Design of Interfaces for People with Blindness

Designing the Complete Learning Environment for Braille Users Studying Mathematics

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***Abstract*—Digital platforms are not automatically accessible for people with blindness, it must be designed for multimodality, both regarding the architecture and the interface. With the point of departure in the Nine Laws of Cognition we focus on complex content such as mathematics and how it could be accessible for Braille readers. The aim of this paper is to highlight and to discuss what is required from digital platforms to support mathematic Braille. The situation for Braille users learning mathematics is not at all very satisfactory. When using the ASCIIMath format (a mathematical markup language) in digital reading and writing, Braille users practice a format not in use by teachers or sighted peers. What we are aiming at here, is to identify the functionality and the technical infrastructure needed to make the design of a truly usable learning environment possible.**

Keywords; EPUB3; ASCIIMath; Braille digital platforms.

I. INTRODUCTION

The digitalization of society makes it possible to design computer interfaces accessible for people with blindness and low vision. Digital platforms are not automatically accessible for people with blindness and low vision, it must be designed for multimodality, both regarding the architecture and the interface. In this paper, we will focus on complex content such as mathematics and how it could be accessible for Braille readers. Not by simplifying the complexity but to make it accessible. The aim of this paper is to highlight and to discuss what is required from digital platforms to support mathematic Braille.

When it comes to e-books a technological shift is ongoing. A pilot study was initiated by the Swedish Agency for Accessible Media, MTM (MTM = Myndigheten för tillgängliga medier), in which EPUB 3 (EPUB = electronic publication) was introduced for users with blindness. EPUB 3 is an e-book file format and a technical standard for production and consumption of digital books, and for other various publications. It is not specifically aimed for users with print impairments, but with the ambition to be accessible for all users [1]. The EPUB 3.2 specification states that "EPUB 3 defines a distribution and interchange format for digital publications and documents. The EPUB format provides a means of representing, packaging, and encoding structured and semantically enhanced Web content—including HTML [HyperText Markup Language], CSS [Cascading Style Sheets], SVG [Scalable Vector Graphics] and other resources—for distribution in a single-file container" [2].

A. *Complex content for Braille users*

Braille consists of a cell containing six dots that could be combined in 64 different ways. Even though Braille has specific combinations of dots representing the various letters in the alphabet, and though the Braille cell combinations are not based on letter sign similarities but on other principles, Braille needs to be considered as a unique writing system with its own writing principles. Braille is used for various kinds of notations, text, phonetics, music, mathematics, and science. With the use of certain Braille patterns as composition signs, it is possible to vary the meaning of the following braille cells, and thus creating a very large number of character representations in Braille. An example is given in Figure 1 showing how letters are discriminated from numbers.

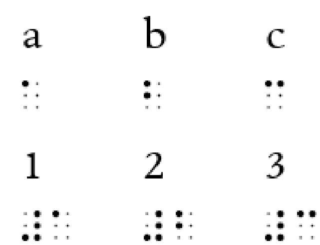

Figure 1. Braille letters with the special composition sign for numbers change meaning to numbers.

However, this ability of Braille in representing various notations is not in itself enough to make it possible accessing complex content in digital form, such as mathematics.

Complex could be defined as something consisting of many different and connected parts. Mathematics is complex and denoting or involving numbers or quantities containing both a real and an imaginary part. The notation systems for mathematics are also complex and in more advanced mathematics many kinds of expressions exist built on known and unknown variables. Expressions are often notated in print in a two-dimensional form, e.g., fractions and square roots. For a Braille reader, all this will be presented in a linear form as shown in Figure 2.

$$z = \frac{\frac{7x-6y}{5x+8y}}{\frac{7x-6y}{8y+5x}}$$

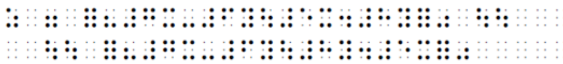

Figure 2. Mathematics in Braille is mainly linear, here an example of a complex fraction in Swedish Braille.

The principles for how to represent mathematics in Braille (Braille standards) vary considerably between languages and countries. In Swedish Braille, a mathematical expression may be written within a regular text, whereas in an English text special Braille signs are needed indicating that the content is mathematical. In Figure 3 this difference is shown with a simple mathematical example.

