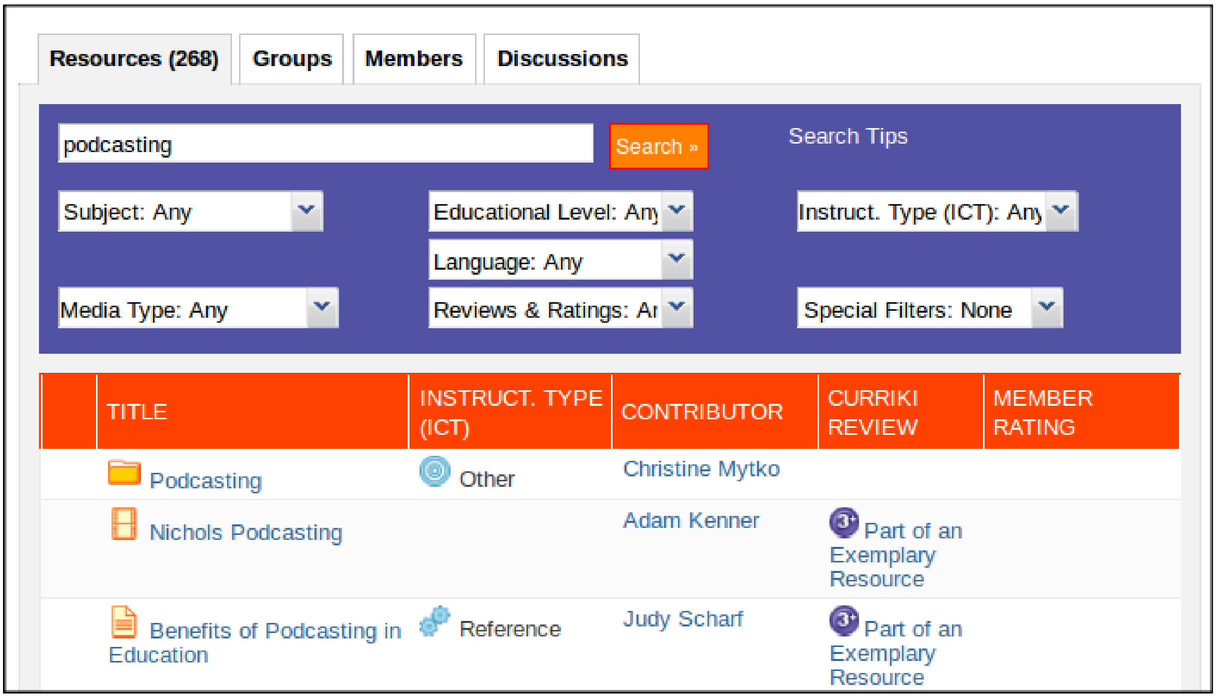


Illustration 11: Advanced search abilities shown at the top of a List View of search results (from Curriki)

4.2.2 List views and search results

A *List View* in this context can be described as a view of many resources on one web page listed one after the other vertically. It will often have a pager to allow users to navigate forwards and backwards through the list of results. An example of pager is highlighted in Illustration 12.

Illustration 12: A pager at the foot of a List View showing search results

We can compare the more minimal approach of Curriki with that of OER Commons when returning a result for a search term. Curriki uses design techniques to offer a hover over description for the list view as shown in Illustration 13.

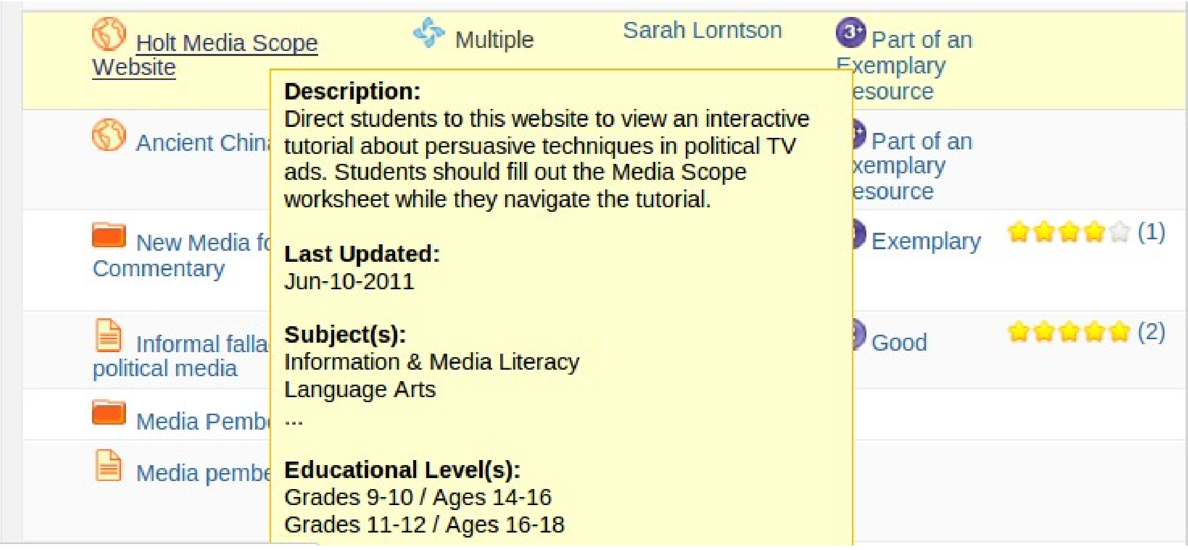


Illustration 13: Hover text shows a more complete description of resource in List View (Curriki)

OER Commons has a more graphically appealing list view shown in Illustration 14. It includes an image of the resource and an icon describing conditions for use. A 'more' link is available to allow users to find out more about the resource without clicking through to the full detail page.

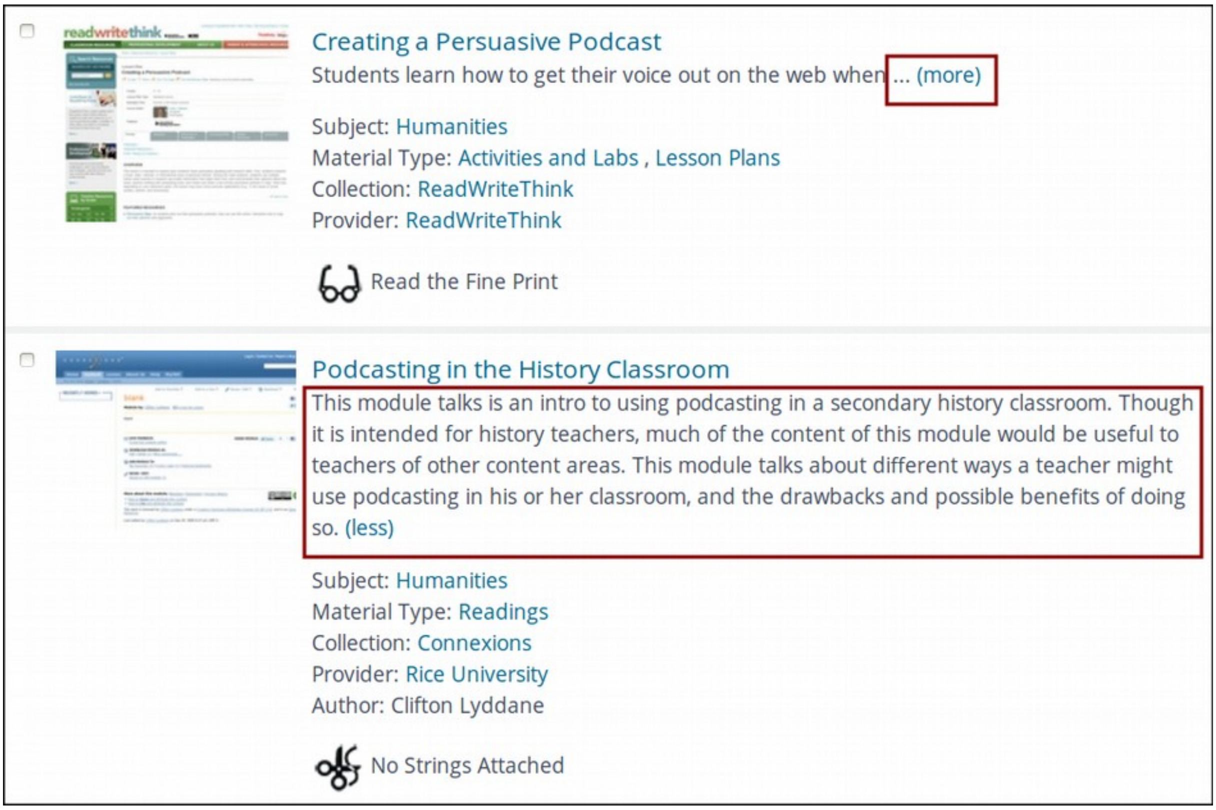


Illustration 14: List View with option to show more detailed description (OER Commons)

4.3 Browsing

Browsing is a less defined pattern than the list view. We can imagine browsing being driven by the scenario of a user who visits a resource without a clear idea of what they are looking for. Different repositories approach this situation in slightly different ways.

OER commons has a prominent Browse All menu item which takes you to a page listing different subject areas, Grade Levels and Material Types shown in Illustration 15. The number of resources in each of these categories is also listed. Clicking on any of the categories will take you to a results list page where your search can be refined further.

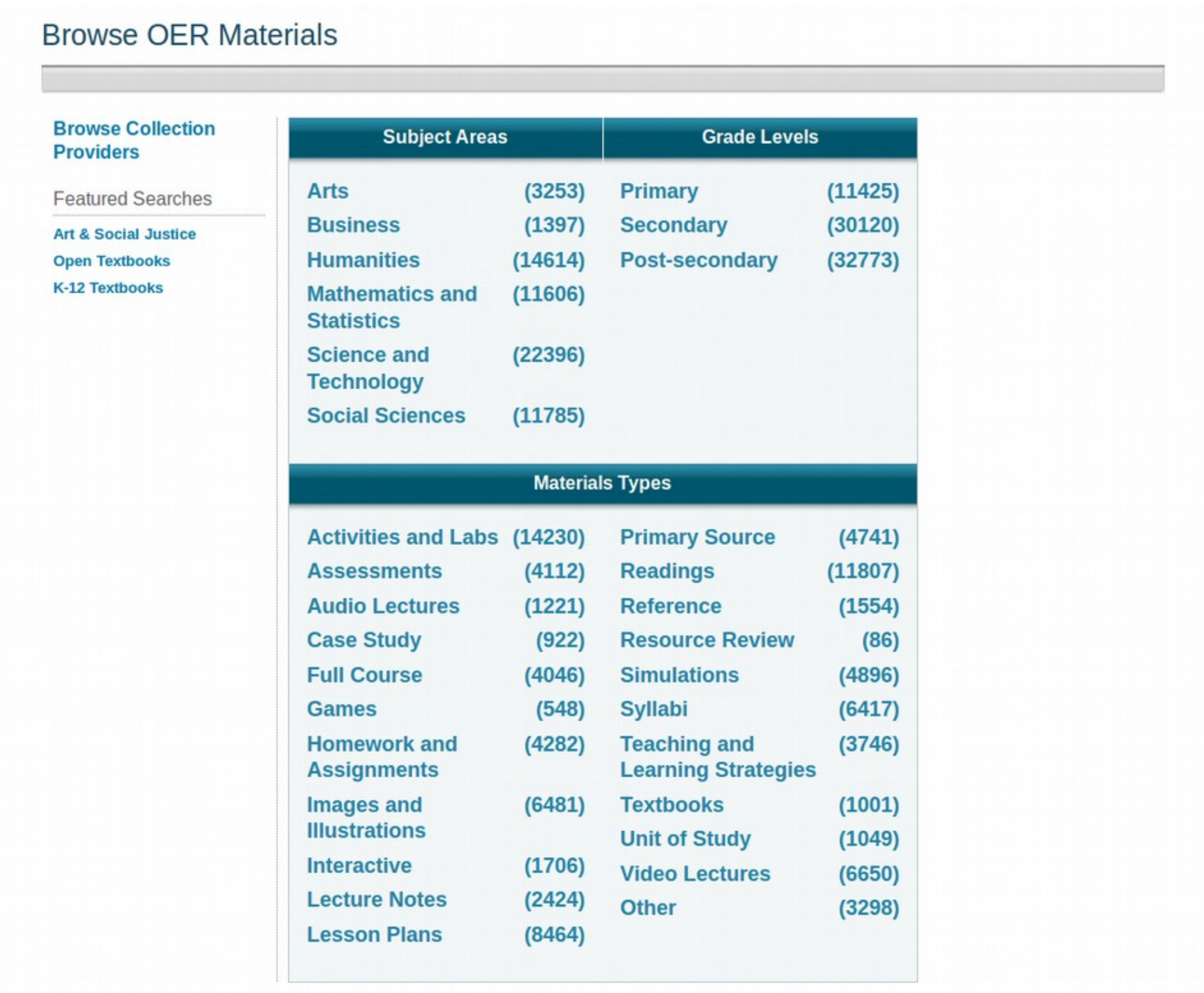


Illustration 15: Browsing resources (OER Commons)

Curriki is initially a little tricky to browse by subject. The functionality to view by category is three, not very prominent, clicks away from the front page. However, the ability to browse via wide categories and then more specific sub-themes is potential is very useful as shown in Illustration 16.

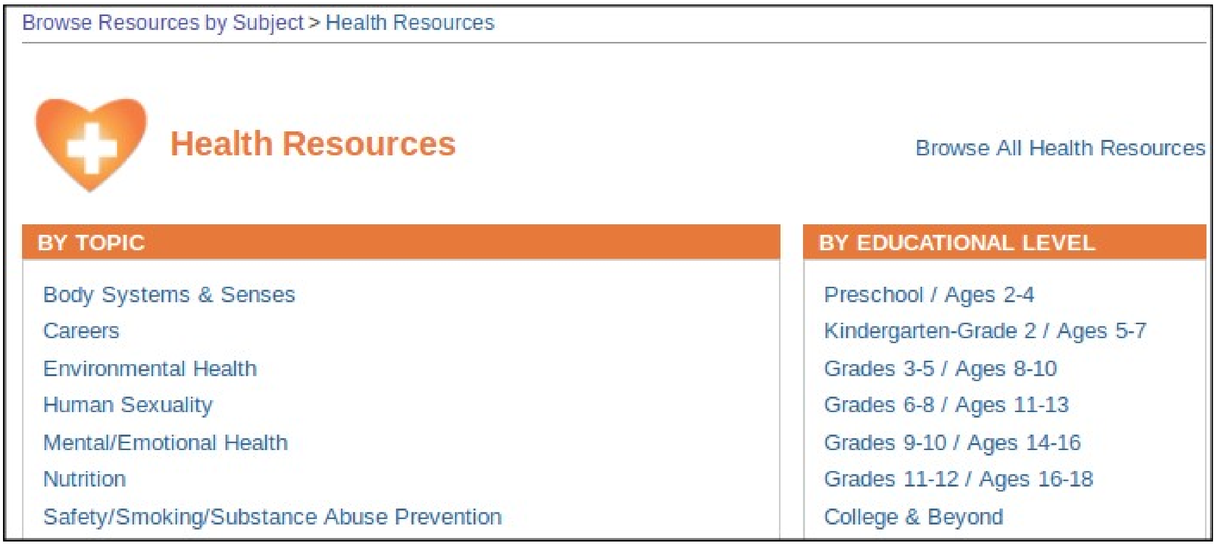


Illustration 16: Browsing by subject categories and sub-categories (Curriki)

OpenStax CNX encourages several ways to browse content. The main search bar invites you to choose from one of 6 main subject areas which are structured around broad University faculties. There is also a link from the landing page to a graphical *Contents* page which allows you to choose from the same six options (Illustration 17). Both of these routes point the user towards a broad search results page.

Illustration 17: Browsing content categories on Open Stax CNX

There is a Featured Books section on the front page of Open Stax CNX which present resources in a branded fashion with a book cover (Illustration 18).

