

Using InDesign Tool to Develop an Accessible Interactive EPUB 3: A Case Study

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Abstract: EPUB (Electronic Publication) is a format primarily used for digital books. EPUB 3 is based on the Open Web Platform, HTML, CSS and JavaScript. In short, EPUB content can be considered as a web interface. Thus, existing accessibility guidelines and techniques can be applied in order to obtain an accessible eBook. In our study, we investigate if popular editing tools are sufficiently mature to support the authors in designing interactive and multimedia EPUB 3 fully accessible via assistive technology like screen readers. To this purpose, in this work, the Adobe InDesign tool has been used to prepare an interactive EPUB 3 prototype as a case study. Our aim was to analyze whether the InDesign tool was able to support authors in getting a fully accessible interactive EPUB 3. The results revealed that accessibility is not fully guaranteed directly by the tool: some additional steps are required by the authors or professional operators.

1 INTRODUCTION

With the latest version of EPUB version 3 (IDPF, 2014) content authors are able to develop highly interactive eBooks. By “interactive” we mean that specific content is shown according to user actions. In addition some input is required from the reader in order to better offer details and further contents and personalize the reading experience (e.g. by reusing the user’s name throughout the eBook). Moreover, quizzes are interactive features that should/could be included in an eBook. Interactive contents can offer the advantage of turning the passive learning experience into a more interactive engagement (Fenwick Jr et al., 2013). Thus editors and tools should support the content writers and technicians in designing and achieving accessible eBooks, including those offering multimedia and interaction features.

The aim of our study is to investigate whether design tools are sufficiently mature to effectively support content authors or professional operators in preparing accessible EPUB 3 documents, with special attention paid to interaction features. EPUB stands for Electronic PUBLICATION and is a format primarily used for digital books. Numerous tools are freely or commercially available on the market to

design and develop eBooks. The Adobe InDesign¹ is one of the most widely-used authoring tools in publishing houses. Adobe InDesign is a publishing and typesetting application produced by Adobe Systems. It can be used to create digital documents, such as presentations, books, eBooks, posters, flyers, newspapers, etc.. InDesign also supports export to EPUB and SWF formats so as to create e-books and digital publications, including content suitable for tablets. In addition, InDesign supports XML, style sheets, and other coding mark-ups, making it suitable for exporting tagged text content for use in other digital and online formats.

In this work, the accessibility support offered by InDesign tool is evaluated in order to make a contribution to the digital publishing field. The resulting EPUB 3 must be compliant with accessibility guidelines and criteria (W3C, 2017b) to ensure a suitable interaction with the assistive technology. One of our two research questions was to verify whether the editing InDesign tool was really effective in supporting authors in applying those accessibility guidelines. We investigated if a popular design application was able to accomplish

¹ Adobe InDesign, <https://www.adobe.com/it/products/in-design.html>

properly common functions in preparing accessible digital contents, such as (a) alternative descriptions for images and figures, (b) document structure divided into sections and sub-sections through headings, (c) metadata, and (d) digital publishing semantics. The second question was whether the Adobe InDesign tool is mature enough to support accessibility in the design of interactive and multimedia features for EPUB 3. This question is more specifically aimed at evaluating how InDesign works with the design of (a) interaction UI components (e.g. text fields and buttons), (b) scripts to handle “live content” which is dynamically updated according to user actions (e.g. quizzes and different table views), and (c) multimedia audio contents which can be activated by the user.

The paper is organized as follows: section 2 introduces related works in the field, and section 3 the methods used to conduct the study. The eBook prototype is described in section 4. Section 5 presents and discusses the results obtained by working with InDesign tool in preparing the EPUB 3 prototype. Sections 7 and 8 present a short discussion and some suggestions for authoring tools developers. Section 9 concludes the paper.