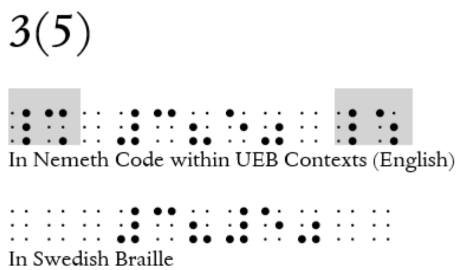

Figure 3. The Nemeth code for mathematics uses “switch indicators” for when the user should interpret Braille signs as mathematics – here marked in grey. In Swedish Braille no such indicators are used.

B. From Library for the blind to Agency of Accessible Media

In 1980 the library of the Swedish Association of the Visually Impaired was reorganized, becoming the core of the then founded Swedish Library for Talking Books and Braille, a governmental agency. The mission for the Swedish Library for Talking Books and Braille was to make already existing, published books and music notations accessible for Braille readers and readers of talking books. The content ranged from fiction, poetry, popular science to books for children, but also course literature for students at universities. The target group were people with blindness or low vision. That group expanded over the years to include people with different kinds of reding disabilities, such as dyslexia, cognitive disabilities, diseases causing spasms, and other problems when reading printed books. The disability could be permanent or temporary. Because of the expanded target group and the variety of media due to the digitalization, the Swedish Library for Talking Books and Braille, made a shift in their focus and became the Swedish Agency for Accessible Media (MTM) in 2013. MTM produces and distributes literature and magazines in accessible formats for people with reading disabilities and actively participates in the development of accessible media.

A simplified definition of media is literature and magazines made by MTM. Accessibility of these media includes talking books, Braille books, e-textbooks, literature in sign language, tactile picture books, Braille calendars, the easy-to-read news magazine *8 sidor* (8 pages), and easy-to-read books. The ability to make media accessible rests on theories about our senses, how they work individually and in combination. The interest for how different senses work and in which way a loss of one sense affects an individual has a long history. Much of the research regarding blindness has focused on the relation between vision and touch [3] [4]. What kind of information could be replaced by touch when someone has lost their eyesight? Research has been in relation to Braille reading, and tactile pictures, but also on spatial understanding and blindness [5] [6]. A study from 1965 contains both an extensive literature review on reading of talking books and a study that compared sighted students with students with blindness in relation to what they have comprehend of the content [7]. This study is representative for research from the first decades of the use of talking books, since the focus for the early studies was not on comparing Braille reading and talking books, but on making comparisons between sighted and non-sighted reading talking books. Talking books were introduced during the 1930s, e.g., in 1934 by the National Library Service at the Library of Congress, and in 1935 by the Royal National Institute for Blind (RNIB), and further developed during the following decades. The first talking book was recorded on disc and was played on special designed turn tables and it was not until tape recorder were developed in 1950s it was spread to a larger audience with blindness. To begin with, there was an over-reliance on its ability to replace Braille. This could partly be explained by the enthusiasm for the technology and partly by a simplified production of talking books compared to Braille. The Braille books were manually copied by people that had knowledge in Braille while recording talking books could be made by anyone that had some reading aloud skills. The development in technology and reading devices for recorded books has been striking from tape recorder to cassette recorder, to Walkman, MP3 (a coding format for digital audio), Daisy players (Daisy = digital accessible information system) and smartphones. The development of accessible Braille has followed the same noticeable development, with refreshable Braille displays for computers, Braille printers, and refreshable Braille displays to use in combination with smart phones. However, later discussions have brought up the necessity of access to the written language for people with blindness, the necessity of access to Braille. Both for learning outcome and for democratic reasons literacy is important.

In section II, the cognitive processes in relation to accessing platforms that support problem solving in mathematics are explored. In section III, multimodality is discussed, and in section IV, the focus is on usability and

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technical development, the challenges and what ought to be developed to improve the usability for Braille readers studying mathematics. In section V, we suggest further research and development in order to progress in the creation of a complete, flexible, and usable learning environment for Braille users learning mathematics.

II. COGNITIVE PROCESSES

The cognitive psychologist Barbara Tversky presents The Nine Laws of Cognition in her book, *Mind in Motion: How Action Shapes Thought* (2019). These laws serve as a basis for discussion in this book, combined with socio-cultural perspectives. The laws are as follows:

1. There are no benefits without costs.
2. Action molds perception.
3. Feeling comes first.
4. The mind can override perception.
5. Cognition mirrors perception.
6. Spatial thinking is the foundation of abstract thought.
7. The mind fills in missing information.
8. When thought overflows the mind, the mind puts it into the world.
9. We organize stuff in the world the way we organize stuff in our minds.