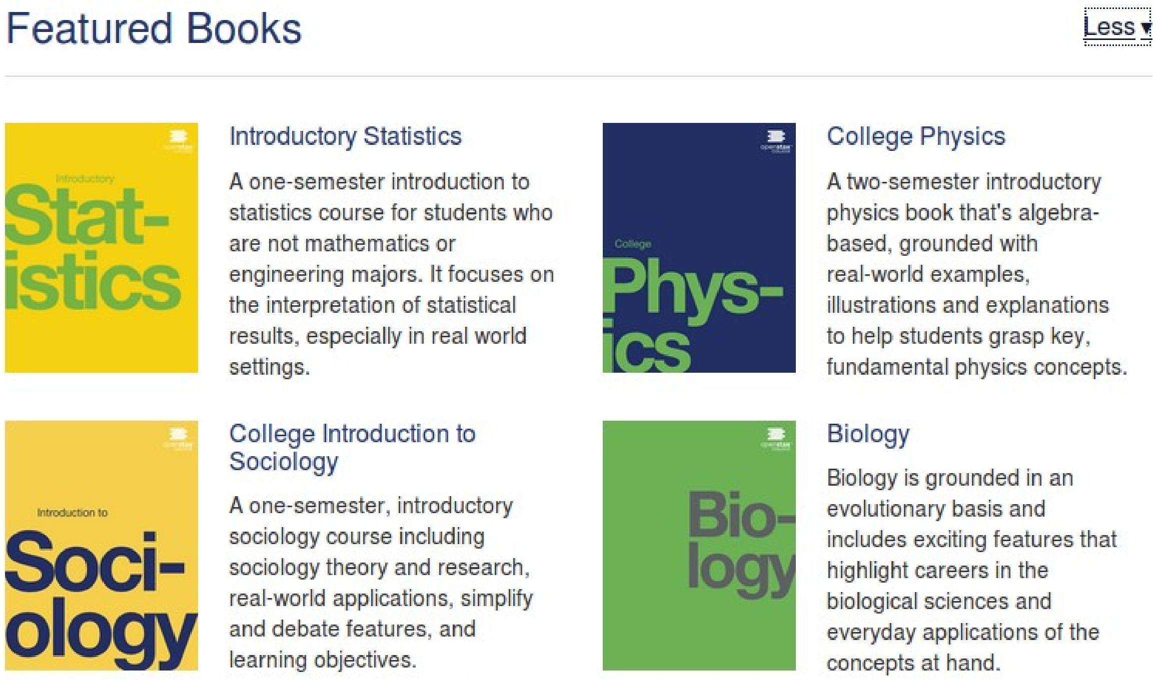


Illustration 18: Resources as featured books (Open Stax CNX)

Open Stax CNX uses the concept of *lenses* as another way of browsing content content. Lenses are collections of resources that have been brought together by community participants or project partners. They provide a window into the collection for certain areas.

Lenses may be task driven or grouped around a much more specific subject area than the broad 6 top level categories allow. Endorsement lenses exist to allow organisations to use their own quality criteria to assure readers that the resources selected are of a high quality.

4.4 Guidance for educational use

Many repositories have the ability search or filter based on educational level. There is no standardisation to this feature but levels are often based on age range. There may also be categories for college and adult education. OER Commons allows for a more flexible approach allowing the selection of more than one level when searching for resources or inputting data (Illustration 19).

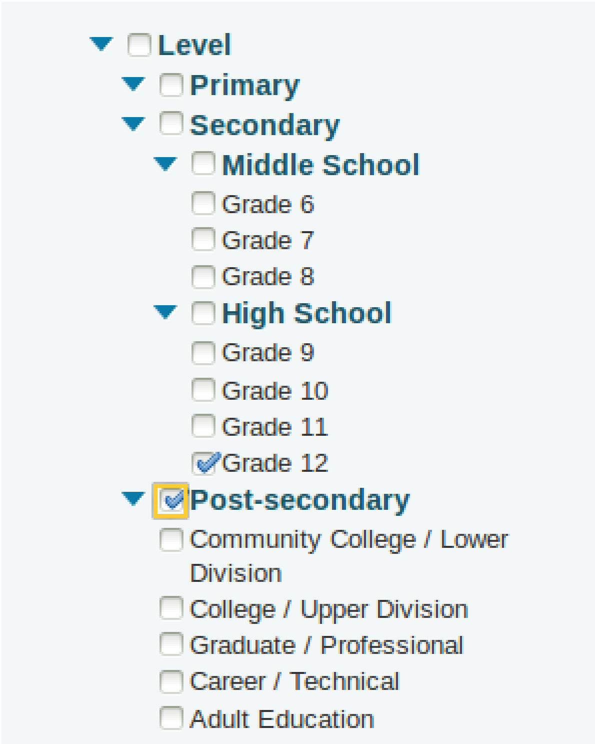


Illustration 19: A flexible approach to learner level (OER Commons)

While Curriki has limited options for educational guidance, it does allow users to search or browse by educational level. It is also possible to search for Instruction Type, which is categorised into the options Activity, Asset, Book, Curriculum or Other (Illustration 20).

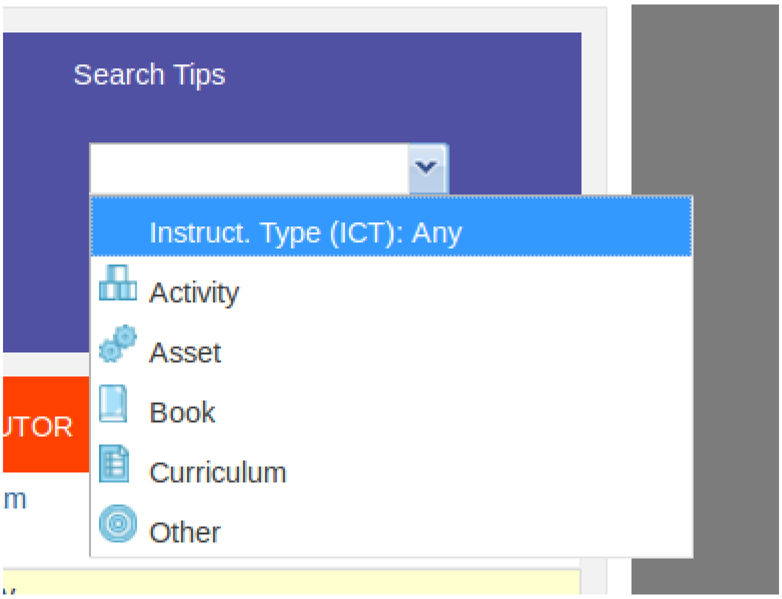


Illustration 20: Filtering by Instruction Type (Curriki)

While other subtypes exist for Instruction Type, it is not possible to filter search results by these sub-types. Search results may not be easy to decipher as they contain information in the form of text and icons determining various levels of data with no clear key (Illustration 21).

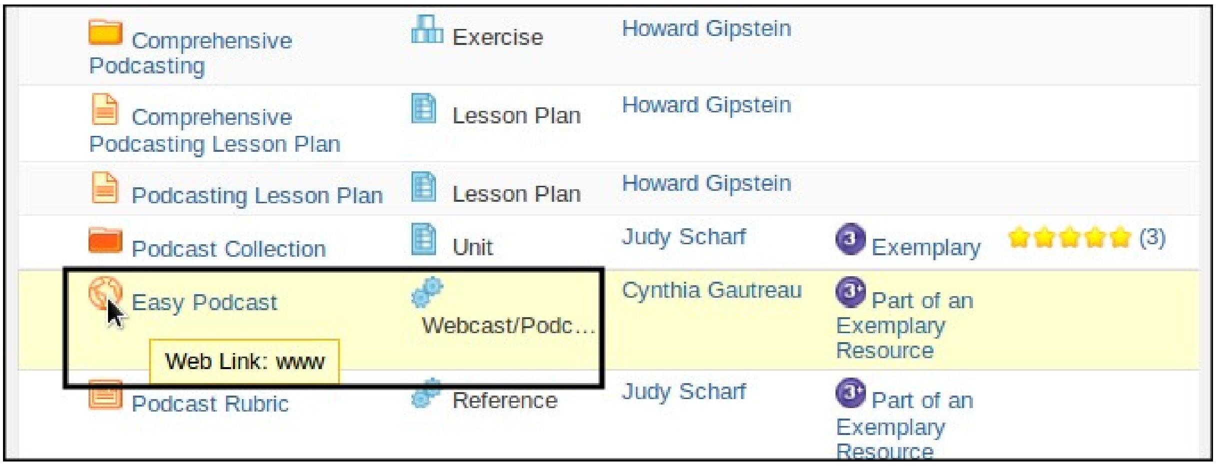


Illustration 21: Combination of icons and text to indicate type (Curriki)

The advance searching and filtering abilities of OER Commons allow a similar but more intuitive process for searching for materials based on criteria for guidance for use (Illustration 22).

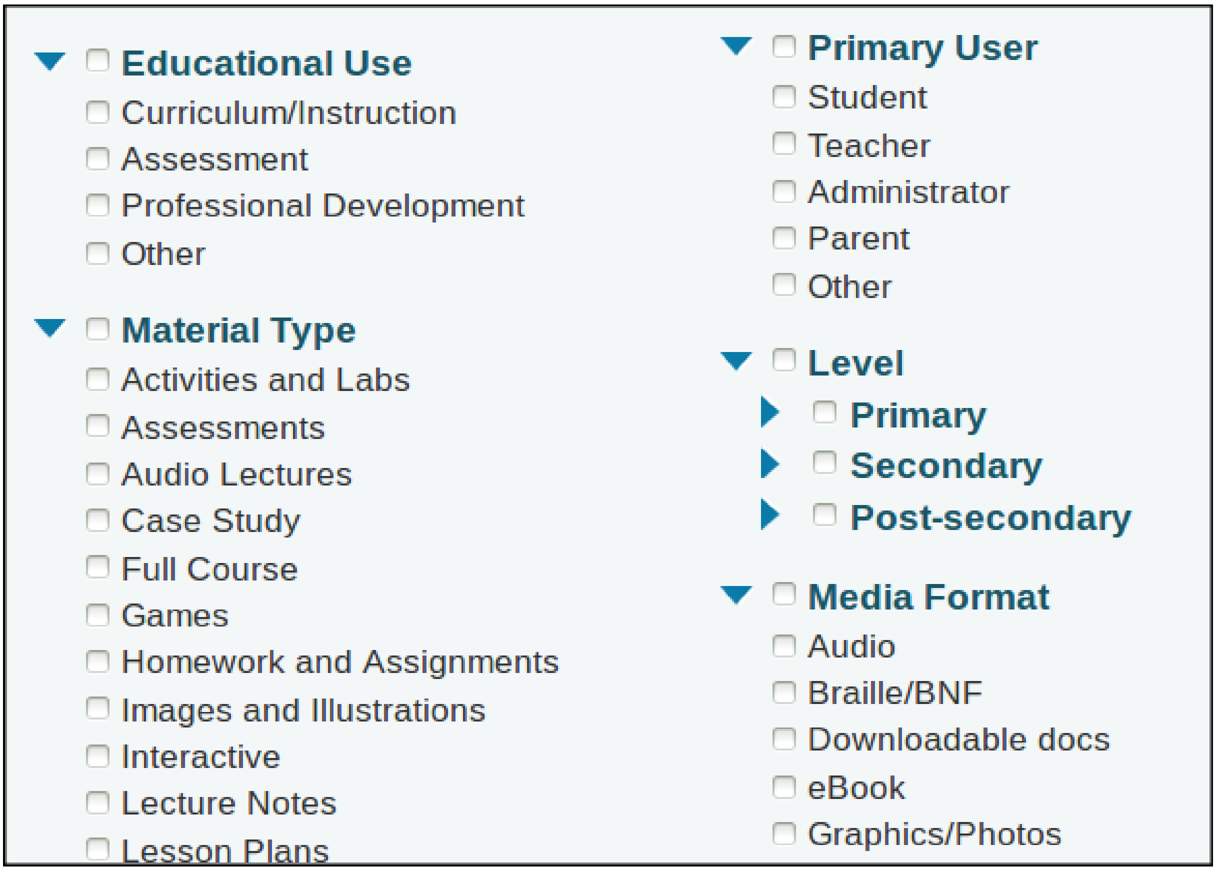


Illustration 22: Flexible approach to searching based on guidance for use (OER Commons)

It is remarkable that while all three examples offer some categorisation based on the kind of resource material, with the exception of the extremely limited Educational Use category of OER Commons, there is no ability to accurately describe the use of materials with reference to either educational theory or to the overall educational purpose of the activities.

4.5 Technical adaptability

4.5.1 Licencing

All content on Open Stax CNX has a permissive Creative Commons Attribution Only licence as default. This decision was a deliberate choice to make the process of reusing and remixing content less problematic (OpenStax CNX, n.d.).

Curriki allows users to choose from a range of licences. In the style of a wiki, Curriki allows other users of the repository to edit and adapt resources in place. This can lead to some confusion when it comes to users accessing information about reuse. Under the information tab of a resource, the

RIGHTS AND ACCESS INFORMATION section can contain seemingly conflicting information (Illustration 23).

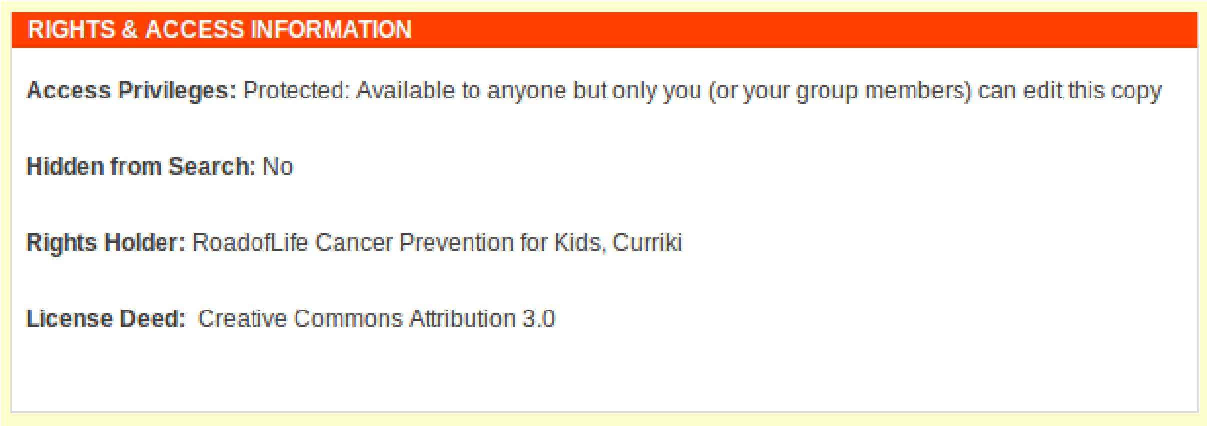


Illustration 23: Rights & Access Information (Curriki)

The Access Privileges shown in Illustration 23 apply only to the technical process of editing the resource on the Curriki site. However, the wording ' *Access Privileges:Protected* could cause confusion around the reuse of this content despite the fact that is is available under a permissive Creative Commons Attribution licence.

OER Commons moves beyond the listing of licences to use categories offering simple guidance on what the implication of the licence are for reuse. The categories are:

- No Strings Attached
- Remix and Share
- Share Only
- Read the Fine Print

Detail and list view pages portray these categories using icons in addition to text (Illustration 14).

Illustration 24 shows how the advanced search has a more granular approach of searching for licences and how the categories listed above co-respond to individual licences.

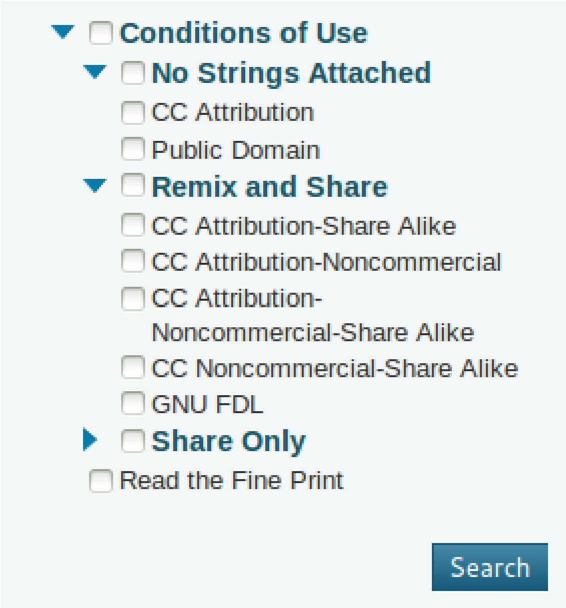


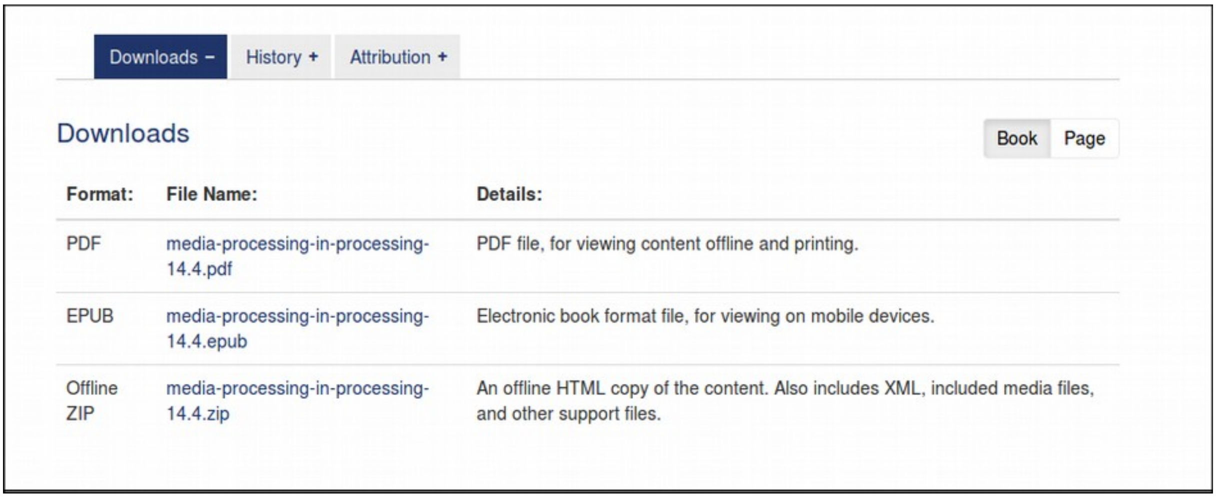
Illustration 24: Advanced search by Conditions of Use (OER Commons)

We can see that while all systems allow the choice of licences which support the 4Rs, only Open Stack CNX forces users to use a licence which supports the full spectrum of openness (Illustration 6). Additionally, we can make a distinction between Curriki which simply allows users to choose a licence and OER Commons which provides greater guidance for use for users who are new to the process of licencing their material.