2 RELATED WORK

Numerous studies and researchers have been investigating accessibility in digital publishing for several years (Brady et al., 2015; Calabrò et al., 2009; Schwarz et al., 2018). The publishers’ standard and accessibility format were integrated to achieve accessibility in the mainstream eBook industry (Kasdorf, 2018). Nevertheless, accessibility issues are still encountered when reading via assistive technologies, like a screen reader on both desktop and mobile platforms (Bartalesi and Leporini, 2015; Leporini et al., 2019). Several studies have focused on accessibility and usability for reading activities and features (Henry, 2012; Miller and Ranum, 2012). Other works propose specific reading tools or audio books for blind people, such as those described in (Kulkarni and Bhurchandi, 2015; Lundh and Johnson, 2015). Our approach consists in using the widely-used EPUB format developed with everyday design tools.

Interactive eBooks have been investigated in various studies in the literature (Fenwick Jr et al., 2013; Gavrilis, 2013; Miller and Ranum, 2012). While these studies introduce the usefulness of interactivity in an eBook, they do not consider accessibility and interaction features included

directly in the EPUB format. Furthermore, to the best of our knowledge, no work considers how accessibility support is provided by design tools.

3 METHOD

To evaluate accessibility support offered by the InDesign tool, an interactive and multimedia eBook prototype has been developed by two of the authors, one of whom has long experience in the digital publishing field and editing tools. A textbook has been selected as basic contents to be enhanced through interaction and multimedia features.

The eBook prototype has been designed by using (1) InDesign (version CC 2019) as the primary tool to develop the eBook core, and to obtain the EPUB 3 (reflowable) format. After that, the resulting EPUB has been modified via (2) the Sigil software to manipulate the document², (3) HTML5, CSS and JavaScript to add accessibility features and interaction functions which were not directly supported by the InDesign software, and (4) WAI-ARIA techniques (W3C, 2017a) to address some accessibility features.

In this work, we evaluated both (1) accessibility guidelines provided by Adobe as accessibility support offered by the tool, and (2) the accessibility support observed in adding interactive and multimedia contents to the document prototype.

The settings used for exporting the EPUB 3 as output document can play a meaningful role for effective accessible contents. Figure summarizes the settings used to export the EPUB prototype by InDesign. We checked the exported EPUB document according to the EPUB Accessibility 1.0 guidelines (W3C, 2017b) to test what accessibility features of the file can be managed in InDesign and what requires additional work.

- General Tab:
 - Version: EPUB 3.0
 - Navigation TOC: Multi Level (TOC style)
 - Content:
 - Order: Same as Article panel
- Text Tab:
 - Footnotes: In pop-up (EPUB 3)
 - Lists:
 - Bullets: Map to unordered lists
 - Numbers: Map to ordered lists

Figure 1: InDesign settings to export the EPUB format.

² Sigil editor, <https://sigil-ebook.com/>

4 eBOOK DEVELOPMENT

4.1 Interactive EPUB

The textbook “Pinocchio” has been selected as a case study of content to be converted into an interactive and multimedia EPUB format. The chosen contents offered by the ‘Pinocchio story’ do not include particular interactive features. However, once the main contents (text and figures) were designed, some interactive and multimedia features were provided to enrich the resulting eBook. For instance, an audio file has been linked to some phrases and words within the story; a dynamic table or edit fields have been designed. Each chapter, for instance, has been characterized by a set of questions aimed at focusing on particular contents related to that chapter (see Figure 2). In the previous work (Leporini, 2019), more details about the interactive EPUB prototype design are described.

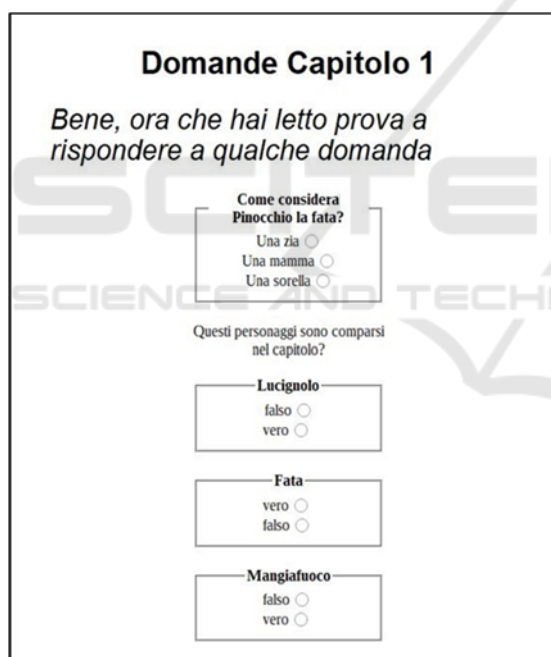


Figure 2: Example of questions form in the eBook.