These laws illustrate how the mind gets involved as we navigate the world and interpret our environment. Even though our mind and senses are dependent on physiological conditions, the way we think, the emotional condition we are in and how we organize 'stuff' in our mind are also highly dependent on the cultural traditions that we belong to, as well as on our living conditions. It is a relationship between cognitive aspects and a socio-cultural perspective, which is a combination of culture, cultural traditions, socio-economic conditions, and societal aspects. These aspects need to be taken into consideration when designing for people with blindness and low vision.

A. There are no benefits without costs

The lack of one sense will causes challenges for a person, to make something accessible does mean that some effort is needed. To make a platform or a software accessible for a Braille reader means it could be usable with a Braille display or by synthetic speech. Synthetic speech will require more strain on working memory than using the Braille display. Since a Braille display only show one row at the time it does not give the same overview as screen display.

B. Action molds perception

Perception is not something that comes to us, we need to be active to perceive the environment. To be able to perceive the Braille letters motion is needed, one must move the fingertips on a display or a printed sheet to recognize the letters. However, how the movement goes and how many fingers that are involved, if both hands are used or not, depends on the individual [8]. The same goes for audio information, one can hear a sound, voice, or noise, but to perceive the content or identify what is causing the noise we must listen actively.

C. Feeling come first

If we are not motivated to read, learn, or do something, we do not gain either understanding or knowledge. The feeling is often affected by what supports or hinders the use of a platform or a software. By designing for accessibility there is chance that the user feels addressed and by that motivated to take the effort to use the platform.

D. Mind can override the perception

Seeing is something we learn, and we continually learn to do it [9]. When we have something in front of us, it could be an object or a view, we do not always look at what we see since memory overrides perception. For a person with blindness, it is not always that they perceive what they touch or hear, since they are occupied by previous experience that works as a grid between them and the environment. We experience the world from our own bodies, that involves previous experience and memory that are involved in all perception.

E. Cognition mirrors perception

What we see, touch, and hear, influences our mental images, and our mental images influences the perception of the environment [10]. Like sighted people, blind people learn to touch and hear continually. It is a way to learn about the environment, or as Tversky [11] puts it: "Mental spatial frameworks can be used to store and organize ideas, any kind of idea…" She argues that spatial mental frameworks can organize ideas, and mental image is not necessarily created in relation to pictures, it could as well be created from words [11].

F. Spatial thinking is the foundation of abstract thought

Much of our thinking is ordered in space and time, we think of the future or the past, where we have put things and how to organize our desk or files in the computer. Spatial thinking is also a part of spatial awareness. Spatiality could be discussed on both micro and macro level. On micro level we could discuss various phenomena, such as design of a text, a computer interface or Braille book. Spatial thinking includes logic, something that could be communicated. Platforms and interfaces aiming to support people with blindness need to have a spatial and hierarchical structure that follow the logic of the content and the intended use.

G. When thought overflows the mind, the mind puts it into the world

Like sighted people, blind people need to take notes, or jotting in textbooks to remember important parts. Printed Braille books do not allow jotting in the book, the notes need to be made separate as text or voice memos. A possibility to integrate jotting and the writing of exercises within a teaching material, creating an interactive textbook, should be possible within an EPUB 3 publication, but is not commonly spread yet. For the time being, exercises are made in parallel, e.g., as MS Word documents.

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H. We organize stuff in the world the way we organize stuff in our minds

In early 2000s Lev Manovich [12] argued that for an interactive multimedia program to be interactive, the user needs to go into the head of the programmer, that is to understand his or her logic. This is still the case in many situations, but most of us has been trained in how to find out the logic of the designer of a program. To make complex content accessible such as mathematics and science for people with blindness, a user involvement is necessary.

III. MULTIMODALITY

The term modality could be defined either as a sense or as a medium such as text, picture, or sound. Often when we talk about multimodality, we include both definitions, since a multimodal process involves the use of various senses when we are watching a movie or read a book that includes text and pictures. However, a single media can involve a multimodal process, we read about an environment and imagine how it looks like, or we read about a specific sound and hear it inside the head. To design for multimodal experience among people with blindness, and low vision, it is necessary to have knowledge in how tactile perception works, how audio input can support activities, and the principles for Braille reading.