4.5.2 Formats

While OER Commons and Curriki take an inclusive view of the kinds of format which they allow users to upload and share, Open Stax CNX forces authors to use their online authouring systems or conversion tool. This ensures that all content in the system is in the same interoperable format.

Open Stack CNX organises around two main levels of granularity. A book level or a page/ module level. Books consist of different modules. The strength of this system is that both books and modules can be downloaded as either pdf, epub or zip of html files (Illustration 25). This ability allows users to be able to retain ownership of content if they want to move to another systems, as promoted in Wiley's fifth R, retain. .


Downloads − History + Attribution +

Downloads

Book Page

Format:	File Name:	Details:
PDF	media-processing-in-processing-14.4.pdf	PDF file, for viewing content offline and printing.
EPUB	media-processing-in-processing-14.4.epub	Electronic book format file, for viewing on mobile devices.
Offline ZIP	media-processing-in-processing-14.4.zip	An offline HTML copy of the content. Also includes XML, included media files, and other support files.

Illustration 25: Download format (Open Stax CNX)

The wiki based nature of a Curriki makes it unclear how exactly you would download and adapt them outside of the eco-system of the Curriki website. While the advanced search features does allow you to search by general media type and Instruction Type, there is no way to restrict by encoding type to return only, as an example, genuinely editable text type rather than pdfs.

OER Commons has a large number of different file formats available. This stems from the fact that resources come in from various sites. The View Resource button presents the original source page inside an iframe, for imported resources. As such, much of the material available is not technically suitable for adaptation. It is however possible to filter choices by media format. Filtering by eBook or HTML would be likely to return resources that are easily technically adaptable.

For material authoured on OER Commons, the site uses a system called openauthor. The end result of the openauthor tools is to create a resource that can flexibly be remixed and downloaded in multiple formats including pdf, epub and SCORM packages. It can also be imported into a Google Docs account. This workflow rates highly against an ALMS analysis as both epub and SCORM formats are open and adaptable and there are freely available desktop tools or online tools available to do so.

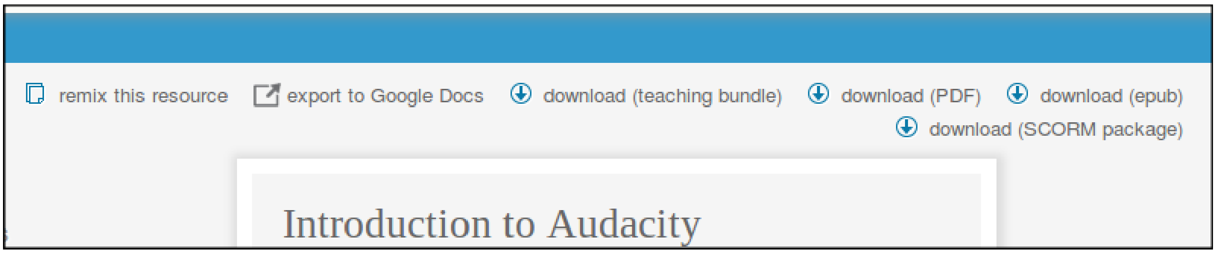


Illustration 26: Formats available for material created on OER Commons

OER Commons strikes a balance between the pragmatism of a system which allows the aggregation and distribution of a wide variety of formats and one which encourages the distribution of material using formats which score well given an ALMS analysis.

4.6 Usability observations from a contributor perspective

The input of data into OER repositories is key to achieving our aims of increased discoverability and providing guidance for use. The JISC infokit on Digital Repositories outlines the need for a “good submission workflow” (McGill, n.d., p. 79).

In terms of submission workflow, Open Stack CNX, the oldest of the systems suffers greatly from over-complexity. There is no “what you see is what you get” (WYSWIG) editor for text content. Image files and other attachments must be uploaded in a separate content tab from the text editor and there is no easy way of integrating these images into the body of text. The process compares badly with the more user-friendly authoring systems which are available for blogging platforms (for example Wordpress) which will be familiar to many self-publishers of OER.

A similar criticism can be levelled at the other parts of the interface of Curriki. As an example, the process for selecting the Instructional Type on the Curriki data entry form is complex. The field consists of a controlled vocabulary of 37 items. While a help page is provided to allow users to read up on the definitions of each type, the sheer volume of choice is a barrier to effective usability.

Additionally, while more than one of the options can be selected, the process involves using a combination of keyboard short cuts and the mouse (Illustration 27).

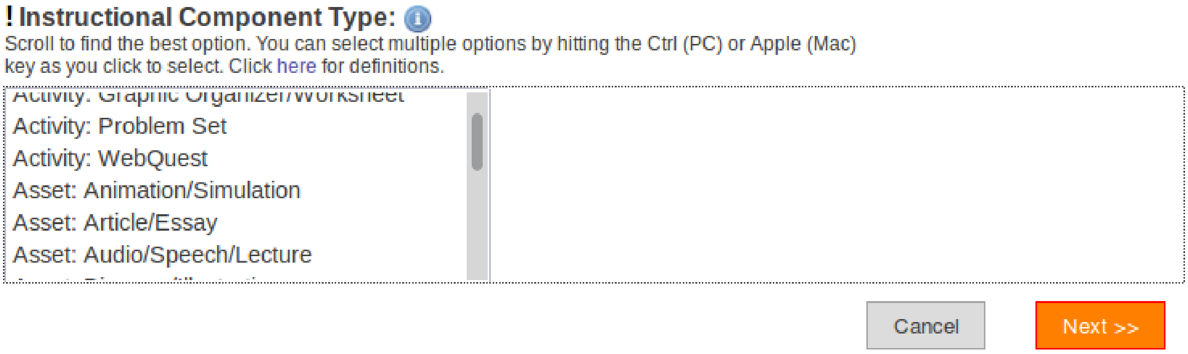


Illustration 27: Selecting controlled lists (Curriki)

The usability of Curriki also falls down when entering information about licences. They are presented in no discernible order and unlike OER Commons (see Illustration 24) no explanation of the significance of the licences is given.

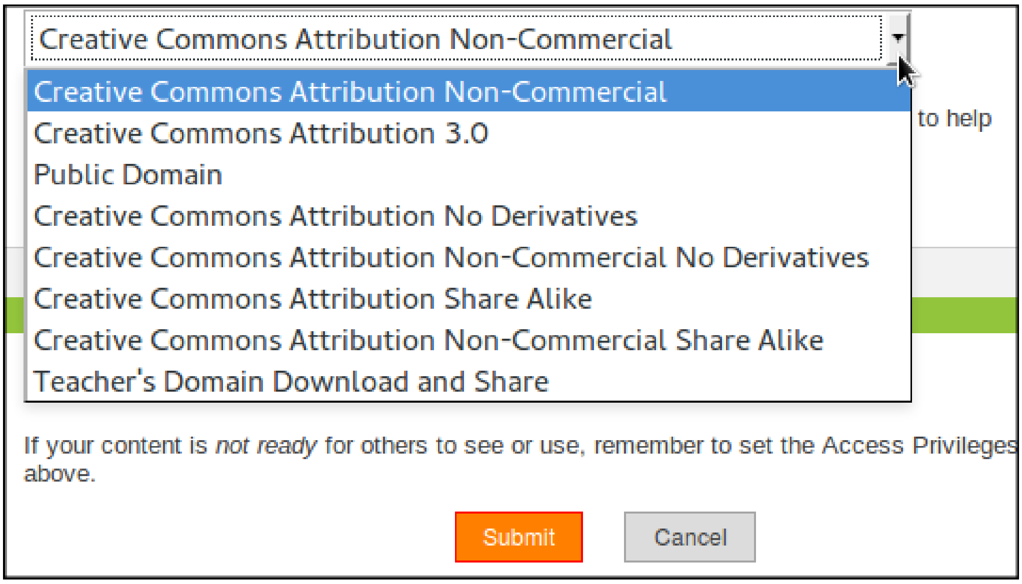


Illustration 28: Entering a licence Curriki

The open author editor used by OER Commons is by far the most advanced and user friendly interface for uploading and authoring of the three reviewed. A detailed summary of its functionality is available as a help page (OER Commons, n.d.).

The process of using open author has three key stages called write, describe and submit. These stages can be navigated using prominent text and icon based menu (Illustration 29).

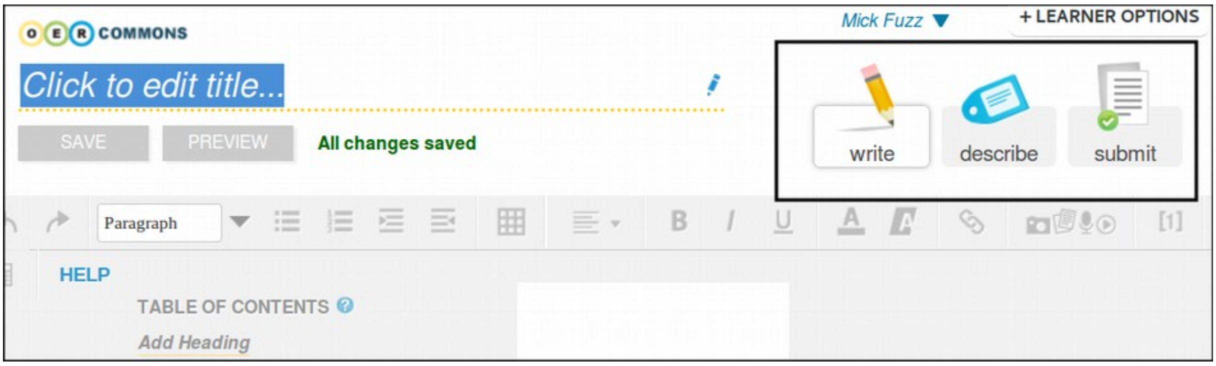


Illustration 29: Open author system (OER Commons)

The write section of the process is similar to a blog system focusing on content. The describe tab allows a detailed description of the learning resource (Illustration 30).

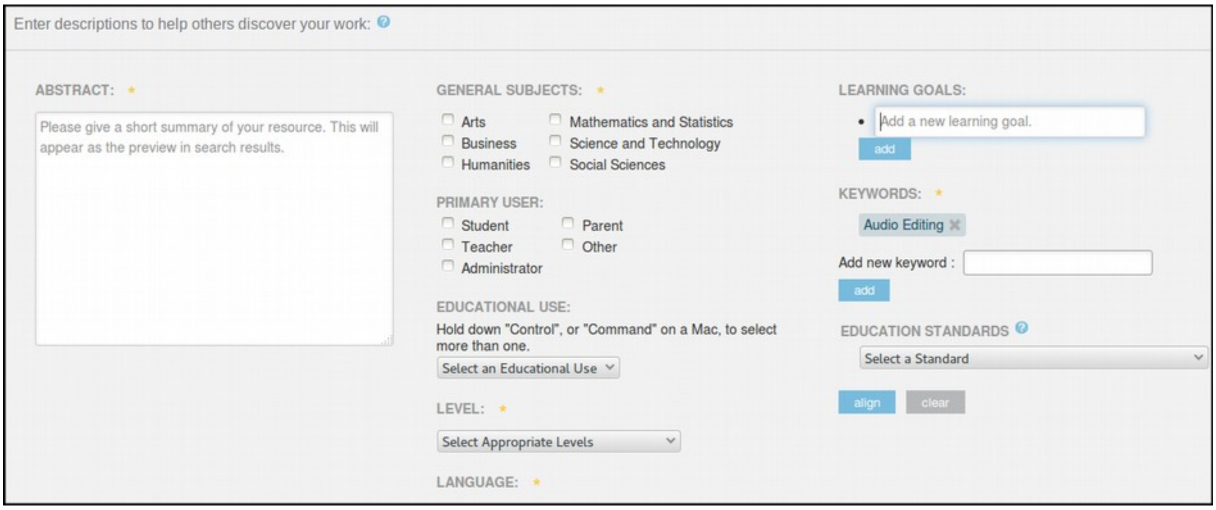


Illustration 30: Describing resources (OER Commons)

This overview shows a screen optimised for larger displays which uses design to minimise scrolling and reduces the overwhelming impact of a long form.

While the form demands a lot of detail, there are certain design techniques which increase usability. For example, the process for entering keywords uses a process known as auto-complete.

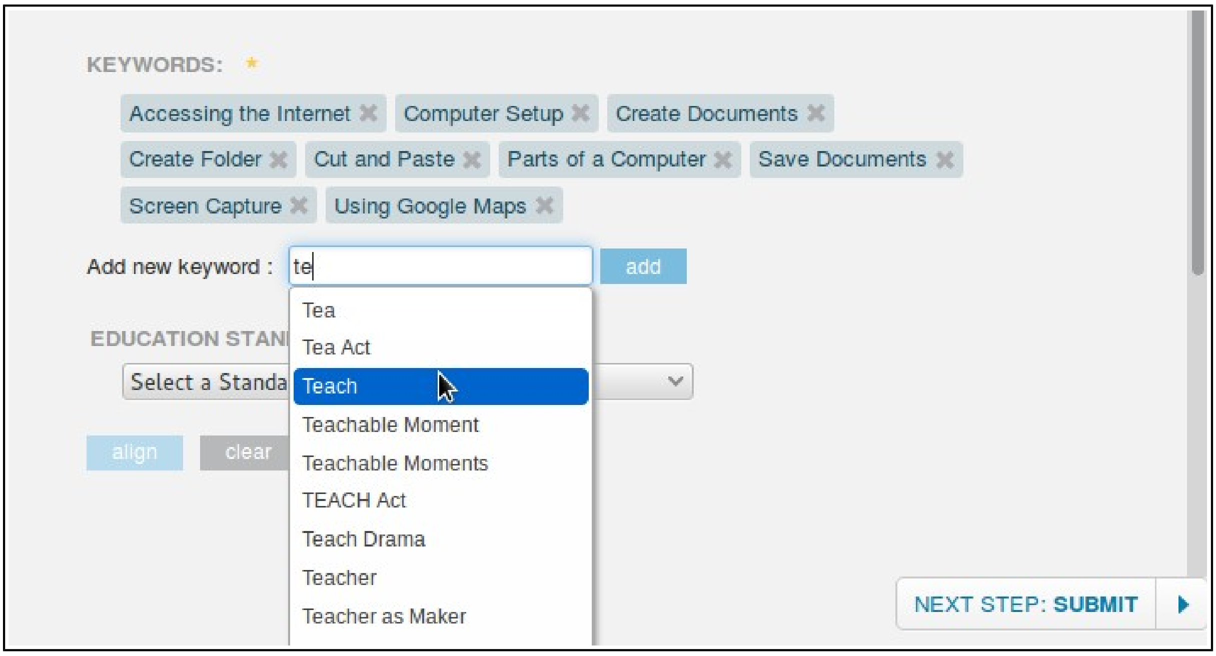


Illustration 31: Entering keywords (OER Commons)

Auto-complete is a common design pattern which is used in a variety of applications especially in the area of web apps. When typing a word the system will take a user's input and compare the first letters to a bank of other words. If and when they match a list of words will be presented to the user to select (Illustration 31).

Auto-complete serves two main purposes. Firstly, it may reduce the amount of typing the user needs to do and thus increase user satisfaction when filling in the input form. Secondly, the words suggested, in this case tags entered by other users of the system, work to normalise user input. Specifically, the process can prevent spelling mistakes or the creation of lots of different ways to describe similar resources.

Controlled lists are dealt with in a similar but slightly different way. When the user clicks into a limited list of options is presented. We can see an example of this in Illustration 32.

