

### 8.3. Accessibility Review Of Open Educational Resources

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#### Abstract

Open Educational Resources (OER) are relatively new for educators in Europe, but are gaining traction with new incentives for creation and adoption.

Trained project staff members surveyed the accessibility of 60 OER textbooks written for a wide variety of courses commonly taught in the first years of college. The texts were evaluated against twenty-six accessibility metrics based on the international Web Accessibility Initiative and the US Section 508 guidelines. Flaws were noted, and recommendations for improvement given to the authors.

In order to build accessibility into open educational resources, authors need to be more aware and better supported.

#### Keywords

Open Educational Resources, accessibility review, education, textbooks.

#### Introduction

##### **Open Educational Resources, accessibility, and European educational institutions**

Open Educational Resources (OER) are openly licensed, digital materials available at low cost. Open Textbooks, part of OER, often originally created with a traditional All Rights Reserved Copyright, have been converted to a Some Rights Reserved copyright. Adopting instructors can modify these materials to fit their instructional needs.

The OER-HE (Open Education Resources in European Higher Education) project called EADTU, catalysed by the William and Flora Hewlett Foundation, is granted by the EC. [1] Its objective is to create a strong European conceptual basis for OER, linked to social and constructivist learning. European OER adoption varies widely by country, and between institutions with different historical backgrounds (such as religious or political affiliation). A non-exhaustive research in November 2010 of 426 European universities showed that 57



European institutions are members of the OpenCourseWare Consortium (OCW) and 101 are members of the European Distance and E-Learning Network (EDEN). These numbers show emerging European interest in OER. See below Table for particulars.

Country	Institutional Members of OCW	Institutional Members of EDEN
Austria	1	4
Belgium	1	9
Denmark	1	-
France	3	7
Germany	-	6
Greece	-	5
Ireland	-	6
Italy	-	11
Netherlands	3	5
Norway	-	12
Portugal	-	7
Spain	40	11
Sweden	-	2
Switzerland	1	5
United Kingdom	7	11

**European members of the OpenCourseWare Consortium and the European Distance and E-Learning Network**

#### Disability and accessible education

The prevalence of Europeans with disabilities is generally reported as over 15 % of the population, depending on the definition of disability. [2]

The UN Convention on the Rights of Persons with Disabilities, adopted in 2006, explicitly states: "Discrimination on the basis of disability means any distinction, exclusion or restriction on the basis of disability which has the purpose or effect of impairing or nullifying the recognition, enjoyment or exercise, on an equal basis with others, of all human rights and fundamental freedoms in the political, economic, social, cultural, civil or any other field. It includes all forms of discrimination, including denial of reasonable accommodation." [3] Article 24 deals with the topic of Education, where the State Parties shall ensure an inclusive education system at all levels and life-long learning.

By a series of policy statements, Member States of the European Community committed to improve the accessibility of public websites generally. In particular, the Riga Ministerial Declaration indicated that all public websites should be accessible by 2010. Recent monitoring of the status of web accessibility in Europe shows, however, that progress toward this goal remains slow. [4]

Educators have both an ethical and a legal responsibility to provide materials that can be utilized by all students regardless of disability. By doing so, they can improve the lives of all learners. As an example, video captions enable learners who are audio impaired to follow a sound track. These same video captions also support students who are learning a new language, are dyslexic, or have learning disabilities.



## The Project

### Context

Funded by The William and Flora Hewlett Foundation, College Open Textbooks [5] is a United States-based collection of colleges, governmental agencies, education non-profits, and other education-related organizations that are focused on the mission of driving awareness and advocacy for open textbooks. The work of College Open Textbooks includes providing training for instructors adopting open resources, peer reviews of open textbooks, and online professional mentoring networks that supports authors who open their resources. At the time of writing, College Open Textbooks has reviewed more than 100 open textbooks for use in community college courses and identified nearly 700 open textbooks.

The goal of the project described here was to evaluate 60 open textbooks from different subject areas and in different formats against 26 common metrics for accessibility, reaching an in-depth, consistent and quantitatively comparable scoring. The work was done by Virtual Ability, Inc. Summaries of the evaluations are presented on the College Open Textbooks website (<http://collegeopentextbooks.org/opentextbookcontent/accessibility-reviews-.html>).

### Metrics

The twenty-six chosen metrics were based on the WCAG and Section 508 guidelines, and best practices regarding cognitive accessibility. These metrics were further grouped into the four WCAG POUR principles: Perceivable, Operable, Understandable, and Robust [15]. These metrics and the principles to which they are assigned are shown in below Table.

Principle	Metrics
<b>Perceivable</b> material can be accessed using any intact sense or through assistive technology.	Text alternatives to images, Colour contrast, Screen flicker
<b>Operable</b> content works correctly with assistive technology.	Style sheets, Image maps, Data tables, Frames, Electronic forms, In-page navigation, Timed responses, Structural markup for heading, lists, and quotations
<b>Understandable</b> material makes sense.	Use of colour, Readability, Simple visual formatting, No visual clutter, Definitions, Visual-semantic organizers, Error-free input, Easy recovery from errors, Language identifier
<b>Robust</b> content works now and in the future.	Non-mouse operation, Equivalent alternatives for multimedia presentations, ARIA, Customizable, Captions for any audio, Alternative text for images that provides equivalent information

**The four POUR principles and associated metrics**

Eleven of the metrics were determined to be not applicable for PDF documents. These included image maps, frames, and ARIA.