We perceive and understand our surroundings through our senses. Many researchers believe that the ability to interpret the impressions we get through our senses are innate, others that we through experience learn to interpret the various sensory impressions we get through sight, hearing, feeling, taste, and smell [5]. There is also an extensive discussion as to whether our senses conflict with each other or interact, and if so how. Too much input from different modalities can lead to cognitive load [13]. An individual who is either congenitally blind or that later acquires an injury, will not obviously develop the other senses to compensate for the missing. Instead, it can work the opposite way. It is therefore important to stimulate and activate, for example, a child with blindness so that he or she really utilizes touch, smell, and hearing.

The orientation system is fundamental to the others which are: the visual, the auditory, the haptic and the taste-smell system. The basic orientation system interacts with the other systems and constitutes a frame of reference for these [14]. It can be assumed that people with blindness become better at interpreting tactile information than sighted. Not because there is a special one sensitivity, but because you concentrate and practice in a different way than sight needs to do. The tactile perception is very limited. We can only feel one small area at a time, the sense of touch does not function as seeing where one can get an overview of a large area at the same time. What can be perceived by touch is what we are in direct contact with.

Auditory input, such as read out text or synthetic speech, is common for people with blindness, and function as a support or supplement to Braille. However, when studying mathematics, a combination of braille and audio is necessary since it requires too much cognitive load to use audio only.

IV. USABILITY AND TECHNICAL DEVELOPMENT

During 2021 MTM is performing a shift to EPUB 3 as the overall production format for various media types, leaving DTBook (DTBook = Digital Talking Book), a Daisy XML production format (XML = Extensible Markup Language). Daisy is an international standard designed to be a complete audio substitute for print material and is specifically designed for use by people with blindness, low vision, and dyslexia. Based on the MP3 and XML formats, the Daisy format has advanced features in addition to those of a traditional talking book. MTM is furthermore planning to use EPUB 3 as distribution format for talking books (with text and recorded sound). The present distribution format is called Daisy 2.02. This change has been prepared and expected for many years and is a part of a global shift in electronic publishing and in accessible publishing for persons with print disabilities.

Driving forces in the development of industry standards for accessibility, in both mainstream publishing and in specialist accessible publishing by organizations for people with a print disability, has been the Daisy Consortium [15], the International Digital Publishing Forum (IDPF) [16], the World Wide Web Consortium (W3C) [17], and others. This technological shift will lead to accessibility improvements for Braille readers. To be noted here, and of importance, is the use of standard internet technologies in EPUB 3, such as HTML5 and CSS3.

EPUB 3 publications will in most cases have built in accessibility features, such as:

- Being readable with assistive technologies.
- Having text that fits all screen sizes.
- Having adjustable text (font, color, font size and line spacing).
- Being navigable by chapter, section, page, sentence and more.

A. Pilot study of EPUB 3

But accessibility does not come by itself, to prepare for the coming shift to EPUB 3 as a consumer format at MTM a pilot project was performed in 2018. The overall purpose was to "create increased usability for customers at MTM and SPSM (The National Agency for Special Needs Education and Schools) by the transition to a more modern consumer format for various digital products which today are delivered in the Textview format [a local e-book format] and in the Daisy 2.02-format". The pilot project produced a requirements document for a usable digital reading experience by Braille users, based on a survey with 7 Braille users and 10 teachers/counsellors working with visually impaired. A thorough study of current recommendations and best practices in accessible digital publishing was carried out and a first draft of production guidelines was created. These guidelines are today in active use. A production process for creating valid and accessible EPUB 3 files was established. A sample book for testing purposes was created, as well as a set of feature tests based on the gathered requirements. Testing was performed with Braille users [18].

The need to fulfill certain prerequisites before introducing EPUB 3 as a distribution/consumer format were observed, including the following:

- EPUB 3 reader software and screen readers must function well together. This means, e.g., that keyboard shortcuts are coordinated and does not have competing functions in the reader software and in the screen reader respectively. Information must be sent to the refreshable braille display and to the speech synthesis equally.
- Access to original pagination/page numbering when available to enhance navigability.
- Skippability or escapability, i.e. the possibility to escape from certain content such as tables, and to continue to read the main content.

Concerning mathematics in EPUB 3, the pilot study stated that, since the EPUB 3 specification allows the embedding of mathematical markup with MathML (Mathematical Markup Language), it is very likely the best choice to handle mathematics in digital master files. The need for development of support for the Swedish language for MathML was therefore highlighted, both for output in braille and in speech synthesis.