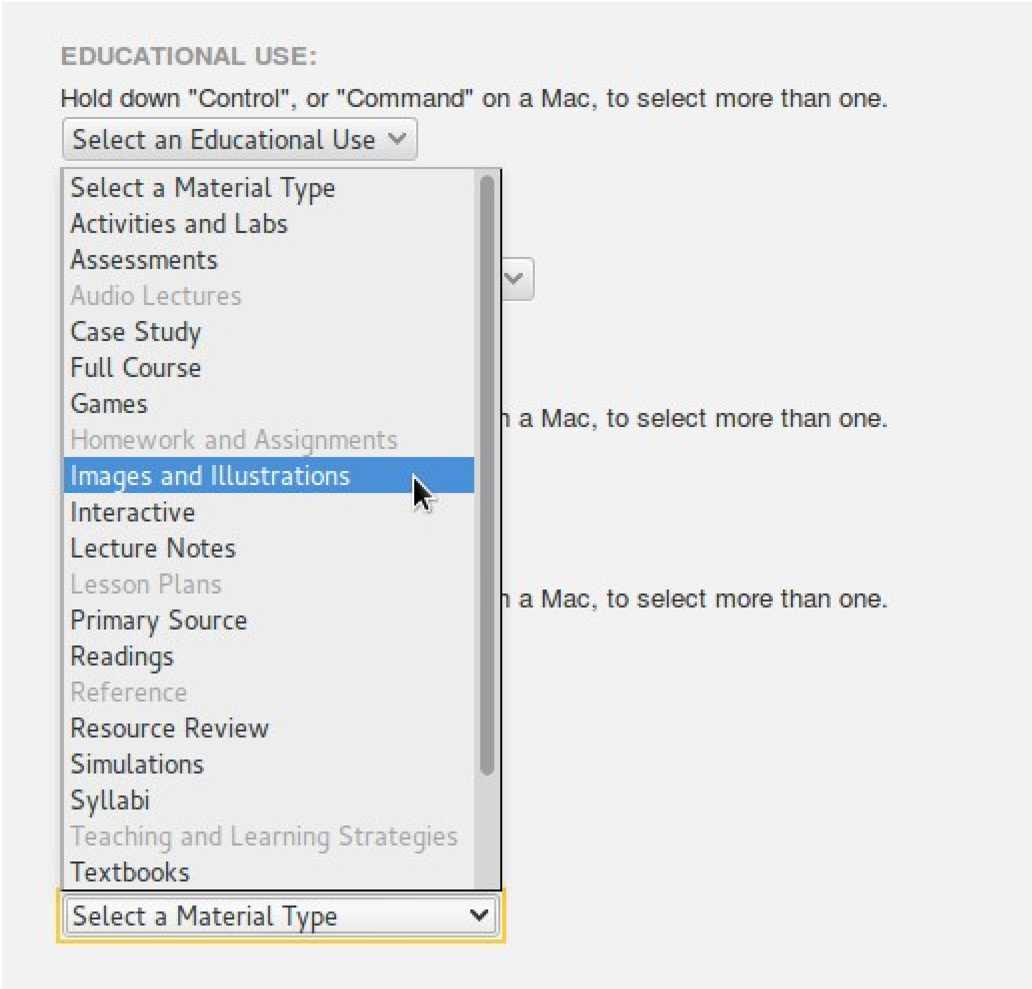


Illustration 32: Controlled list of resource type (OER Commons)

The options that have already been selected are 'greyed out'. When the user clicks on an option it is added to a list above the field.

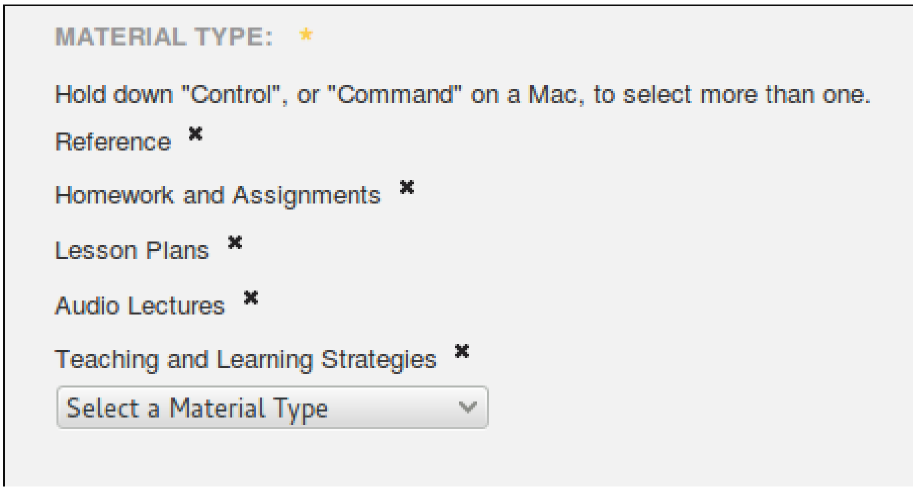


Illustration 33: Choices are easily deleted (OER Commons)

Previously selected options can be deselected by the user clicking the X next to the option (Illustration 33). This process appears far easier to use than the process of selecting controlled lists offered by Curriki, shown in Illustration 27.

The final stage of the three part publishing process is the Submit tab. This screen contains a simple licence chooser tool.

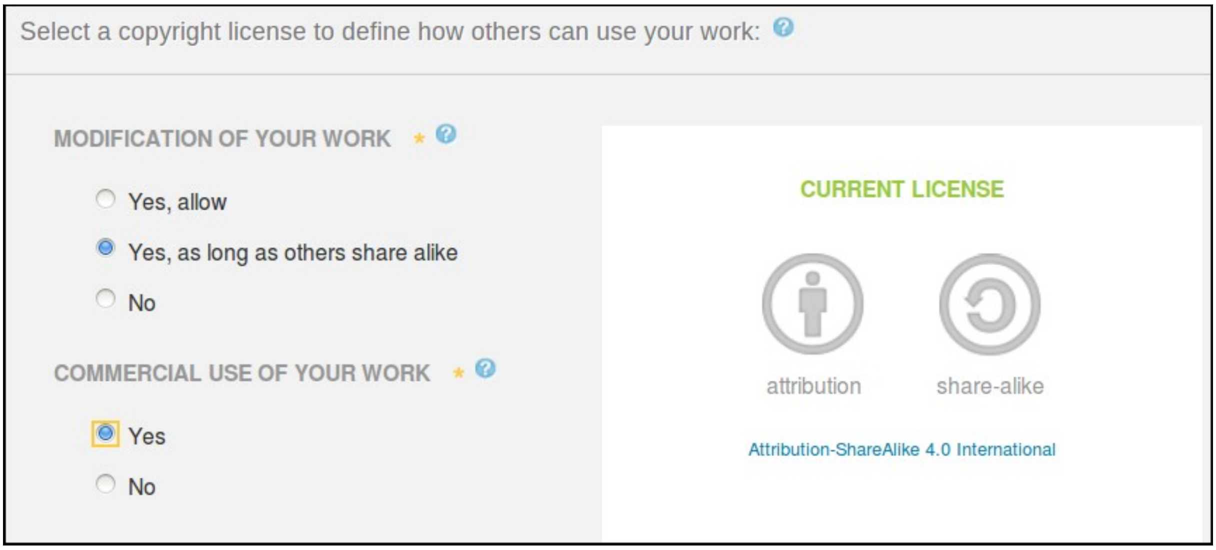


Illustration 34: Creative Commons licence chooser (OER Commons)

Users are asked two questions and a Creative Commons licence is selected based on their responses. This process is shown in Illustration 34.

4.7 Conclusion of review

The review identified several areas of good practice and some areas where current practice seems lacking. Several design patterns emerged from the survey of repositories that we can use to increase the usability of the tool created for our project. Details of decisions on which patterns and practices to adopt are contained in the following section on implementation of the project.

5 Implementation

The research carried out for the literature, technical review and analysis of the three repositories brought to light a wide range of issues and areas of good practice that are relevant to the objectives of the project.

The variety of advanced features contained in the OER repositories reviewed suggests that to replicate all functionality would be very difficult. The process to limit the functionality of the software tool drew on the priorities of the user requirements of the pilot group.

Design and implementation was not a linear process for this project. As an example, the design of the project was not fully completed before investigating and choosing a suitable technology. Implementation has been complex and iterative. It has involved evaluation of technical possibilities and then necessary revision to design based on time limitations and of restrictions imposed by the technology chosen.

For the purposes of this report, it is not appropriate to relay the full complexities of this process. As such, reporting of implementation follows a non-linear, technical compartmentalisation. I have chosen to use the Model, View and Template design pattern used in this project as a framework. Design decisions taken are incorporated into each section. These sections are prefaced by a summary of user requirements and of the choice of technology. Some sections may embark on an explanation of a subject which spans different areas of this Model, View, Template approach due to the intertwining of design and technologies.

5.1 Summary of user requirements

User requirements were gathered in a co-design process which became known as Duct Tape University. The process is covered fully in a separate report (Chesterman and Turley, 2014). This report is available at the following URL: http://blog.ducttapeuni.org/duct-tape-uni-process. This section gives an overview of the resulting user requirements. The chief users of this project were decided in a stakeholder analysis as follows:

- tutors teaching the Do I.T. course at Community Arts North West (CAN)
- learners taking part in the Do I.T. course
- trainers and artists associated with CAN

There was agreement from the pilot group that the tool created to sharing learning resources should have the following qualities:

- be accessible via the web as a website
- allow the uploading of information about materials hosted elsewhere
- allow the downloading of resources without visiting other websites
- allow any user of the web to download or browse the website without authentication
- be usable by course tutors, associated tutors and learners to upload learning materials
- use LRMI metadata to categorise learning materials

Metadata schema was decided by the group in a discussion process which took into account the priorities of data needed for the target groups and issues of usability and cognitive load. A full description of the metadata schema chosen is available in section 5.3. The LRMI and schema.org framework was used as part of the co-design process as a guide to facilitate and accelerate choice of metadata. This was particularly useful concerning decisions surrounding which information to include concerning guidance for educational, technical and legal reuse. The review of OER repositories and literature was another useful source to inform decisions.

NESTA's framework for learning activities, as explored in section 2.2.1 was chosen as the main way to describe educational use. Creative Commons licences were selected for legal reuse and file format type was deemed sufficient to indicate ability for technical reuse.

An example of the implementation of one of the groups choices on learning activity types can be seen in Illustration 35.

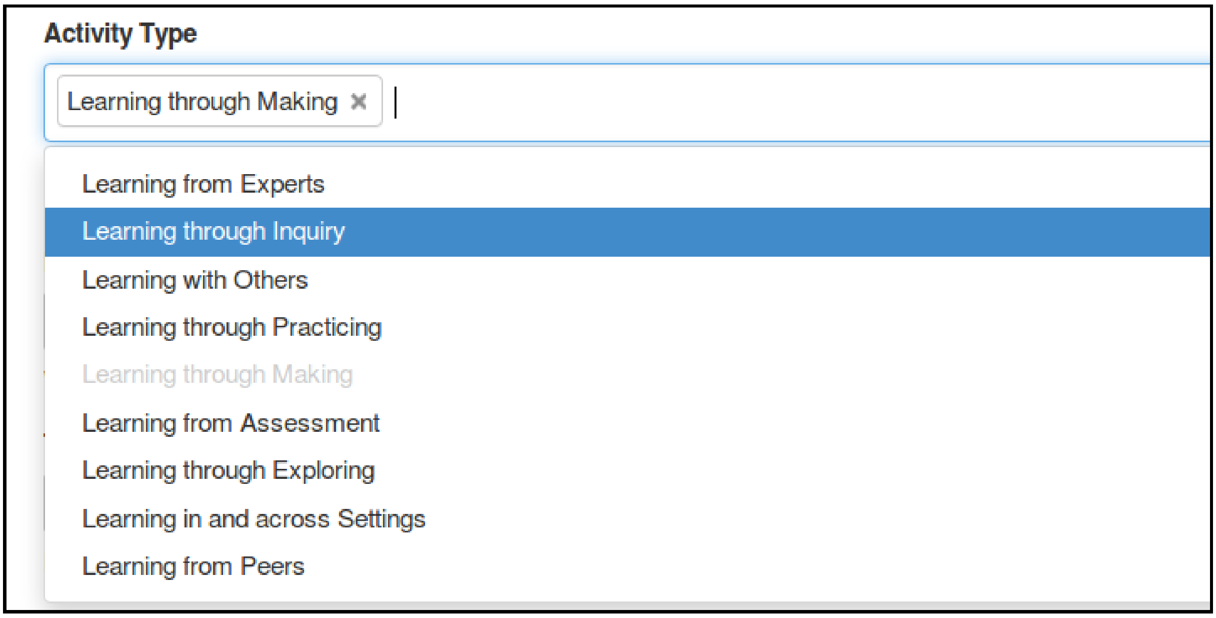


Illustration 35: Group choices for the Educational Use LRMI option

The process of design the tool based on the needs of the pilot group had to be adapted to the limitation of the time of participants. The result was an accelerated co-design process which involved many techniques of community participation and facilitation to maximise the effectiveness of communication between participants.

While the initial co-design process was effective as a way to began to explore issues of

Illustration 36: User-generated sketch of a list view from co-design process

categorising resources to promote guidance for use, there was a strong desire from the pilot group that they should be able to alter certain metadata options as the training course was underway without having to alter the source code of the tool. The process to allow these alterations as part of the Django admin interface is outlined in section 5.3.1.

The use of design patterns that emerged from review were used to guide participants to make informed and realistic choices over design. These design patters are covered in section 6.1. The two design patterns of a list view and design view were chosen as a base for collaborative design activities, some of which took place outside in the streets of Manchester's Northern Quarter. Still of the outputs of these activities are shown in Illustration 36 and Illustration 37.

Further functionality was based on user stories that emerged in the co-design process. The group agreed that here should be no distinct separation between learner and teacher access levels. However, it was acknowledged that some information was more relevant to teachers than to learners and design methods were suggested to avoid cluttering the view of learners.

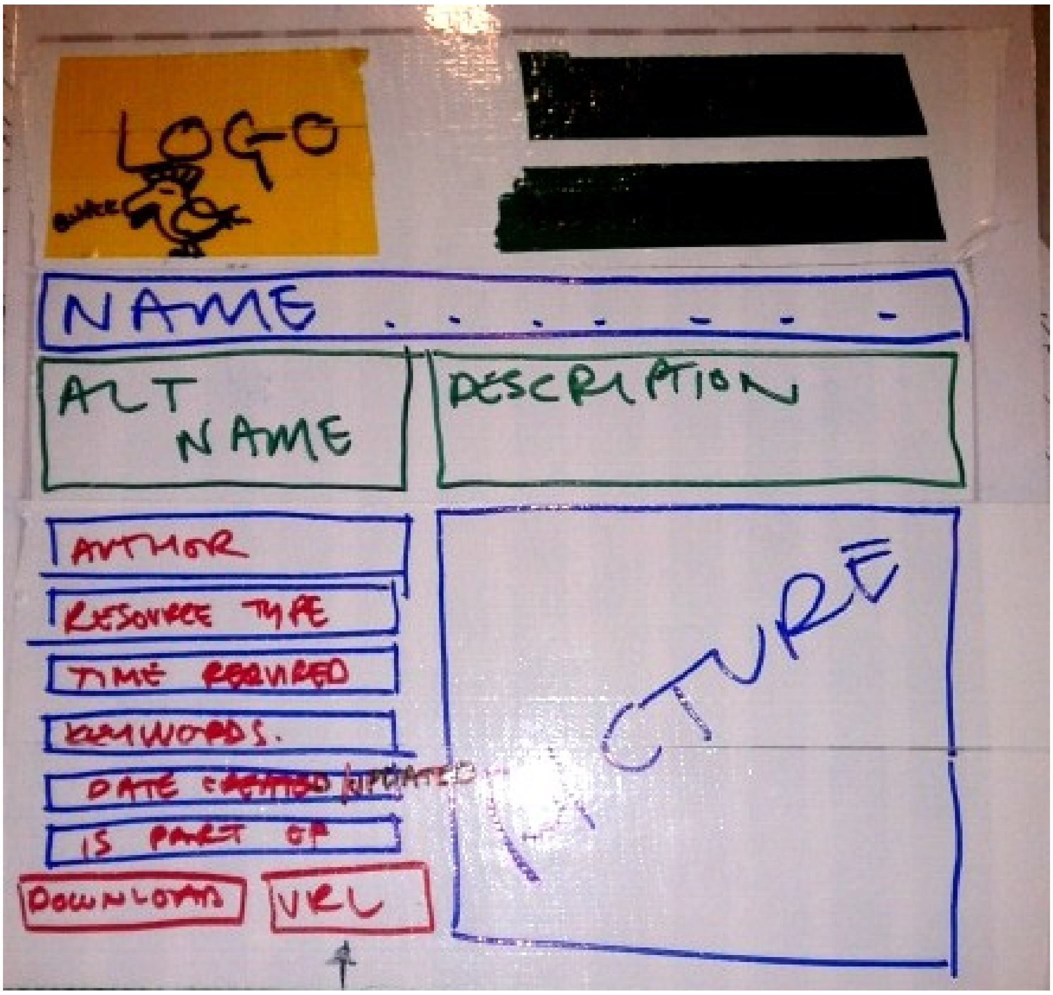


Illustration 37: Extract of detail view design created with duct tape

5.2 Choice of technology

This section details of the specific issues and justifications behind the choice of technology for this project. It also contains a summary of the creation of a development environment and the installation and migration of the project to a production server.

5.2.1 Off-the-shelf or bespoke technology

A key decision to be made was to choose if the end website should be based on an existing content management system (CMS) or built from scratch using a web framework.

Existing CMS products have advantages. One key advantage is that they often exist in a context of a body of users and developers who are familiar with the product. The three products that I evaluated for this project were Moodle, Drupal and Wordpress all of which are used extensively both in Higher Education and across the wider sector. All three products are Free Software and use LAMP server technology, namely: Linux, Apache server, MySql database and PHP scripting language. My evaluation was not particularity deep, but I offer the following summary of some advantages and possible disadvantages as a record of the process.

Using Moodle as a base for an OER repositories would have benefits as many academic departments already use Moodle as a virtual learning environment (VLE). My impression based on a quick review was that the code base was not very pleasant to work with, suffering from being iteratively developed by various authors and projects over time without adequate refactoring.

WordPress is widely used a blogging platform can be used to create more complex websites. It can be easily configured to work as a network of independent websites which share the same code base. Many universities and other educational projects use this network-based blog approach as a way for students to share educational experience and showcase resulting work. Indeed, the pilot group for this project has a WordPress network for participants at http://mcrblogs.co.uk.

