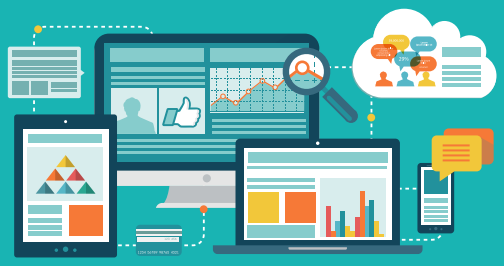
Developing digital accessibility using R Markdown



Remote teaching during the pandemic accelerated the move towards writing teaching materials in accessible and inclusive ways.

Digital accessibility has become a must in Higher Education. However, the main document format used in teaching, especially in STEM subjects, has consistently been the PDF. As the dissemination of teaching content moved from paper-based to digital, the PDF document revealed its shortcomings in terms of accessibility. For instance, the semantics of a mathematical expression in a PDF document would not be accessible to a visually impaired or blind person. This raises important considerations. Have you tried to read a PDF document on a mobile phone? How can we, as educators, produce materials that can be made digitally available and accessible?

A reader from an academic subject within Humanities or Social Sciences might say that Microsoft Word or PowerPoint are perfectly acceptable, and indeed more accessible, alternatives to PDF documents. Unfortunately, documents in these formats can (and will) display differently in different devices or operating systems, especially if the document contains symbols or mathematical expressions, making them undecipherable to everyone. That's why, despite requiring a steep learning curve, LaTeX (***https://www.latex-project.org/***) has been the common software of choice to write documents with mathematical content for decades in academia. Before digital accessibility came to the forefront of the education agenda, the decisive advantage of using LaTeX was the output: a beautifully formatted PDF document where mathematical expressions will display correctly in any operating system.

However, in a digitally accessible environment this isn't enough anymore. A better alternative is to use Markdown, originally ***developed by John Gruber***, to allow web writers to produce HTML files through a plain text formatting syntax that is both easy-to-read and easy-to-write. One could also argue that, because by design it is so simple, this makes it a more inclusive tool for producing academic materials. Educators can use it without requiring any prior programming knowledge. Despite its straightforward syntax, Markdown also allows a large number of features including, but not limited to, tables, footnotes, mathematical expressions, citations, links and figures. A user-friendly interface is R Markdown (***https://rmarkdown.rstudio.com***), which uses John MacFarlane's Pandoc package (***http://pandoc.org***), to convert the user's Markdown-formatted plain text into a variety of possible output formats, such as HTML, MS Word, PDF, RTF, EPUB or PowerPoint. The HTML output is particularly interesting for producing digitally available accessible documents.

Easier to learn

There are several additional advantages to Markdown. From a practical standpoint, Markdown is much easier to learn than other ***markup languages*** such as LaTeX. People without any programming experience can produce high-quality scientific documents using Markdown. Users with basic knowledge of LaTeX syntax can, with Markdown, produce documents with fully accessible mathematical expressions detectable by screen readers. One Markdown plain text source can be used to produce documents in multiple output formats. This can, for instance, be useful for providing a downloadable PDF or MS Word version of a digitally available source constituted by multiple HTML pages.

Markdown can be used to not only improve the accessibility of the output documents on the student's end, but also to improve the technical quality of the documents produced by the students themselves. First, it allows students without programming knowledge to quickly learn Markdown's simple syntax to produce high-quality documents. Second, visually impaired students (and educators) can use Markdown to produce scientific documents as the process can be fully controlled by a keyboard using plain text. This can be achieved through the Accessible RMarkdown Online Writer (AROW, ***http://www.arowtool.com***): see Seo and McCurry (2019).

During the pandemic, confronted with the lack of accessibility of PDF documents and the need to move completely online, the author wrote all the teaching materials for two modules on life insurance mathematics in HTML using R Markdown. Because the programming language used in these modules is R, a further advantage of R Markdown is that R code 'chunks' can be inserted into the document. It became ideal for lecture slides, seminar questions and formative assessments. A larger multipage HTML document with the lecture notes was also very well received by students who would often use this document both in and out of class. Comments from anonymous module student feedback were "lecture notes were clear and well produced", "well organised lecture notes", "absolutely beautiful lecture notes".

References

Seo, J. Y. and McCurry, S. 2019. LaTeX is NOT Easy: Creating Accessible Scientific Documents with R Markdown, *Journal on Technology and Persons with Disabilities*, 7, pp.157-171. Available at: ***http://hdl.handle.net/10211.3/210398***. (Accessed 05 January 2022).

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