B. Usability challenges for Braille users learning mathematics

The Swedish Braille Authority is the official language caring authority for Swedish Braille under the auspices of MTM. It has been noted and expressed by the Swedish Braille Authority, that teaching material and teaching methods for students learning mathematics using Braille have a large potential to be improved.

The current learning materials produced by SPSM and MTM for Braille users contain mathematic content in the ASCIIMath format. This is a practical and useful choice by the agencies since the Braille users may by themselves write mathematical expressions in the ASCIIMath format using a normal computer keyboard.

The situation for Braille users learning mathematics is not at all satisfactory though. When using the ASCIIMath format in digital reading and writing, Braille users practice a format not in use by teachers or sighted peers. This means that Braille users cannot present their exercises in a format that teachers and peers are familiar with.

Braille users may also get paper Braille teaching materials from SPSM and from MTM. The Braille standard for writing mathematics on paper is very much different from reading and writing digitally in the ASCIIMath format. We can see here that Braille users need to be acquainted with several alternative mathematical formats, which is not expected from their sighted peers – their cognitive load is hence comparatively heavier.

The possibility to use Braille as input, to write mathematical expressions by using a Braille keyboard, is not present. Neither is the possibility to choose the paper Braille standard for mathematics as output format, nor speech input or output for Swedish.

The choice to produce mathematic content in the ASCIIMath format seems to have been the least bad choice, meaning that it has provided the Braille user with some functionality, but not at all satisfactory in usability. What we now imagine is that the technical development has created a possibility to go beyond present and earlier technical barriers.

Current testing in 2021 at MTM has used MathJax software embedded in the EPUB 3 book to render mathematical expressions. The MathJax project is an open-source software product that provides support for mathematical markup directly in HTML source code, such as LaTeX (a document preparation system), MathML, and ASCIIMath markup. As output MathJax may produce HTML and CSS, SVG, or MathML. The MathJax software seems to be in the forefront in current technology for producing or rendering mathematics.

V. Discussion

The vision is a complete, flexible, and usable learning environment for Braille users learning mathematics by providing all complementary input and output possibilities that are relevant for Braille users, for the individual to choose from.

The result from the EPUB 3 pilot study indicated that the readers would benefit from the multimodal input where Braille and synthetic speech could be combined simultaneously. Since the EPUB 3 presupposes a text to be well-structured in markup, it supports a spatial and hierarchical structure that follow the logic of the content and the intended use. That reduces the cognitive load which influences the way people learn [13]. For people with blindness this is important, as they are limited to senses (touch and hearing) that do not allow an overview of the material they are reading.

The EPUB 3 format supports spatial thinking [11] since it offers the possibility for good navigation in the book, enabled by a strict hierarchical structure in markup. Navigation in relation to page numbers is not guaranteed though, it depends on page numbers being present in the source material and if the EPUB reader software has the functionality to render page numbers. The possibility to skip parts in a text such as figure and tables is enabled through supporting markup.

The ability to make use of the various parts of a flexible learning environment, such as Braille keyboard, speech, ASCIIMath and MathML (with regular keyboard) enhances multimodality. Since multimodal processes are involved in learning situations it is important that people with blindness have access to several modalities. Such flexibility will motivate the Braille reader since it gives a feeling of freedom [11].

The various output modes required for a flexible learning environment are similar but have more variants: refreshable Braille devices, speech, Braille embossers, ASCIIMath, MathML, and SVG for images. The ability to emboss mathematical content in paper Braille is an important feature for Braille users, just as printing is for print users.

Image output (e.g., the SVG format) is crucial for Braille users, e.g., when delivering exercise assignments to sighted teachers. The possibility to send images with mathematical content to refreshable Braille devices that can reproduce images and graphs in a tactile mode, such as the Graphiti from Orbit research, would enable Braille users yet another way to interact and explore mathematical content. That will support the ability to get spatial overview and support spatial thinking since it is the foundation of abstract thoughts [11].