Drupal is a CMS which has extensive possibilities to configured to be used by a learning community. It can be adapted to meet needs for different user levels and access to community areas. Drupal has an ecosystem of user contributed modules. One such module offer support for schema.org metadata.

When it comes to extending the functionality of Drupal, beyond installing pre-written modules, Drupal has a reputation of having a steep learning curve for developers. This appears to be because it contains a lot of path-dependency-based design decisions that need to be researched and assimilated.

5.2.2 Justification for the choice of Django framework

For this project I chose to use the Python based web framework Django. Given that Drupal, Wordpress and Moodle are successful products within the sector and could be adapted to fulfil the core objectives of this project, why consider the alternative of developing a new tool?

The decision was mainly due to the issue of path dependencies of existing CMS products. To achieve the aims of the project with any of the three products investigated they would have to have core functionality of the existing code over-ridden. This was problematic on a couple of levels.

Firstly, it presented an unknown in terms of the amount of work that would need to be done. The process of over-riding any one element of a product can be like a 'rabbit hole' in terms of the amount of research and reverse engineering needed to make that particular change or enhancement.

Secondly, as the project is to be assessed as part of a Msc in Computing, basing the project on an existing CMS would make it more difficult to assess than a project which involves coding each line from scratch.

Django is a web framework which uses the python language. Framework in this context means that there is support for many of the common requirements of web applications. This includes a database access API so that you can define object models and database creation and access are automated without the need to write MySql statements.

Django also profits from a healthy eco-system of components in the form of self-contained python apps. The functionality of these apps or packages can be said to be more flexible in the way they can be implemented than the approach of using or writing WordPress plugins or Drupal modules.

The Django community has a system of categorising and peer-reviewing many of the apps suitable for CMS projects.

5.2.3 Django environment

The development environment for this project consisted of the following tools:

- Ubuntu 14.04 Gnome edition
- Eclipse IDE with PyDev plugin
- pip, virtualenv and virtualenv wrapper
- Django 1.6 with built in development server
- SqLite
- Git
- South

This choice of tools was based on a synthesis of two well known Django tutorials (Greenfeld and Roy, 2013; Love, 2009) and my own research and experiences.

I chose not to use a virtual machine approach using Virtual Box for development. The reasoning behind this was that the laptops that I was using did not have enough RAM to allocate memory to a virtual machine and keep core system running smoothly.

The Bitbucket web service was used as a git repository to allow access and synchronisation of code from various development machines.

The use of pip, virtualenv and virtualenvwrapper is common practice for Django development. While, these tools were new to me and took some time to master, they proved to be extremely useful and I outline their function below.

Virtualenv is a tool to abstract the installation of packages into discrete environments. In practices this means that it is possible to have many different versions of python or Django on one machine without conflicts occurring. Virtualenvwrapper is a simple extension which makes the process of creating, managing and swapping between environments easier.

Pip is a command-line package manager for python packages. It works in a similar way to the apt package installer for Debian operating system and facilitates the installing and uninstalling of python apps.

South was the tool with the largest learning curve. It provides a way to abstract alterations to database schemas made necessary by changes to the object models. It resolves a key issue of distributed development, namely the need for a way to represent incremental database changes in text files which can be checked into a revision control system (like git or CVS) and a facility to undo these changes and roll back to a previous database schema if needed.

While Django's built in development server and the use of the configuration free SqLite database were sufficient for testing, the production environment needed to use a more resilient approach as these technologies are not recommended for use in production.

While MySql and other database choices are supported, PostgreSQL is recommended for use with Django by the official documentation other tutorials. Apache was chosen as a server technology as it was already installed on the production server.

Migration from development to production server was helped greatly through the use of git, pip and virtual environments. Django best practice invites each project to create a file called requirements.txt in the base directory of each applications using a pip command.

```
pip freeze > requirements.txt
```

The pip freeze command outputs a list of the python packages installed in the virtual environment. As such, on retrieving project files from the git repository, relevant dependencies can be installed using the following command.

```
pip install -r requirements.txt
```

5.3 Models

This section deals with the area of object models and the metadata schemas for the project. After consultation and co-design process with the pilot group (Chesterman and Hilary, 2014) the schema arrived at is shown in Table 3.

Name in Model	Human readable name	Mapping to schema.org / LRMI
title	Title	http://schema.org/name
alternativeHeadline	Learning outcome in a nutshell	http://schema.org/alternativeHeadline
Description	Description	http://schema.org/description
provider	Creator (author / organisation)	http://schema.org/provider
image	Image	http://schema.org/image
tags	Tags	http://schema.org/about
categories	Category	http://schema.org/about
inLanguage	Language	http://schema.org/inLanguage
learningResourceType	Resource Type	http://schema.org/learningResourceType
educationalUse	Activity Type	http://schema.org/educationalUse
useRightsURL	Licence	http://schema.org/license
timeRequired	Time Required	http://schema.org/timeRequired
educationalRole	Audience	http://schema.org/Audience
interactivityChoices	Interactivity Type	http://schema.org/interactivityType
educationalAlignmentURL	Skills frameworks and Open Badges	http://schema.org/AlignmentObject
isBasedOnURL	Original Source Web Page	http://schema.org/isBasedOnUrl
Media Objects		http://schema.org/encoding
MediaObject.encodingFormat	File Format / Encoding type	http://schema.org/encodingFormat
MediaObject.contentUrl	URL of file / webpage	http://schema.org/contentUrl

Table 3: Metadata schema chosen for learning resource

The process of choosing a schema was made more complex by the level of abstraction needed by the inclusion of the Media, Audience and Educational Alignment objects.

This abstraction is best explained with a concrete example. We can look at the Educational Alignment object as it is relevant to the objectives of this project to include guidance for educational use.

A full implementation of the LRMI Alignment Object would involve users entering the information in Table 4.

Property	Expected Type	Description
alignmentType	Text	A category of alignment between the learning resource and the framework node. Recommended values include: ‘assesses’, ‘teaches’, ‘requires’, ‘textComplexity’, ‘readingLevel’, ‘educationalSubject’, and ‘educationLevel’.
educationalFramework	Text	The framework to which the resource being described is aligned.
targetDescription	Text	The description of a node in an established educational framework.
targetName	Text	The name of a node in an established educational framework.
targetUrl	URL	The URL of a node in an established educational framework.

Table 4: LRMI properties of AlignmentObject

There is a choice available to those using LRMI to choose how deep to go in describing learning resources and associated media objects. This choice is guided by the balance that needs to be struck between the desirability of extended metadata for discovery and the usability of input forms, search options and page templates.

Certain elements of this choice resulted in a level of specialism and detail that was not appropriate for the majority of users in the pilot group. Instead a separate meeting with the training manager was used to create an educational framework to support the course which was published to a webpage.

This process allowed a simplification of the input form to allow users to choose from a restricted set of skill sets from a drop down list. The end result allows the implementation of LRMI data into templates which is covered in Section 5.5.

5.3.1 Converting the metadata schema to object model

Following the choice of metadata schema for our learning resources, there were other choices that needed to be made before being able to create a concrete object model. One such choice was to whether to adopt a folksonomy or taxonomy approach to categorising our resources. This decision applies not only for the 'category' field but also for other metadata fields including educational use and learning resource type.

A folksonomy approach to the input of learning resource type and educational use has the advantage of promoting a grass roots approach to categorisation. The disadvantage however is that our input form would start to become more intimidating and thus reduce the potential usefulness of data entered. This statement is based on an assumption that the more empty fields requiring user input there are in a form, the less likely a user is to fill out any of them.

There are ways of mitigating the users' sensation of apprehension when facing a series of empty data fields. One such technique is to use pre-populated suggestions of popular keywords or other fields. Others relevant techniques are described later in this section.

There also some debate about value of the use of subject categories if content has been indexed to allow for searching (McGill, n.d., p. 77). However, for our project subject categories are required to allow easy browsing of resources. Some repositories reviewed, Curriki in particular, used a comprehensive Dewey-style system nearly 100 subject categories. For our pilot group this approach was not appropriate.

The preferred solution for this project was to work with the pilot group to create an initial restricted set of choices for the fields of category, learning resource type, and educational use. The admin area of the tool was modified to make it easy for the group to modify these choices. This allows them to tweak choices based on their experience and feedback from other users of the tool.

Critics of this approach may suggest that it would reduce interoperability between repositories if each similar project were to choose their own category choices. However, interoperability is not a priority for this use case. Indeed, restricted formal subject taxonomies have had little impact for self-published 'little' OER. Problems of interoperability may be also mitigated with the use of Schema.org and LRMI to aid discovery via distributed search tools as detailed in section 6.5.

A folksonomic approach to describe resource subject was included in the form of 'tags'. Users are able to enter any number keywords or phrases into the Tags field. In this way, the community of users are able to shape the way resources are described.

5.3.2 Implementation of restricted choices and free tagging

Tagging is a well known pattern for many systems and was tackled with the well used app django-taggit. Its use in input forms in explained more in section 5.5.

```
LICENCE_CHOICES = (

(CCBY, 'No Strings Attached'),
(CCBYND, 'Share only'),
(CCBYSA, 'Remix and Share'),
(CCBYNCSA, 'Non-commercial use'),
)
LICENCE_CHOICES_DEFAULT = CCBYSA

ACTIVE = 'Active'
EXPOSITIVE = 'Passive'
MIXED = 'Mixed'

INTERACTIVITY_CHOICES = (
    (NOTSET, ''),
    (ACTIVE, 'Active'),
    (EXPOSITIVE, 'Passive'),
    (MIXED, 'Mixed'),
)
INTERACTIVITY_CHOICES_DEFAULT = NOTSET
```

Illustration 38: Tuples showing choices unlikey to change in models.py

For choices that are unlikely to change, lists of choices are defined in the code of the models file as python tuples. Examples can be seen for choices concerning licences and interactivity in Illustration 38.

The fields containing choices concerning resource type and educational use and educational alignments all needed to be able to be changed as the project progresses. As such, they are editable via the admin interface. In order to achieve this they were abstracted as separate objects in the schema. A simplified UML class diagram shows how this was done in Illustration 39. The name of the app created is 'dturead'. (taken from the working title of the pilot project Duct Tape University).

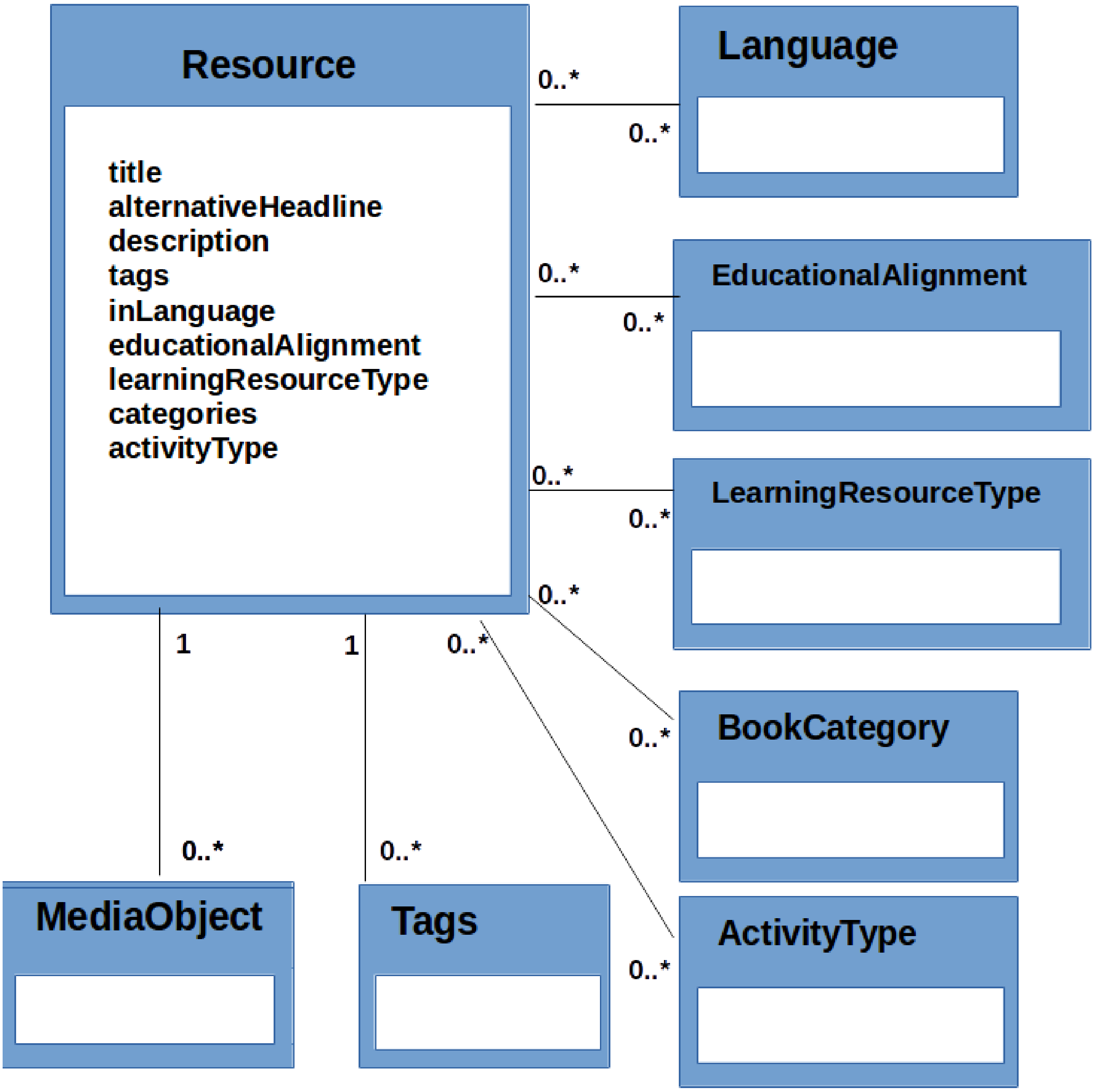


Illustration 39: Simplified UML class diagram showing relationships of the dturead app

Each abstracted object has a separate form on the default admin application as shown in Illustration 40. Project members with administrator access can click on the create button next to relevant section to quickly add, edit or delete existing choices.

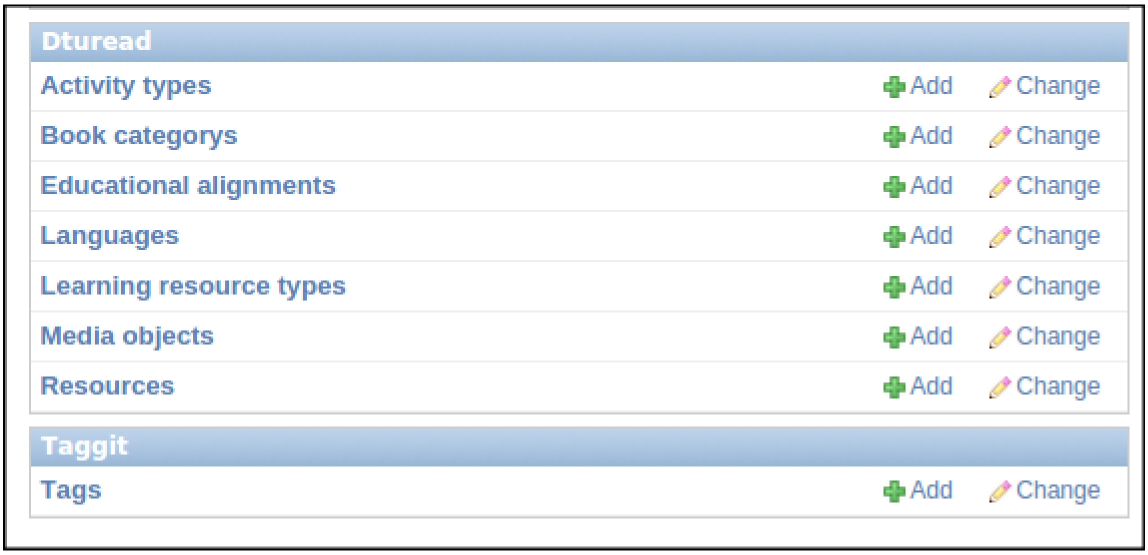


Illustration 40: Screenshot showing abstracted objects in admin interface

5.4 Views

Views in Django take information contained in models and process it ready to be presented in templates. By convention this happens in a file called for views.py. A complete copy of the relevant view.py file for our key app 'dturead' is included in Appendix 8.3. The same process happens when we prepare specialist forms for data entry and editing but the file in question is called forms.py. This file is also included in Appendix 8.3.

The process of the implementation of views and forms aimed to follow good practice for Django coding (Greenfeld and Roy, 2013). A full discussion of the decisions involved in implementation of this project is beyond the remit of this report. Instead, I have selected several key issues which were encountered and summarised the issues and their resolution.

5.4.1 Use of Class-based views

The move of the wider Django community from 'function-based views' to 'class-based views' can be understood of a maturing of certain common design patterns used in web-pages coupled with additional functionality and documentation (Greenfeld and Roy, 2013). The community recommends that developers move away from writing bespoke function-based views towards more generic class-based views as a way of reducing the amount of code they would have to write and increasing the ease of the reuse and readability of their code.

Class view are based around using an object type as a base for certain design patterns. As an example we can look at the Book object of our project. For reasons of path dependency due to following Django documentation learning resources are represented in the code of this project as “Books”.