In short, the main interaction features developed are summarized in Table 1.

Table 1: Interactive features designed in the prototype.

Feature	Design	Development
Personalization by name	Name input and reuse throughout the contents	Text field and JavaScript code
Figure	Alternative text	Alt attribute and

descriptions	and Mp3 audio files	link to mp3
Quizzes	Form with quizzes	Radio buttons
Quizzes	Confirmation	Dialogue window and audio feedback
Dynamic table views	Simple and complex table	Table with 2 and 4 columns
Audio contents	Words linking to audio contents	Links to mp3 files
Notes and glossary	Words linking to a description	Links to text blocks
Table of contents	Chapters titles	Links to chapters

4.2 Procedure

Some functions and features have been considered while preparing the EPUB via InDesign. A new project has been started to begin designing the document. Next, the following aspects have been applied and therefore evaluated in terms of accessibility support:

- Textual contents Structure - paragraphs, headings, reading order, etc..
- Non-textual contents - images, figures, tables (alternative descriptions), audio contents, etc..
- Metadata and additional information – language, document title, etc..
- Navigation and references – table of contents, index, linked parts, notes and footnotes, etc..
- Interactive features and java scrips – input elements (textfields, buttons, links) and JavaScripts to perform actions and checking (e.g. quizzes).
- Exporting and tagging – tags and attributes exported in the EPUB format.

The validation tools EPUBCheck³ and ACE (Accessibility Checker for EPUB)⁴ were used to verify code correctness and accessibility guidelines compliance.

5 INDESIGN EVALUATION

In this section, we investigate what accessibility features of EPUB 3 format can be achieved using the

³ ePub checker: <https://github.com/w3c/epubcheck/releases>

⁴ ACE: <https://inclusivepublishing.org/toolbox/accessibility-checker>

standard functions available in InDesign. This authoring tool software allows a content creator to run scripts and even to insert HTML code in the page that can help while creating a native accessible EPUB. However, since these solutions are not part of the standard tool, we did not include them in our evaluation. Thus, herein we consider (1) the standard features available in the InDesign tool to prepare common accessibility properties to include in the document, and (2) the steps to perform in order to include interactive and multimedia features in the eBook.

5.1 Semantic Tagging

InDesign allows the author to assign semantic tags to text content (headings, paragraphs, strong, emphasis) using paragraph and character styles, but there is no way to define export tags for frames (for example `<main>`, `<section>`, `<article>`, etc.).

The EPUB 3.0 standard defined the attribute `epub:type`⁵ and a specific taxonomy to describe the semantic role of an HTML element in the publication. Next, the specification EPUB 3.1 deprecated it and suggested using the HTML `role` attribute instead, with a specific dictionary: `epub-accessibility`⁶. InDesign allows a creator to add the `epub:type` attribute only to frames and not to portions of text; also there is no way to add the `role` attribute. InDesign allows the application of only the `epub:type` attribute (no longer supported by the EPUB standard) and not the `role` attribute (supported by the EPUB standard and by WAI-ARIA).

5.2 Reading Order

InDesign offers a specific tool – the *Articles panel* – to define reading and exporting order for reflowable formats, such as for EPUB documents. So, the accessibility requirement related to the reading order compliance is supported by InDesign.