The future complete, flexible, and usable learning environment would rely on the EPUB 3 format and on current technology for producing and rendering mathematics, most notably the MathJax software. The development of the software should preferably be made with consideration to multimodality and the cognitive aspects that are presented in the Nine Laws of Cognition. We have identified what is needed for people with blindness to have access to complex content in Braille:

- The possibility to write in Braille, to input Braille – note that there are fundamental differences in how Braille standards for mathematics are constructed in various languages and countries.
- Conversion between Braille and MathML/ASCIIMath/LaTeX needs to be developed.
- The possibility to output Braille to various devices including embossers.
- Conversion between MathML/ASCIIMath/LaTeX and Braille needs to be developed and/or adapted to various languages, such as Swedish.
- An individual choice in input and output settings.
- Software that can display mathematics visually using MathJax and HTML5, both within and outside the EPUB 3 context.
- Software that can display mathematic content written by Braille users.
- Interaction with refreshable Braille devices that are able to produce images and graphs, such as the Graphiti, an interactive tactile graphics display from Orbit research.

VI. CONCLUSION

The conclusion is that more knowledge is needed when designing the interfaces for a future learning environment for Braille users learning mathematics. What we are aiming at, is to identify the functionality and the technical infrastructure needed to make the design of a truly usable learning environment possible. Central is the possibility to use Braille as input and output mode, to switch freely between the available input and output modes, and the possibility to make these choices individually. Crucial for the motivation in Braille users to learn mathematics is an interface that is designed with regard to cognitive aspects and taking available modalities into consideration, that is touch and hearing.

A. Future research

The Swedish Braille Authority has identified the need of performing several investigations or knowledge overviews in preparation of the creation and design of a more complete, flexible, and usable learning environment for Braille users learning mathematics:

- A knowledge overview of teaching materials/resources and methods for sighted learners in mathematics. What are the various teaching materials/resources and methods? Which of them works, and which does not work, for Braille users? Why does certain teaching materials/resources and methods work well?
- A knowledge overview of the learning situation in various countries for students learning mathematics using Braille.

REFERENCES

[1] The World Wide Web Consortium (W3C). *EPUB Accessibility 1.1: Conformance and Discoverability Requirements for EPUB Publications*. [Online]. Available from: https://www.w3.org/TR/epub-a11y-11/ 2021.07.01

[2] The World Wide Web Consortium (W3C). *EPUB 3.2: Final Community Group Specification 08 May 2019*. [Online]. Available from: https://www.w3.org/publishing/epub3/epub-spec.html 2021.07.01

[3] D. Katz, The world of touch,, L.E. Kreuger, Ed. A Psychology Press Book, Hillday, New Jersey: Routledge, 1989.

[4] Y. Eriksson, Tactile Pictures. Pictorial representations for the blind 1784–1940. Diss. Acta Universitas Gothoburgensis, 1998.

[5] J. M. Kennedy, Drawing and the Blind. Pictures to Touch. New Haven: Yale University Press, 1993.

[6] S. Millar, Space and Sense. Oxford: Routledge, 2008.

[7] F. J. Crowley, A Comparison of the Listening Ability of Blind Students and the Listening Ability of Sighted Students in the Intermediate Grades. Bronx: Fordham University, 1965.

[8] Y. Eriksson and K. Fellenius, Interaction between Braille and tactile pictures for a deeper understanding. Terra Haptica. Tactile picture, Cognition, Education, 2014, pp 55–65.

[9] Y. Eriksson, Bildens tysta budskap. Interaktion mellan bild och text [The silent message of the image. Interaction between image and text]. Lund: Studentlitteratur, 2017.

[10] N. Mirzoeff, How to See the World. UK: Pelican Books, 2015.

[11] B. Tversky, Mind In Motion, How Action Shapes Thought. New York: Basic Books, 2019.

[12] L. Manovich, The Language of New Media, Cam. Mass.: MIT Press, 2001.

[13] G. Cooper, Research into cognitive load theory and instructional design at UNSW. In: Retrieved October 22 (1998), p. 2003.

[14] J. J. Gibson, The Ecological Approach to Visual Perception, Houghton Mifflin Harcourt, 1979.

[15] The DAISY Consortium. [Online]. Available from: https://daisy.org/ 2021.07.01

[16] International Digital Publishing Forum. [Online]. Available from: http://idpf.org/ 2021.07.01

[17] The World Wide Web Consortium (W3C). [Online]. Available from: https://www.w3.org/ 2021.07.01

[18] From Textview to EPUB 3 – a Swedish pilot project for the introduction of EPUB 3 as consumer format at MTM and SPSM, final report, Stockholm: MTM, 2018.