Generic class views exist in Django to display a list of objects of similar type and to display a detail page for a single object (Django Software Foundation, 2014a). Both of these patterns correlate with patterns found in our review of OER repositories.

For our project the process of writing a view for the page that displays a list of objects was as simple as writing two lines of code (Illustration 41).

```
from django.views.generic import ListView
from .models import Book

class BookListView( ListView):
    model=Book
```

Illustration 41: Generic List View in Django

We can see that a generic list view and the relevant model is imported into the view.py file and a new specific view is defined using the imported model the base. The corresponding entry in the urls.py file of the 'dturead' app is simply:

```
url(r'^$', views.BookListView.as_view(), name = "list" )
```

When following this pattern a template file should be included in the templates folder of the relevant app with the name based on the model and a suffix of _list.html, so in this case *book_list.html*.

In many cases the generic class view cannot achieve all of the functionality needed for our application. This is shown in the example of form views in section 5.4.2 . Another example of this is the adaptation of the generic list view to create a view of resources by category as shown in Illustration 42. We can see that the location of the template has to be manually specified and the get_queryset function of the generic ListView is overridden filtering to retrieve only resources identified by a particular category type passed in through a URL argument.

```python
class CategoryList(ListView):
    queryset = BookCategory.objects.all()
    template_name = "dturead/book_list.html"
    paginate_by = 10

    def get_queryset(self):
        """
        Include only entries tagged with the relevant category
        """
        return Book.objects.filter(categories__slug=self.kwargs['category'])
```

Illustration 42: Adapted list view for a list of resources by category type

The level of support for class based views from the community is such that functionality extending generic views can often be found in mature standalone django apps. Examples which are used for this project include django-braces (used for user access) and django-extra-views (used to support inline forms to add MediaObjects shown in Illustration 44).

5.4.2 Model Forms

For our target group the default input form of the admin app did not have a high enough level of usability. The decision to create a custom form increased the amount of innovation and research needed to complete the project considerably. Indeed, this area represents the main area of innovation in terms of coding and design of this project.

There is a similar process to class-based views which can be applied to the use of custom forms known as 'Model forms' (Django Software Foundation, 2014b). The syntax is very similar to that of class-based views. An extract of the relevant forms.py file is shown in Illustration 43. This demonstrates how a ModelForm view can be customised so that certain fields can be excluded and the order of fields of forms altered.

```python
from django import forms
from django.forms import ModelForm
from dturead.models import Book

class BookForm(ModelForm):

    class Meta:
        model = Book
        exclude = ('slug', 'isVisible',)
        fields = [ 'title', 'alternativeHeadline',   'tags',
                  'categories', 'description',
                   'image' , 'useRightsURL', 'inLanguage',
                  'timeRequired', 'learningResourceType', 'educationalRole',
                  'interactivityChoices' , 'educationalUse' , 'provider' ,
                  'isBasedOnURL', 'educationalAlignmentURL'  ]
        widgets = {
            'description': Textarea(attrs={'cols': 80, 'rows': 10}),
            'isBasedOnURL':forms.TextInput(attrs={'placeholder':'http://' }),

        }

        help_texts = {
            'description': _('Please enter as complete a description as possible'),
            'tags': _('Enter Tags to describe the subject resource in keywords.'),
```

Illustration 43: Model form showing customisation of field order

This form is implemented in a view called BookFormCreate. The process is shown in Illustration 44.

```python
class BookFormCreate( CreateWithInlinesView):
    model = Book
    form_class = BookForm
    inlines = [MediaObjectInline]
    template_name = 'dturead/book_inlineformset_4.html'

    def get_success_url(self):
        return self.object.get_absolute_url()
```

Illustration 44: View incorporating a Model form

5.4.3 Adding Search capabilities

Search capabilities were added to the application using a combination of django-haystack and whoosh apps. This process was not straightforward, however adequate instructions for replication can be found on the relevant documentation website (Lindsley, 2013).

A simple process for filtering search results was implemented for the end project. Illustration 45 shows the results of a search for 'wordpress' filtered by the resource type of 'full course'.

While this search page implements the functionality requested by the target group, there is room to improve the usability and visual design of the end result.

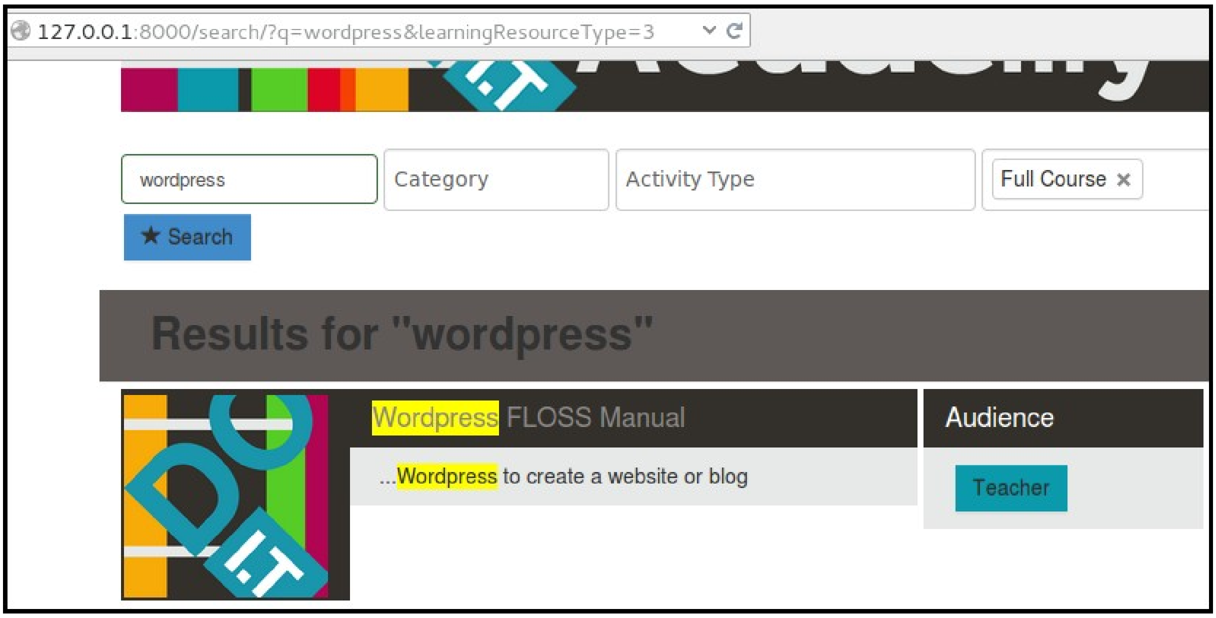


Illustration 45: Search results filtered by resource type

5.5 Templates

Django uses Templates a way to separate logic and data processing from presentation in web pages. Django passes information from the database, through views and forms and by the time it gets to templates all data should be ready to wrap in relevant HTML, css and javascript to create the end web page. As such, in this section the main focus is on the user experience and design.

5.5.1 Use design to maximise metadata entry

The process of encouraging users to enter as much data as possible is a challenge which is faced in many situations. We noted previously the tension between the inclusion of metadata to allow searching by attributes and the negative effect that a large input form has on user experience.

The review of OER repositories in section 4 showed a variety of techniques used in web-forms to allow users to enter metadata. While further testing is needed, some techniques emerge as being more usable and intuitive than others. Certain techniques to increase usability of forms were prioritised for implementation in this project. These include auto-complete, tooltips and suggested keywords which can be replicated to aid user input of metadata in input form fields. This section details the specifics on these techniques and the technical details of how they were implemented in the project website.

5.5.2 Adding custom helper text in forms

The process of helping users enter data often includes giving extra information beyond a simple label of the name of the metadata field. This text is often referred to as helper text or as placeholder text if it is located inside the field of the form. Illustration 46 shows placeholder text (1) and helper text (2).

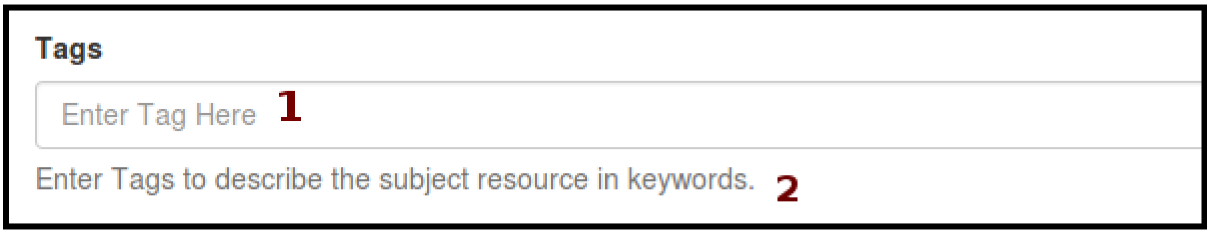


Illustration 46: Placeholder text (1) and helper text (2)

A key aim for the implementation of this area of the project was to create a structure in the forms.py file of the application that allowed a flexibility of approach to add helper and placeholder text when appropriate.

There are several ways to implement labels, helper texts and placeholders using Django. My intention with this project was to follow as closely as possible to standard Django practice as recommended by common tutorials in otder to make code reuse easier. However, the level of complexity needed for some of the javascript based solutions required that I use a couple of approaches.

Firstly labels and helper texts could be easily overridden for most fields via in the "class Meta" section of our model form (Django Software Foundation, 2014c). This is shown in Illustration 47.

```
widgets = {
    'description': Textarea(attrs={'cols': 80, 'rows': 10}),
    'isBasedOnURL':forms.TextInput(attrs={'placeholder':'http://' }),

}

help_texts = {
    'description': _('Please enter as complete a description as possible'),
    'tags': _('Enter Tags to describe the subject resource in keywords.'),
    'isBasedOnURL': _('The webpage of the source document or the original from which a copy was made'),
    'alternativeHeadline': _('<a id="popoverData2" class="btn" href="#" data-content="Learning Outcome"
    'timeRequired': _('How long will the activity take?'),
    'educationalRole': _('Who is the main audience for this material?'),
    'interactivityChoices': _('What kind of interactivity will happen?'),
    'provider': _('Who created the resource?'),
    'image': _('An image of the material or associated with the resource'),

}

labels = {
    'alternativeHeadline': _('Learning outcome/s in a nutshell'),
    'image': _('Subject Tags'),
    'image': _('Image of resource'),
```

Illustration 47: Placeholders, helper texts and labels in class Meta in forms.py file

The technique shown in Illustration 47 did not work for the abstracted objects of our data model including the elements of language, resource type and others shown in Illustration 39. These helper texts which relied on the Select form widget need to be overriden via the __init__ function. This process is described as overloading Django form fields (Greenfeld, 2013). It is shown in Illustration 48.

```
def __init__(self, *args, **kwargs):

    self.base_fields['learningResourceType'].help_text = 'Type of learning material'
    self.base_fields['categories'].help_text = _('Choose what section the resource will appear in')
    self.base_fields['inLanguage'].help_text = _('Select language of resource')
```

Illustration 48: Overloading Django form fields

5.5.3 Auto-complete for keywords

Our project implements an auto-complete solution as a way to increase the usability of the input form and reduce many different but similar keywords being entered. As an example, if we were to add a resource on web design and were asked to enter tags to describe the resource, many different variations could added to the system by users in many ways including:

- web design
- webdesign
- webpage design
- webpage creation

- webpage designing
- web designing

The project website aims to improve this situation by using the auto-complete solution. As shown in Illustration 49, when a user types in the Tags box a list of words in the tags database are shown in a drop down list.

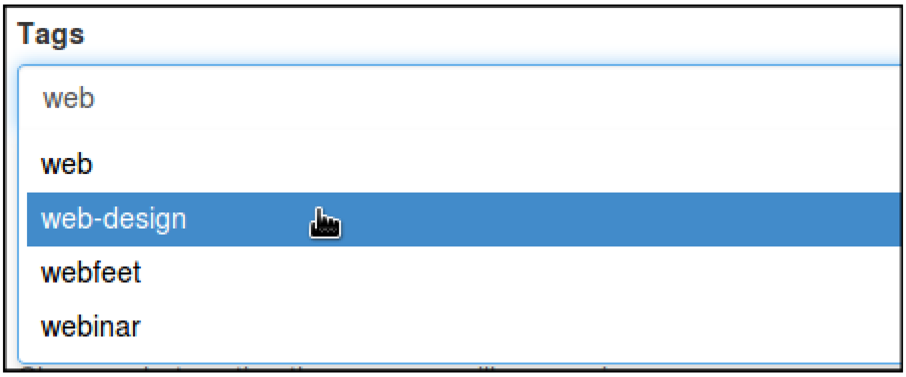


Illustration 49: Autocomplete on the Do I.T. Academy input form

When the user clicks on a selection from the list, the selection is shown in the tag box. It can be deleted if the user clicks on the x next to the term, as seen in Illustration 50.

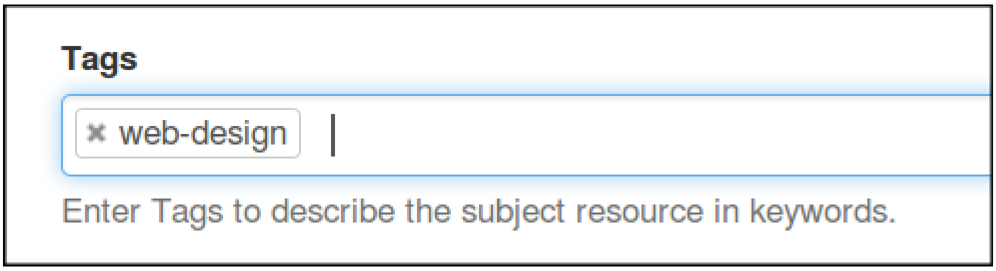


Illustration 50: Users can delete tags easily

This feature was implemented using django-taggit and another app called django-taggit-autosuggest-select2. One of the advantages of this approach is that there was already work done on css to harmonise the look with other parts of the input form.

5.5.4 Creating usable drop down multi select choices

The default way that Django admin forms encourage the selecting more than one option as shown in Illustration 51 has serious drawbacks in terms of usability as explored in section 4.6.

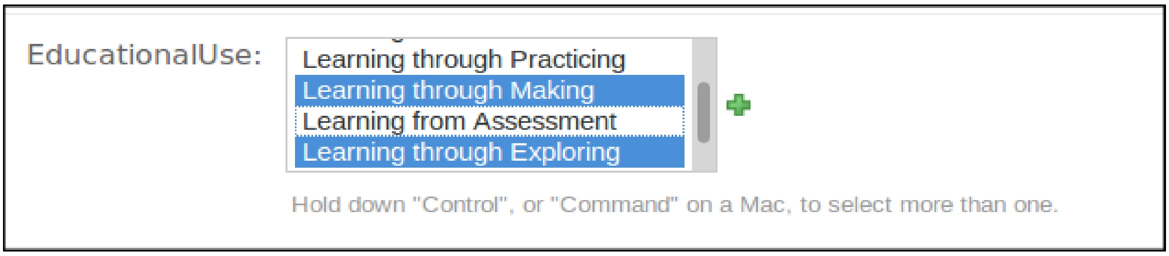


Illustration 51: Selecting multiple choices in Django admin interface

Initial research showed that a jQuery approach was suggested to overcome this problem. Further research uncovered a combination of a javascript library called 'chosen' in combination with another app called crispy forms. Crispy forms provided way of creating custom forms which allowed the creation of a form helper which enabled a css class to be passed to specific fields.

When options are selected they are shown within the Category field again with an 'X' to allow de-selection. This is shown in Illustration 52

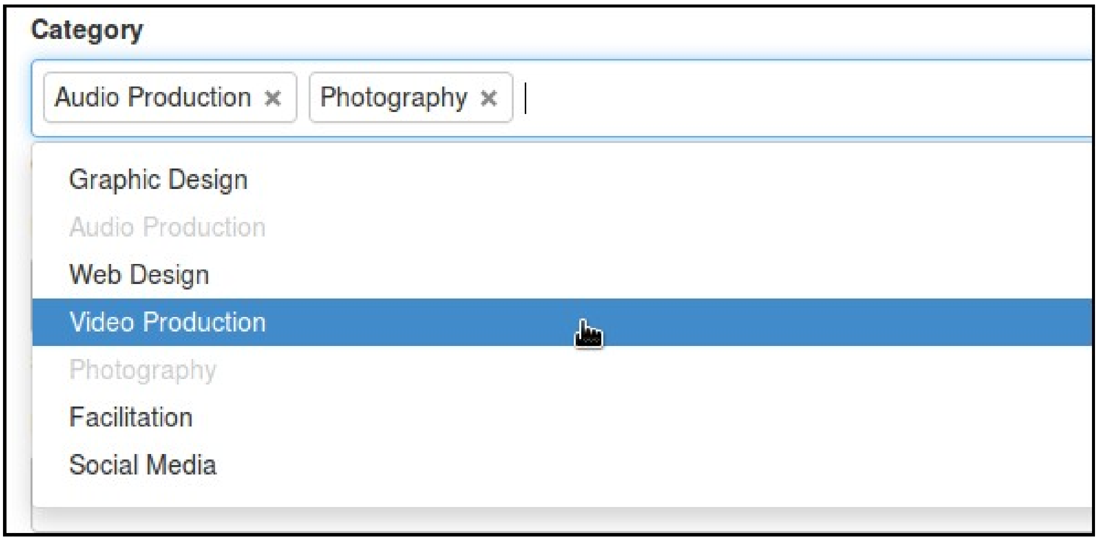


Illustration 52: Chosen and crispy-forms for controlled lists

5.5.5 Adding LRMI data to templates

The process of adding LRMI to web pages can be done in several ways. This project chose microdata as it appears to be the option favoured by Google and there are several tools which can be used to test output.