## Methodology

### Special points of attention regarding the evaluation process

Special attention has to be given to defining the most objective evaluation and scoring methods for each metric. The evaluated textbooks represent 17 subject areas, from history to mathematics. To evaluate metrics of the Understandable principle, the evaluator must have content knowledge of the domain.

Also, it would not have made sense to apply a simple formula for a readability score (in this evaluation process, the Flesch Reading Ease Score) without preparation and selection of appropriate texts. Chemical equations, or sentences containing many non-English nouns, would invalidate the scoring algorithm. Still, the end result of evaluations should be consistent regardless of the different subject areas of the texts. Thorough preparation of the material to be evaluated is a critical success factor.

Another point of attention for this type of project is the project team itself, which should be constituted of very diverse members, with different abilities and disabilities.

A significant number of these texts, 42 %, were published as downloadable PDFs. Specifically regarding PDF textbooks, the assumption is made that only the PDF textbook itself should be reviewed, not the website from which the PDF is downloaded. If the website is inaccessible, the PDF is in effect also inaccessible. Strictly seen, the accessibility of the hosting environment should be reviewed too. In this project, this was out of scope. Also, some website-based textbooks require a login. The evaluation of accessibility for the login activity was out of scope.

The Virtual Ability project team evaluated 999 metrics, both quantitative and qualitative, of which 718 (72%) were for website-based textbooks and 281 (28%) for PDF textbooks. If all metrics had been evaluated in all books, a total of 1560 metrics would have been evaluated. In actuality, 999 metrics were scored and recorded, as shown in Table 3. Textbooks were initially screened for metrics that should be marked “not applicable”, such as books with no images, no audio, or no multimedia. Automated tools were unreliable for detecting images that needed to be evaluated for alt text. They would sometimes give error indications of images without alt texts, whereas manual validation of the automated check might show that these were visual backgrounds to text or some other cosmetic usage, and therefore the images should not have had alt-text.

	Number
Total potential metrics to be screened	1560 (60 * 26)
Total without “Not Applicable” for PDF documents	1296
“Not Applicable” after additional initial screening	297
Actual number of metrics screened	999

**Numbers of metrics**



### Sources of website-based textbooks

Textbooks that reside on websites may originate in three manners. Some authors create their own websites. Other authors use a sponsoring institution's website. Increasing numbers of OER textbooks are collected on platforms where a structured format is provided by the platform developer. This project evaluated textbooks from five different platforms, as shown in below Table.

Platform	URL	Number of Books
Connexions	<a href="http://cnx.org/">http://cnx.org/</a>	8
Flat World Knowledge	<a href="http://www.flatworldknowledge.com/">www.flatworldknowledge.com/</a>	3
Open Learn	<a href="http://openlearn.open.ac.uk/">http://openlearn.open.ac.uk/</a>	3
Open Learning Initiative	<a href="http://oli.web.cmu.edu/openlearning/">http://oli.web.cmu.edu/openlearning/</a>	3
MediaWiki	<a href="http://en.wikibooks.org">http://en.wikibooks.org</a>	4
MediaWiki	<a href="http://en.wikiversity.org">http://en.wikiversity.org</a>	2
MediaWiki	<a href="http://chemwiki.ucdavis.edu">http://chemwiki.ucdavis.edu</a>	1

**Textbook platforms**

## Results

### Results for website-based textbooks

These websites exhibited common accessibility issues, independent of source, generalized in following Table.

Issues	Percent with this issue	Examples of issue
Structural semantic organizers	42 %	Headers not nested or ordered; headers used for page layout; improperly coded bulleted lists
Table headings	39 %	Missing headings
Table attributes	31 %	Missing titles and/or summaries
Fixed width page	23 %	Makes it difficult to change font size or screen resolution
In-page navigation	36 %	Non-sighted readers need non-linear navigation capabilities
Data entry with Flash	8 %	Inaccessible to screen readers
Reliance on scripts	6 %	Inaccessible to screen readers
Non-mouse operation	19 %	Keyboard indicator not shown



Issues	Percent with this issue	Examples of issue
Use of frames	8 %	Excessive scrolling required with fixed size frames; content wrap/line breaks make variable width frames content unreadable

**Common accessibility issues in web-based textbooks**

### Results for PDF textbooks

A set of features required for full accessibility of PDF documents is shown in Table 6. No PDF textbooks evaluated in this project were accessible on metrics in the Operable and Robust principles. Most probably, the authors used Microsoft Word, which did not have any export function to tagged PDFs until version 2010 (release date April 2010).