5.3 Non-textual Content

An alternative description has to be applied to any graphical content in the eBook. InDesign allows a creator to add an alternative description through the alt text attribute to images, but this has limited support. In fact, there is no solution for creating `<figure>` groups containing an image and a `<figcaption>`. Thus, just the alt text was applied to

the images. The only image for which it is not possible to set the alternative description is the cover image, as it is automatically generated by InDesign during EPUB export. Whereas, for more complex figures equipped with captions we had to handle the code by hand.

Multimedia content (audio and video) can be placed in the publication, but there is no way to manage different tracks (for example: closed captions, audio description, sign language) and even to manage attributes, link “*aria-label*” that is required to indicate where to find the transcript or whether audio descriptions are available. Therefore, also in this case the support is very limited.

5.4 Tables

Accessible tables can be created in InDesign, with two limits:

1. adding a table summary (alt text) is not supported;
2. only rows can be marked as table headings.

5.5 Language

Language can be correctly set at every level of content using paragraph and character styles, but the exported HTML has no `lang` attribute in the `<html>` element (as required by the EPUB Accessibility 1.0 guidelines), it is applied to the `<body>` element.

The HTML files containing the cover and the table of contents are exported without any `lang` attribute.

5.6 Navigation and Reference

InDesign offers the tools for creating Tables of contents and indexes. The first ones (Tables of contents) are fully interactive and accessible, whereas the second ones (indexes) are generated as static texts, so are not useful in the interaction with the digital document.

Footnotes and endnotes are correctly managed and exported by InDesign.

The EPUB Accessibility 1.0 guidelines require that in the case of an eBook with paginated equivalent (for example a paper book), the EPUB must contain a mapping for the reflowable content to the pages of the paginated publication. This is not possible to achieve through the InDesign version available at the time of writing.

The EPUB standard defines the possibility to link specific parts of the book (e.g., introduction, list of images, title page, copyright page, etc.), which are

⁵ <https://idpf.github.io/epub-vocabs/structure/>

⁶ <https://www.w3.org/TR/dpub-aria-1.0/>

so called *Landmarks*. InDesign automatically generates links for the cover and the table of contents, but there is no possibility to manually add other landmarks.

5.7 Document Title

EPUB Accessibility 1.0 guidelines requires books to have meaningful titles. InDesign exports an HTML file putting the file name as `<title>` element in the `<head>`. So this requirement is partially supported. However, the name is not enough to be compliant, because it is not a meaningful title. The authors should (if necessary) revise it by hand.

5.8 Mathematics

In order to test all accessibility features stated in the EPUB 3 specifications and EPUB Accessibility 1.0, we also tested how to add some math formulae to a document. The only way to put mathematic formulae in InDesign is as images, thus preventing any possibility to access them via assistive technology. An alternative description can be added to each image, but this is not a suitable solution to solve mathematics issues. Moreover, such an approach is for very limited use cases and assistive technologies.

The EPUB 3 standard defines MathML as the proper way to place math formulae in eBooks.

5.9 Metadata

InDesign allows content creators to define bibliographic metadata such as title, author, copyright, description, etc. It is not possible to specify accessibility metadata that describe the accessibility features of the EPUB file, in particular those required by the *EPUB Accessibility 1.0*⁷ specifications: *accessMode*, *accessibilityFeature*, *accessibilityHazard*, and *accessibilitySummary*.

5.10 Font Sizes

InDesign exports font content dimensions in CSS files, using pixels as its unit of measurement. This makes the size fixed, which contrasts with accessibility requirements: EPUB Accessibility 1.0 guidelines require the use of relative sizes (e.g., %, *em*, *rem*), to allow end users to change rendering modalities.

⁷ Reference: <http://www.idpf.org/epub/a11y/accessibility.html#sec-disc-package>

6 FEATURES EDITED BY HAND

The resulting EPUB document exported by InDesign was further handled in order to add (1) interactive elements (textfield, radio buttons, etc.), (2) JavaScript aimed at performing tasks according to the user actions, and (3) WAI-ARIA roles and attributes to address some accessibility issues. For this additional work, we used the Sigil software.