There are already good guides which cover the process of adding microdata to web-pages so this section will concentrate on specific examples of microdata mark up rather than giving an exhaustive guide. Illustration 53 shows how LRMI elements can be added to Django templates.

```
{% for a in book.mediaobject_set.all %}
    <span itemprop="encoding" itemscope="" itemtype="http://schema.org/MediaObject">
        <a class="btn btn-danger" href="{{ a.contentUrl}}">
            <span itemprop="encodingFormat"> {{ a.encodingFormat}}</span>
        </a>
    </span>
{% endfor %}
```

Illustration 53: Implementation of LRMI Media Object in Django template

The resulting HTML is shown in Illustration 54.

```
<span itemprop="encoding" itemscope="" itemtype="http://schema.org/MediaObject">
  <a class="btn btn-danger" href="http://en.flossmanuals.net/_booki/wordpress/wordpress.epub">
    <span itemprop="encodingFormat">epub</span>
  </a>
</span>

<span itemprop="encoding" itemscope="" itemtype="http://schema.org/MediaObject">
  <a class="btn btn-danger" href="http://en.flossmanuals.net/_booki/wordpress/wordpress.pdf">
    <span itemprop="encodingFormat">pdf</span>
  </a>
</span>
```

Illustration 54: HTML output of 2 media objects with LRMI microdata markup

I requested feedback for an initial implementation of LRMI on the mailing list of the LRMI working group and received useful feedback (Barker, 2014c).

Further testing of the implementation was performed using the suggested tools of Microdata Reveal chrome plugin and the Structured Data Testing Tool. A screenshot containing an extract of the output of the Microdata Reveal chrome plugin is shown in Illustration 55.

dateModified:	08/30/2014
encoding:	*ITEM 1*
description:	ELL students can use podcasting as a way to demonstrate the skills they are developing as well as provide a way to reach other ELL students who may be encountering similar (difficulties).
image:	
educationalUse:	Learning through Inquiry
audience:	*ITEM 2*
author:	OER Commons
isBasedOnURL:	https://www.oercommons.org/
educationalAlignment:	*ITEM 3*
interactivityType:	Active
inLanguage:	English
dateCreated:	08/30/2014
license:	http://creativecommons.org/licenses/by-sa/4.0/
ITEM 1	
type:	http://schema.org/MediaObject
properties:	
encodingFormat:	pdf
ITEM 1	
type:	http://schema.org/MediaObject
properties:	
encodingFormat:	epub
ITEM 2	
type:	http://schema.org/EducationalAudience

Illustration 55: LRMI output shown in Microreveal chrome plugin

A full breakdown of the technical implementation of LRMI for the project website is given in Appendix section 8.1.

6 Conclusion

6.1 Results of website production

At the time of writing the tool is in use by the pilot group at the following URL http://doitacademy.flossmanuals.net. The source code used and a small sample data set used for testing is included in the DVD attached in Appendix 8.3.

The design of website resource was based on feedback on three main views of detail, list and front page. The front page view features graphics representing 6 random choices of the fixed subject categories to allow for browsing of resources. The front page design is shown in Illustration 56.

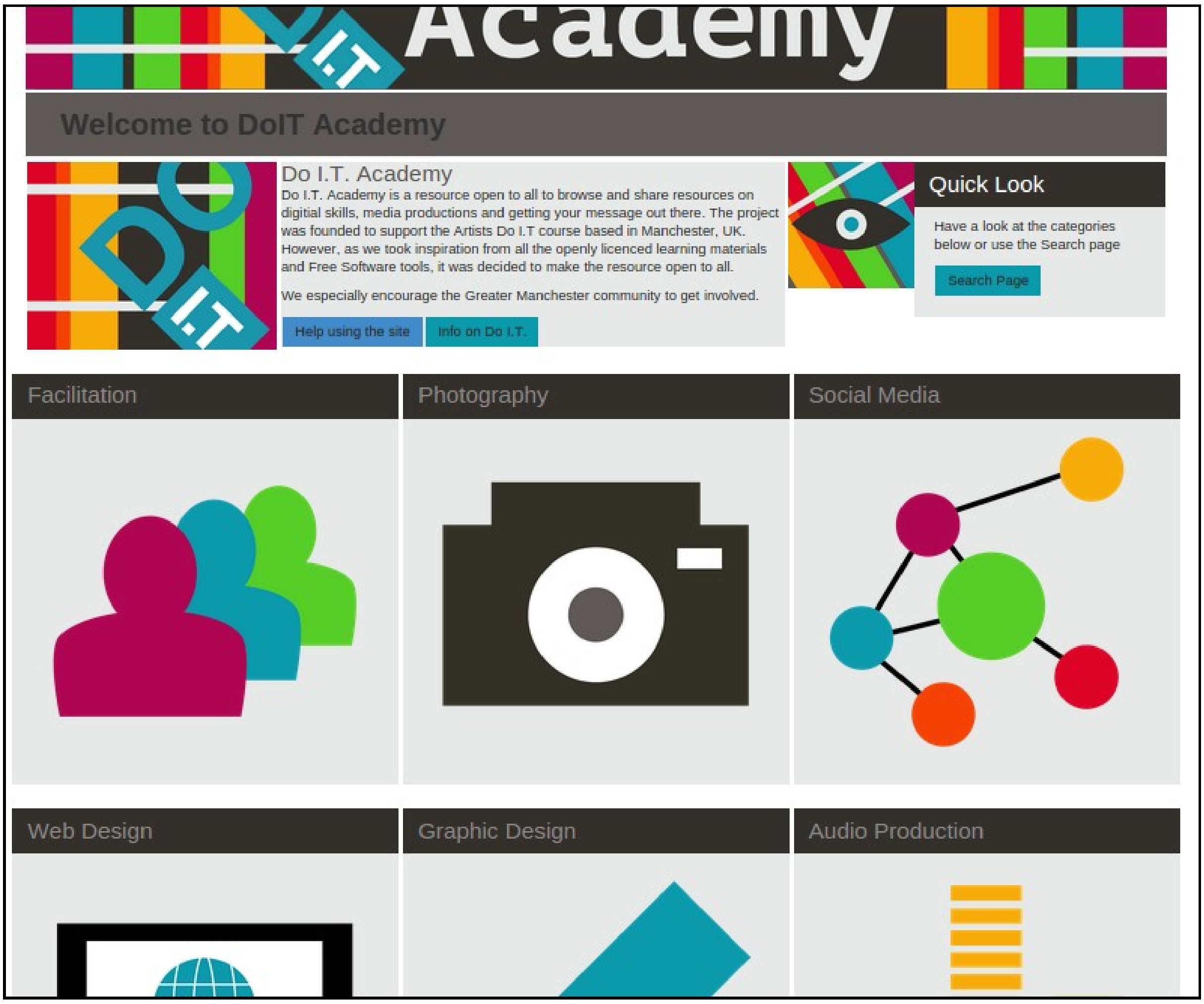


Illustration 56: Design of front page

When users select a category or perform a search they will be presented a list view which contains a list of compressed contents of relevant resource items. The list view is shown in Illustration 57.The implementation of the view of full details is shown in Illustration 58.

We can see that the designs are based on the co-design outputs shown in Illustration 36 and Illustration 37.

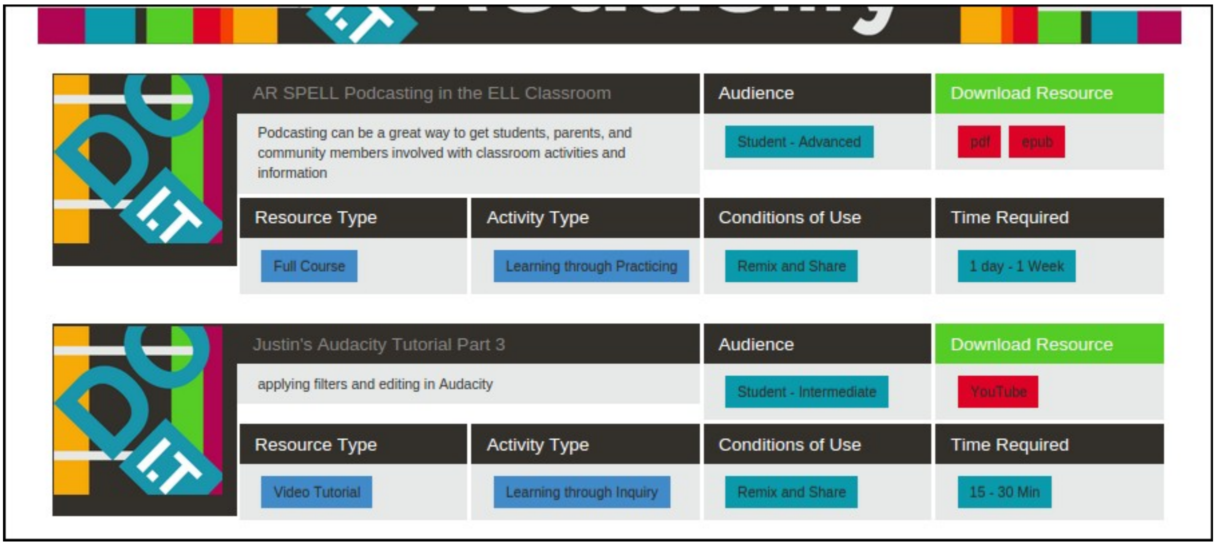


Illustration 57: Screenshot of list view

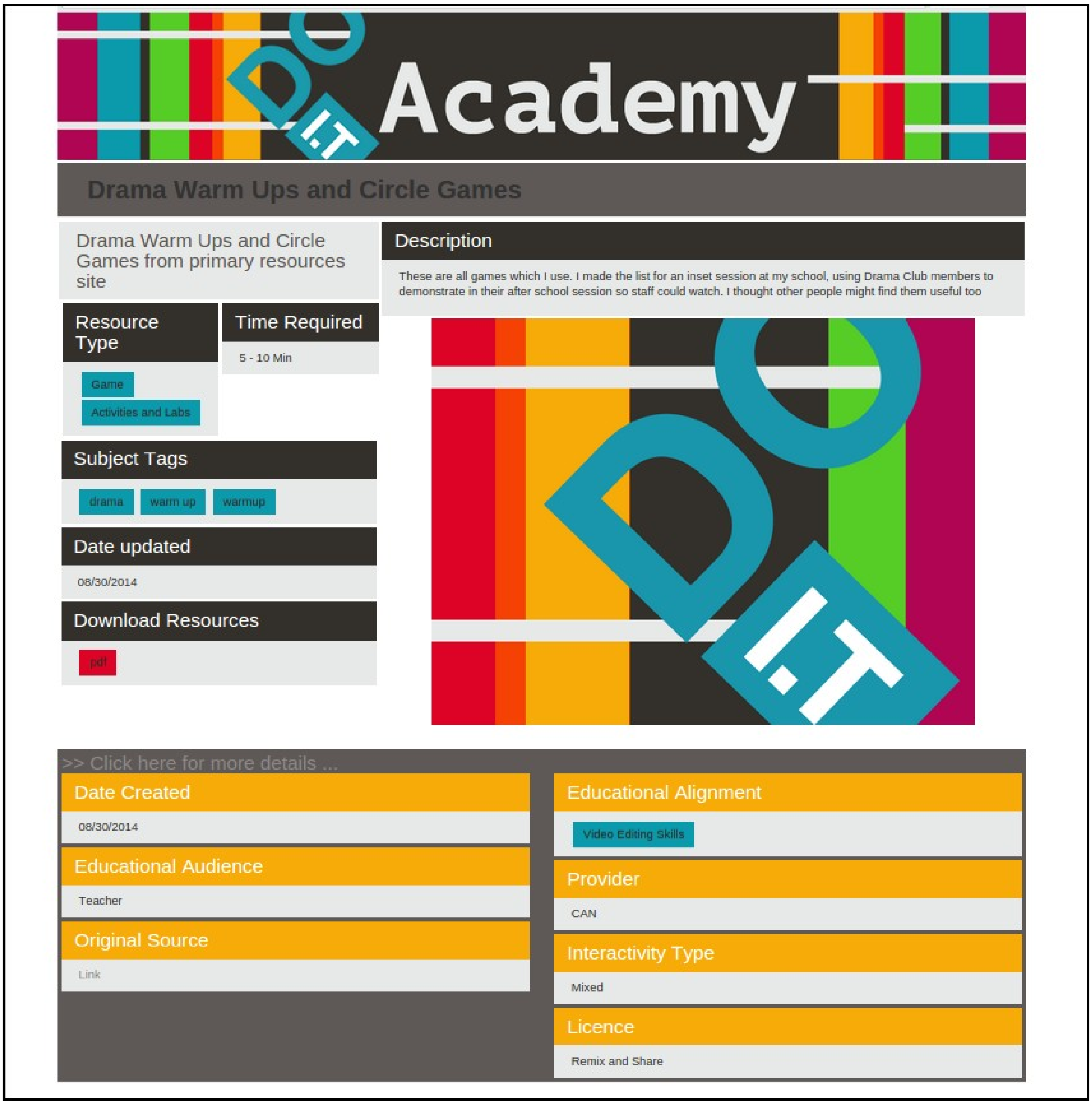


Illustration 58: Screenshot of 'detail view' of resource

The design for each of the pages is based on the css Bootstrap framework which allows page components to dynamically resize for different sized screens.

6.2 Evaluation

Evaluation of the software project at this stage was done by testing the usability of the input form using the format of Brooke's SUS usability test (1996). The SUS test is appropriate for this context of a quick test to give a general comparative indication of the design of the project's input form compared to a Django standard input form.

The process involves a questionnaire asking the following questions.

1. I think that I would like to use this system frequently.
2. I found the system unnecessarily complex.
3. I thought the system was easy to use.
4. I think that I would need the support of a technical person to be able to use this system.
5. I found the various functions in this system were well integrated.
6. I thought there was too much inconsistency in this system.
7. I would imagine that most people would learn to use this system very quickly.
8. I found the system very cumbersome to use.
9. I felt very confident using the system.
10. I needed to learn a lot of things before I could get going with this system.

6 participants were asked to rate the system on a scale of 1-5 for each statement based on if they agree or disagree. A response of 1 means disagree strongly and 5 means agree strongly.

The procedure for the administration of the test is included in Appendix 8.2.

Form A is the unmodified Django admin form as shown in Illustration 59. Form B is the customised form created using the design elements identified in section 4 (Illustration 60).