Required Features
Proper tagging and reading order
Searchable text
Fonts that allow character extraction to text
Interactive form fields (if present)
Non-mouse navigational aids
Specified document or text block language
No security restrictions that interfere with assistive technology
Proper tagging and reading order
Alternative texts for images and interactive form fields

**Required accessibility features in PDFs**

### Results common to all formats

Several major accessibility issues occur across both formats, web-based and PDF. These are mainly issues that are under the author's control and could be included in the author's initial design of the textbook. Common accessibility issues are shown in following Table.

Common Issues	Percent for web-based	Percentage for PDF
Visual appearance	17 %	32 %
Content organization: important/less important	14 %	20 %
Content organization: missing table of contents	12 %	12 %
Content organization: lengthy pages	23 %	4 %
Organizational flow of information	14 %	4 %



Common Issues	Percent for web-based	Percentage for PDF
Inconsistent emphasis	9 %	28 %
Need glossary	54 %	44 %
Inconsistent or inappropriate author's voice	11 %	12 %
Inconsistent visual format	17 %	28 %
Inconsistent reading ease	26 %	44 %
No textual alternatives for missing alt text	63 %	100 %
No alternatives for colour coding	14 %	12 %
Inappropriate comprehension level	27 %	36 %

**Accessibility issues across delivery formats**

#### Quantitative results related to the type of textbook

Regarding the use of platforms, the average score across all measured metrics for textbooks within each group is shown in below Table.

Format	Average Score
Connexions	4
Flat World Knowledge	3
Open Learn	4
Open Learning Initiative	2.4
Wikimedia	4.1
Web-based textbooks	3.5
PDFs	2.7

**Average scores for accessibility**

We can safely conclude that the variation between those scores is, for the most part, related to accessibility issues of the delivery mediums. PDF textbooks scored a low of 2.7, mostly due to the lack of tagging as explained above.

In general, although many issues have been noted, the average score of all 60 textbooks was above the median possible score. The scoring model is shown in following Table.

Numeric Score	Interpretation
1	Lowest, not accessible
2	Poorly accessible, many or important accessibility issues

Also available via the conference website [www.aegis-conference.eu](http://www.aegis-conference.eu)



Numeric Score	Interpretation
3	Average, partially accessible, some accessibility issues
4	Well accessible, but with some accessibility issues
5	Highest, perfectly accessible

Scoring model

Most website based textbooks (including those on platforms) did reach level 4 for Perceivable and Understandable metrics, with scores a bit lower on the Operable and Robust metrics. PDF textbooks reached a slightly lower score for Understandable metrics, dropped under the mean for Perceivable metrics, and were inaccessible regarding Operable and Robust metrics due to lack of tagging.

### Positive findings

Lest it seem that all findings were indications of accessibility difficulties, it should be noted that evaluators were requested to mention particularly well-done features of textbooks that they examined. Positive features noted in more than one text include appropriate readability level (3 PDFs), visual-semantic organization (2 PDFs), consistency of formatting (2 PDFs), and well-structured content within a didactic (journalistic) presentation style (2 PDFs and 1 website).

### Conclusions And Recommendations

The accessibility review of 24 PDF textbooks and 36 website-based textbooks, across 17 subject areas, clearly highlighted diverse issues with accessibility, notwithstanding an overall reasonable score. Accessibility concerns may be split in two parts: the delivery medium, and the content of the textbooks. Whether the web base of the textbook is created by a platform, an institution, or the author, lack of awareness of accessibility features is a likely reason for common accessibility concerns. Regarding PDF textbooks, the most obvious flaw was the lack of tagging, making these books completely inaccessible in several ways. The prevalence of issues confirms the general lack of information about accessibility features of both web- and PDF-formatted OER.

Other elements, including most metrics in the Operable and Understandable principles, are within author control, no matter the delivery mechanism. Therefore, we recommend that authors and platform developers be made aware of the legal, ethical, and technical reasons for providing textbooks in an accessible form. Information about accessibility, particularly about the most easily addressed issues, could be provided on the websites of the collections, websites of associations like the College Open Textbooks, or through author seminars, courses, or webinars available through a variety of venues and professional organizations.

Following awareness, authors and platform developers need how-to knowledge, design tools, and other software to build in accessibility features and test that they work properly. In terms of retro-fitting existing OER materials, using the Economies of Scale principle, the immediate benefits of adapting the various textbook-collection platforms outweigh the cost of individual adaptations of textbooks.





Some authors may need additional professional assistance, particularly for the more technical aspects of accessibility. Post-processing their texts to ensure accessibility would need to occur initially and upon updating. This assistance could be provided by institutional media lab support on campus, private accessibility firms, or consortia of like-minded individuals such as College Open Textbooks.

Finally, incentives for creating accessible online textbooks need to be examined. Additional planning and effort are required to make OER materials accessible to students with special needs or those using assistive technology. What will swing the cost-benefit ratio in favour of designing OER materials so they can be effectively used by all students?

However it is accomplished, providing accessible textbooks to a population of 15 % disabled people is, in our opinion, a responsibility of the educational world and a duty of society.

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