6.1 Interactive Components

According to the InDesign instructions, interactive elements like buttons can be added in order to create editable forms in PDF or EPUB. In InDesign, activating the “Digital Publishing” mode, and using “button and form”, an interactive element can be added. Indeed, such a procedure works for PDF documents, but does not for EPUB ones. In fact, when exporting the InDesign document containing the added interactive elements, into the resulting EPUB document those control elements (e.g., textfields, radio buttons, etc.) are not operable.

The only possible way to proceed is using the function “insert Html”, which allows the operator to enter HTML and insert the requested code for the interactive elements in order to create an interactive object: Each file is included in the tag `<object></object>`. This function makes the exportation time slower and it is not possible to verify if the elements work until the exportation ends.

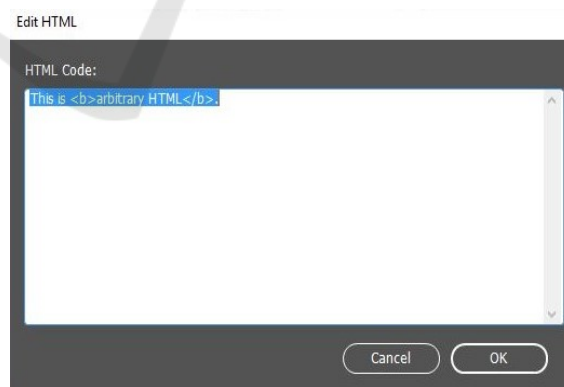


Figure 3: InDesign editor to insert and edit HTML.

In our prototype, we used the function “insert HTML” to (1) add an editable text field for the input user name, and (2) create three interactive forms composed of three radio buttons for handling the answers of each question (see Figur for an example). This allowed us to create multiple-choice questions.

Furthermore, we also designed by hand two simple buttons (simple and complex view) to handle the possible views for a table (i.e. a view with 2 or 4 columns).

Once the document was exported in the EPUB format, we further edited those elements in order to customize them according to our needs. For example, we had to (1) link them to JavaScripts and (2) add WAI-ARIA Roles and attributes for accessibility purposes (see next sections for more details).

6.2 Actions via JavaScripts

To handle the EPUB document behaviors according to the user actions, we coded four main scripts:

- Check.js: this script gets the string edited by the reader in the text-field (i.e. the user's name), and prints it later in the eBook, i.e. at the beginning of the first chapter.
- AddName.js: this script gets the string edited by the user in the text-field and prints it at the beginning of each question form.
- Form.js: This script handles the questions in the forms. When the reader clicks on the answer radio button, the script performs the success/failure check.
- SimpleView.js and Complexview.js: this script manages the table views by switching between a complex or simple view.

All the scripts were added to the exported EPUB file and linked to the interactive elements. Using Sigil tool, we can edit the scripts in order to be able to modify them, if necessary. However, editing the scripts directly in InDesign and testing them is not allowed by the tool itself. On the other hand, Sigil allows for editing the scripts and test if they work.

WAI-ARIA Techniques

WAI-ARIA (Accessible Rich Internet Applications) is a specification written by W3C, which defines a set of additional HTML attributes that can be applied to elements so as to improve accessibility wherever it is lacking. This technology can help in adding in further semantics that browsers and assistive technologies can recognize and use to let users know what is going on (Brown and Harper, 2013).

In our prototype, WAI-ARIA semantic tags have been used especially for the dynamic contents and parts in the eBook. For example, we used `aria-live="assertive"` in the tag `<script>` to advise the assistive technology when the script modifies the page of the eBook.

We used Sigil for coding this, because doing it directly in InDesign was not possible. In fact, modifying the `<script>` tag firstly edited in InDesign and then exported in the EPUB document is no longer allowed. Figure 4 and Figure 5 show the possible scripts.

```
<script src="../../Misc/Form.js"
type="text/javascript"> </script>
```

Figure 4: The tag `<script>` resulting after the InDesign exportation.