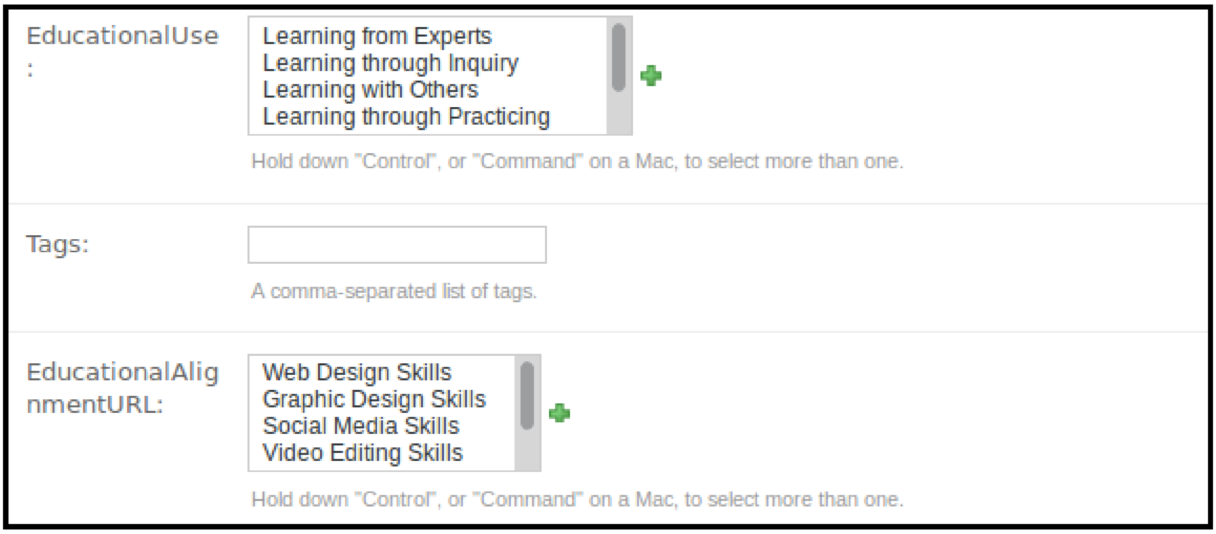


Illustration 59: Form A: default Django admin input form

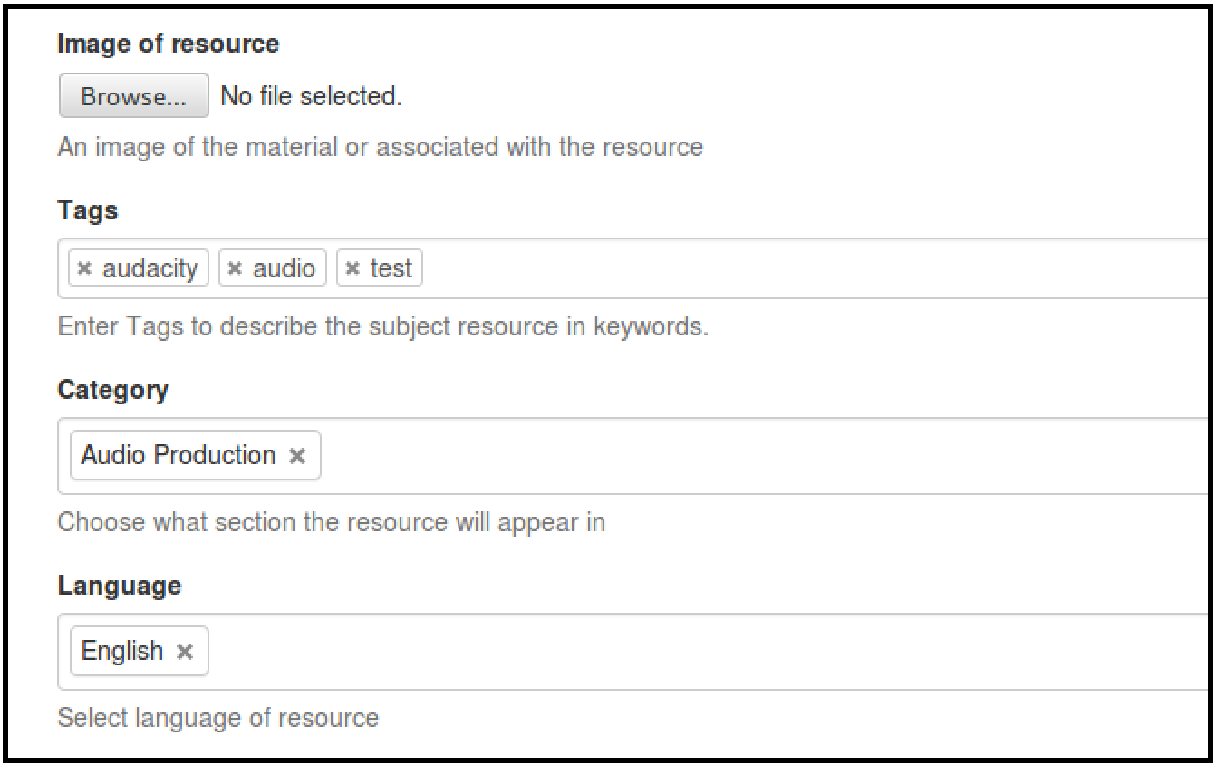


Illustration 60: Form B: customised input form with design elements informed by review in section 4

A table showing the sum of the 6 scores for each of the SUS questions is shown in Illustration 61. These results show that participants showed a preference for Form B to a greater or lesser extent for each of the 10 questions. As a rough guide high answers of odd number questions indicate greater usability and conversely low answers for even number questions indicate greater usability.

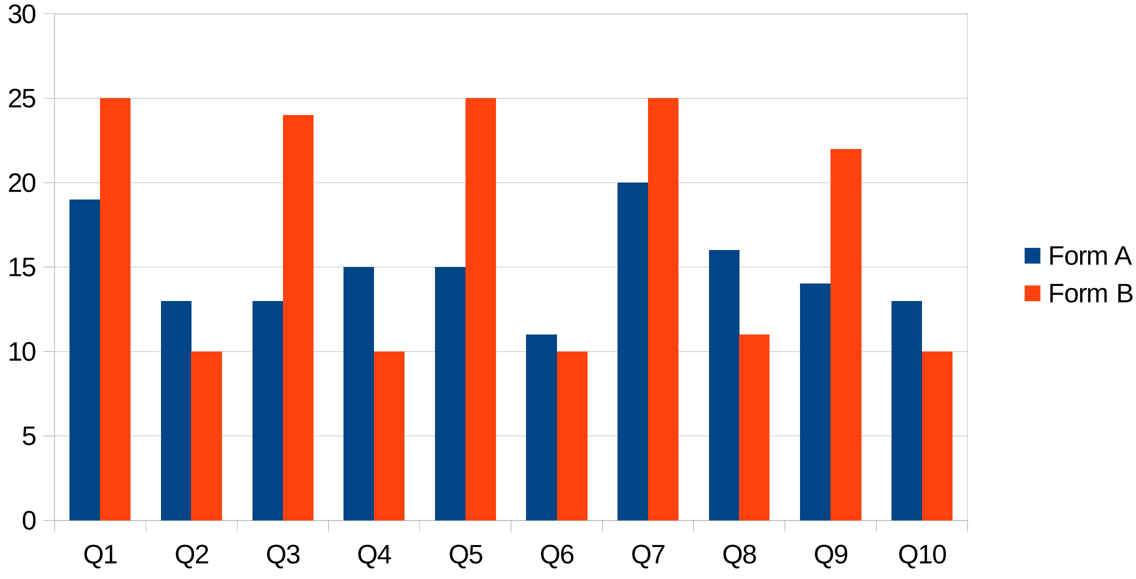


Illustration 61: Result for Form A and B for each of 10 SUS questions

An average score for SUS tests can calculated in the following way. For questions with an odd number, subtract 1 from the user response. For other questions subtract the user score from 5. Add up the converted responses for each user and multiply the total by 2.5. This converts the range of possible values to values from 0 to 100 instead of from 0 to 40.

Illustration 62 represents the average SUS score for the 6 test participants. These results show that, in terms of average score, Form B is preferred over Form A for all but two cases. In one case a preference of Form B is shown and in another case no preference was show.

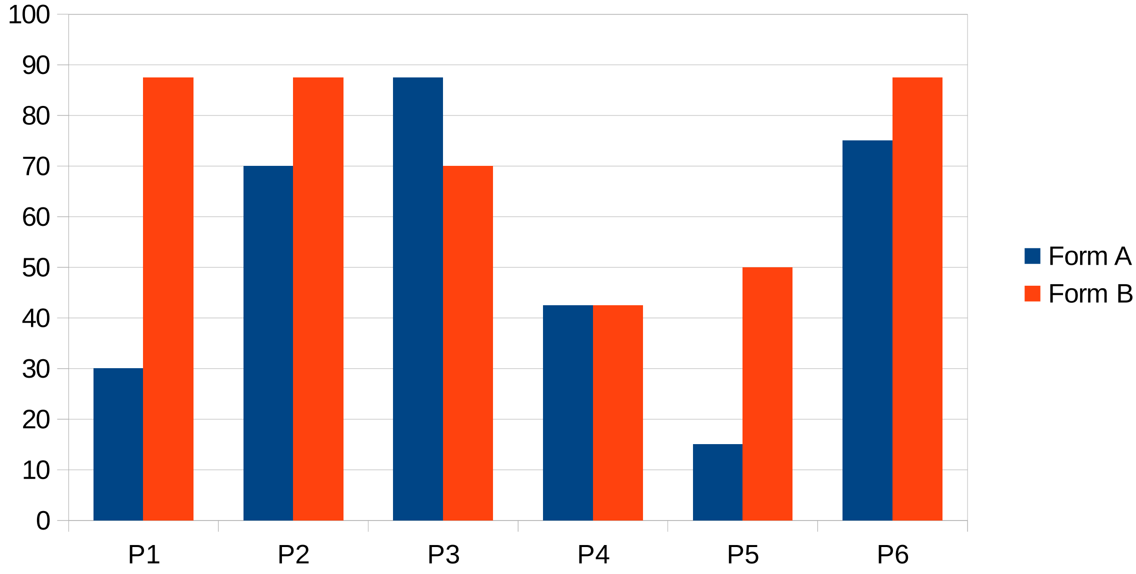


Illustration 62: SUS scores for Form A and Form B for the 6 individual participants

The limitations of the SUS approach should be noted, compared to other techniques of a more qualitative nature. However, a fuller evaluation was unfortunately beyond the reach of this project.

6.3 Revisiting the objectives and questions of the project

This section revisits the project objectives in light of the work carried out. The objectives of the project can be summarised as:

- apply good practices and suitable web-technologies to create of a tool to republish and organise learning material
- use design techniques to encourage users to enter metadata on educational use to address issues of disparate locations of resources and lack of educational context
- increase technical discoverability of materials via search engines
- encourage users to contribute back to the wider community of OER

An opening observation is that adopting the use of the Django framework and the choice of design patterns that it promotes can greatly accelerate and facilitate production of a bespoke repository. The use of reusable django apps and javascript libraries allow a flexible approach to design of delivery of Web 2.0 techniques. The features that can be delivered in this way surpass those possible if development were undertaken without the aid of a web framework and additional contributed code. The process of implementation outlined in section 5 demonstrates good practice allowing the product to be easily reused or adapted.

The process of choosing LRMI data acts as a bridge linking technical concerns and educational aspects as the use of LRMI as a technology not only helped discoverability but also functioned as a way to open a discussion to decide our metadata schema. The parameters and documentation of the schema.org and LRMI projects were helpful to guide decisions concerning the representation guidance on use based on pedagogical theory.

We have seen in the review of literature that the culture of small scale sharing under open licences creates huge opportunities and challenges for effective integration into more traditional learning environments. Our web repository has been created with the aim to support a constructivist view of learning in a blended learning environment. We can hope that it facilitates learning opportunities offered by aggregating and re-contextualising little OER compared to big OER. More research is needed on this aspect.

The project's focus on maximising metadata entry of tags, categories and choices raised interesting questions about usability of input forms. The final approach saw a synthesis of various technical techniques identified in the review of different OER repositories. The resulting input form scored well on a usability test suggesting that this approach was effective.

The approach taken to adopt flexible, user-lead decisions around tagging and categorising resources (an observational approach to describing pedagogic use of OER) was a good fit with best practices observed in the research of the OER in the UK (Loveless, 2009, p. 3).

An interesting area of future work would be further evaluation of tool in terms of the quality of metadata entered by users and level of reuse compared to a control. This could include structured interviews on the use of the repository. This work would help to answer questions around the impact of tailored metadata schema and design of OER repositories raised by our project. A further question would be to ask what is the optimal size and scope of the data in a repository to maximise its usefulness for a community of practice.

6.4 Further reflections

In an academic setting, the approach of this project may help to address the issue of student concerns around the use of third party materials by allowing tutors to explicitly place value on the practice of reuse of OER. Research suggests that student expectations appear to be pliable surrounding OER if they are introduced into the curriculum in this way (White and Manton, 2011, p. 28).

While the effective fostering of communities can help increase OER reuse and address issues of sustainability of OER production and upkeep (Wiley, 2006), research has also shown that theremay be complex tensions involved with the use of OER in bonded communities. (Littlejohn et al., 2015).

This project proposes that the collaborative process of creating LRMI schema and a page design may work to increase identity and ownership over the tool used and thus the process for sharing resources. It has the potential to foster a coherent approach to curating decentralised community based contributions and promotes a participatory model of learning in-line with constructivist educational theory. Early, informal feedback supports these statement but more work is needed to support this position.

In the world of education technology it appears to be important to be able to represent areas of research and innovation in the form of acronyms. A suitable acronym for our tool and the process used is QUAAAC which stands for quick, user-led, accessible, adaptable, academic community (Chesterman, 2014).

The term QUAAAC can be seen a counterpoint to the pervasive dialogue surrounding MOOCs. It is also used as a playful way communicate some of the advantages of this smaller, more flexible way of delivering OER and the benefits of using LRMI and an accelerated co-design process.

6.5 Future work

The following features were identified by the pilot group but de-prioritised due to time constraints:

- user rating of resources

- comments or other forms of more detailed feedback
- hosting of resources in addition to linking out to files
- playlists of linked learning resources listed in order of deployment in lessons

Importing other documents and hosting them could be a very valuable way for the pilot community to avoid dead links in the future which has been identified as a problem for distributed learning resources. (White and Manton, 2011)

We can easily imagine a way of users ordering and saving a linear paterrn of learning resources (ie resources used in a lesson) in our repository. The pilot group expressed that this could potentially be a useful way of sharing pedagogical approaches. We can see a direct link here to the area of learning designs (McAndrew et al., 2006). It would be an interesting approach to see if the system developed for this project could incorporate some of the aims of Dalziel's LAMS system (Dalziel, 2013, pp. 230–243) or the work on the Learning Designer system (Laurillard et al., 2013).

Another area of interest is the potential to harvest LRMI data from web-pages. It should be possible to create a tool based around the input form for our repository which when pointed to a web page containing LRMI data would populate as many fields as possible with the data harvested from the target page. The harvesting process would occupy a middle ground between aggregation and data-scraping.

In terms of interoperability between different repositories it would be valuable to investigate the opportunities given by projects like Learning Registry and Tin Can API.

The Learning Registry platform aims to facilitate the exchange of metadata on learning resources. It promotes LRMI as a metadata base. We could imagine two instances of the our project's codebase using Learning Registry to communicate with each other, to exchange metadata and thus feature the data of the sister repository in search results (Campbell et al., 2013).

Tin Can API is a way of tracking who has done what to learning resources and when. This data is also known as activity data or paradata (Barker and Campbell, 2013). Integration of our system with Tin Can API would provide interesting data about how the resources of the project were being used.

7 References

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8 Appendices

8.1 Full details of LRMI implementation for sample detail page

From http://www.google.com/webmasters/tools/richsnippets?q=http%3A%2F

%2Fducttapeuni.org%2Fdia_test_updated.html

type:	http://schema.org/webpage	
	name:	AR SPELL Podcasting in the ELL Classroom
	alternativeheadline:	Podcasting can be a great way to get students, parents, and community members involved with classroom activities and information
	learningresourcetype:	Full Course
	timerequired:	P1W
	keywords:	test
	about:	test
	keywords:	audacity
	about:	audacity
	keywords:	tes
	about:	tes
	datemodified:	08/30/2014
	encoding:	Item 1
property:	encoding:	Item 2
	description:	ELL students can use podcasting as a way to demonstrate the skills they are developing as well as provide a way to reach other ELL students who may be encountering similar (difficulties).
	image:	http://ducttapeuni.org/dia_test_updated_files/holder.png
	educationaluse:	Learning through Inquiry
	audience:	Item 3
	author:	OER Commons
	isbasedonurl:	https://www.oercommons.org/
	educationalalignment:	Item 4
	educationalalignment:	Item 5
	interactivitytype:	Active
	inlanguage:	English
	datecreated:	08/30/2014
	license:	http://creativecommons.org/licenses/by-sa/4.0/

Item 1

type:	http://schema.org/mediaobject
property:	encodingformat: pdf

Item 2

type:	http://schema.org/mediaobject
property:	encodingformat: epub

Item 3

type:	http://schema.org/educationalaudience
property:	educationalrole: Student - Advanced

Item 4

type:	http://schema.org/alignmentobject	
	alignmenttype:	teaches
property:	targeturl:	http://can.uk.com/current-artistic-programme/digital-arts/do-it/#socialmedia
	targetdescription:	Social Media Skills

Item 5

type:	http://schema.org/alignmentobject	
	alignmenttype:	teaches
property:	targeturl:	http://can.uk.com/current-artistic-programme/digital-arts/do-it/#audio
	targetdescription:	Audio Production skills

8.2 Usability testing script for tester

"Thank you for agreeing to test this website. We will be doing a short task to compare two versions of a form to input data about learning resources.

On your computer you should have two tab open in your web browser.

One is a web page titled "Sample Learning Resource to republish".

The other shows a page with a form on it titled "Enter your Learning Resource"

Please check you can see both tabs and ask for help if you don't understand at this point.

The task is to fill out the page on the second tab based on the information on the first page.

Some fields in the form may be easy fill by cutting and pasting directly from one page to the other. Other parts of the form may require you to think about how you might use this resource as a learner or teacher.

You have 10 minutes to enter as much information as you think is appropriate.

Don't worry. You are not being testing on what you enter.

Try to complete the form without help but do ask me questions if you can't proceed."

8.3 DVD of project code

A DVD of the project code should be attached to this page. If this is missing please contact michaeljchesterman@gmail.com for a replacement. The most relevant code or this project is in the dturead app directory.

8.4 Ethics Form

1 Name(s) of Applicant: Michael Chesterman

2 Department: SCMDT

3 Name of Supervisor: Peter McKenna

4 Title of Project: Do I.T. Academy: Investigating good practices to increase discoverability and guidance for use of OER for a community of practice.

5 Resume of ethical issues: No significant ethical issues were identified.

6 Does the project require the approval of any external agency?
NO

7 Statement by Applicant
I confirm that to the best of my knowledge I have made known all relevant information and I undertake to inform my supervisor of any such information which subsequently becomes available whether before or after the research has begun
Signature of Applicant:


Date: 26 September 2014

8 Statement by Supervisor/Line Manager (*please sign the relevant statement)*

Approval for the above named proposal is granted

I confirm that there are no ethical issues requiring further consideration.
(Any subsequent changes to the nature of the project will require a review of the ethical considerations):

Signature of Supervisor: Peter McKenna Date: 26 Sept 2014

Approval for the above named proposal is not granted

I confirm that there are ethical issues requiring further consideration and will refer the project proposal to the appropriate Committee**