Thus, the tag `<script>` needs to be further edited when the document is exported in the eBook.

```
<script src="../../Misc/Form.js" aria-
live="assertive" type="text/javascript
"></script>
```

Figure 5: The resulting `<script>` tag edited via Sigil.

The same is requested for the attribute `aria-live="polite"`, that we used in the tag `<p id="result">` used for showing the current score achieved. When the user interacts with the questions form, the script computes the new score – which decreases for a wrong answer and increases for a right answer. Consequently, the paragraph needs to be updated each time the script runs. Using this WAI-ARIA attribute and the editing of the code after the document exportation, we were able to immediately test the script success/failure, and successful paragraph updating.

7 DISCUSSION

When considering the accessibility of eBooks or any product, rarely do we pay attention to the accessibility support offered to the authors. In fact, authoring tools should support accessibility while preparing and creating the contents and the user interfaces: the editing tool should support the authors in manipulating and obtaining accessible results to deliver to the end users. In our study, some limitations came up in supporting authors in preparing accessible documents via InDesign tool. Firstly, we observed that InDesign does support basic accessibility features, but to obtain a fully native accessible EPUB some additional work on the exported file is required by hand. Secondly, the tool was very limited for designing interactive elements and forms in the eBook. Several further steps need to be performed by using other editors and tools.

Moreover, for certain accessibility requirements, like those offered by WAI-Aria techniques, specific knowledge is required.

To sum up, the InDesign tool is able to provide accessibility for the basic components, textual contents, alternative descriptions for simple images not equipped with captions, headings and paragraphs. Navigation through the document is partially supported: the table of contents can be generated in an accessible way, while the index is not appropriate. Audio content is not fully supported due to the editor limitation in adding all the types of format. Interaction features and some multimedia contents are not supported by the tool. The evaluation results are reported in Table 2.

Table 2: Summary of the accessibility features supported by InDesign.

Function	Supported	Partially supported	Not supported
Headings	X		
Reading order	X		
Frames			X
Image	X		
Figures and captions		X	
Table summary			X
Table headings		X	
Language		X	
Document title			X
Metadata		X	
Table of contents	X		
Indexes			X
Notes	X		
Landmarks		X	
Multimedia contents		X	
Math formulae			X
UI interactive elements			X
JavaScripts			X
WAI-ARIA		X	

8 DESIGN RECOMMENDATIONS

Based on the results highlighted by this work, some design suggestions can be proposed for authoring tools developers in order to make available the appropriate functions to produce accessible end contents. These can be summarized in functions and features to support:

- *content accessibility requirements*: content structure (headings), reading order, images (alternative descriptions and captions), lists and tables;
- *meta data*: language specification, document title, and other metadata aimed at providing useful information to the assistive technology;
- *audio and multimedia contents*: audio contents and auditory descriptions;
- *interaction features design and editing*: interface controls and elements for the reader interaction with the contents;
- *scripts editing and test*: standard and customizable JavaScripts to add interaction contents and features.

9 CONCLUSIONS

Through an interactive and multimedia EPUB 3 eBook prototype designed for the purpose, in this work we presented the accessibility support effectively offered to authors by the popular Adobe InDesign tool. Both basic and advanced functions and features have been considered in the evaluation.

The study pointed out that even though basic accessibility requirements are supported by InDesign, some additional work is required by the authors. For instance, alternative descriptions can be added to the images via InDesign, but captions are not properly supported. The InDesign tool resulted in very limited support for authors in preparing and delivering multimedia, interactive and customizable contents accessible via assistive technology. Numerous manipulations via other tools (e.g. Sigil) are required by the content authors. To sum up, to answer the two research questions, we can conclude that (1) the InDesign tool is partially mature enough to effectively support basic accessibility features, and (2) the InDesign tool is very limited in supporting accessibility in the interaction and multimedia features. In this perspective, some potential suggestions for developers of authoring tools can be proposed. This is a first contribution to accessible digital publishing for authoring tools developers. As future work, we plan to extend our study to other popular design tools as well as to involve publishing people skilled in editing electronic documents in order to explore their knowledge of accessibility offered by the design tools.

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