



Mag. rer. nat. Mathias Glatz, BSc

A Critical Analysis of E-Books and Web-based Online-Reading Offers

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Em.Univ.-Prof. Dr.phil. Hermann Maurer

Institute for Interactive Systems and Data Science

AFFIDAVIT

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Abstract

Nowadays, digital content is very widespread. Most of the humanly created information is available through computers, smartphones, tablets, and other devices that are usually connected to the Internet. Although many advantages with respect to digital content exist, they are not exploited fully yet.

In this thesis, a critical analysis of e-books, devices and software for reading them, and web-based online-reading offers is given. Its purpose is to point out the current status of functions for adjustments and reading convenience on devices like e-book readers and smartphones. As a result of this, several extensions for existing software are proposed to further improve reading convenience. These are cross referencing & transclusion (inclusion of content from other sources), user groups (classifying readers by their skills and interests), and user feedback & rating techniques (to receive information on errors and for further improvements). Lastly, lists of current software, e-book readers (including specifications), and web-based online-reading offers are given.

Zusammenfassung

Digitale Inhalte sind heutzutage sehr weit verbreitet. Die meisten Inhalte, die von Menschenhand erstellt wurden, sind mittlerweile über Computer, Smartphones, Tablets und andere Geräte abrufbar. Diese sind zudem häufig mit dem Internet verbunden. Obwohl digitale Inhalte sehr viele Vorteile gegenüber konventionellen Inhalten haben, werden diese noch nicht in vollem Maße ausgenutzt.

In dieser Arbeit werden E-Books, Geräte und Software um Bücher zu lesen, sowie webbasierte Online-Angebote für digitale Inhalte kritisch analysiert. Infolgedessen werden diverse Erweiterungen für bereits vorhandene Software vorgestellt, um den Komfort für Leser weiter zu erhöhen. Diese sind Verlinkung & Transklusion (das Einbetten von Inhalten aus anderen Quellen), Benutzergruppen (Leser werden entsprechend ihren Fähigkeiten und Interessen eingestuft), sowie Feedback & Bewertungen von den Benutzern (um Informationen über Fehler und weitere Verbesserungen zu erhalten). Zuletzt werden Listen von Software, E-Book Readern (inklusive deren Spezifikationen), und webbasierten Online-Leseangeboten geliefert.

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1. Introduction

In this thesis, a critical analysis of e-books, devices and software for reading them, and web-based offers for online-reading is done. In further consequence, several extensions for existing software for reading e-books are proposed. These extensions are introduced to make use of advantages of digital content compared to analogue content in form of conventional books.

Therefore, the history of libraries and books is elucidated. Consequently, traditional content in form of books is compared to digital content that is stored on hard discs or other mediums. Further, some insights into the process of digitalisation are given by elucidating projects to digitise books. Also, relevant problems are elucidated and summarised.

Special attention is paid on offers for e-books, devices and software for reading them, and online-reading within a browser. Therefore, widespread e-book file formats are listed and explained briefly. Then, devices that were built for reading e-books are analysed to point out their functions in form of adjustments for text and improvement of reading convenience in comparison to traditional books. These devices are called e-book readers (or e-readers) and have a wide distribution. Further, software for reading e-books on mobile devices and PCs is analysed in the same way. Additionally, lists of current software, e-book readers (including specifications), and web-based online-reading offers are given in the appendix.

Finally, several extensions for existing software is introduced. These extensions are meant for further improvements in reading convenience. They exploit advantages of digital content and technologies like decentralisation of content. More particular, the idea of a modular e-book is introduced. It is based on existing software and techniques but extended with transclusion (to embed content from other sources), user groups (to classify

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readers), and user feedback methods (to receive information on possible errors and improvements).

In this thesis, some screenshots are used to provide a better understanding and explanations of software, e-book readers, and websites that offer online-reading. To avoid the possibility of copyright infringements, any text that is part of a book is disguised by blurring.

2. Libraries

In this chapter, a brief look at the history of libraries, books, and other information-containing material is taken. Further, it is explained why digital content gains more and more importance. Also, *traditional* content (for instance, books) is compared to *digital* content, pointing out that digitalisation has huge advantages with many possibilities for content creators and consumers. Nevertheless, the existence of major risks must be considered. An example is the challenge of long-term preservation.

2.1. Definition, Roles, and Financing

According to (Dictionary.com, 2018) a library is

“a place set apart to contain books, periodicals, and other material for reading, viewing, listening, study, or reference, as a room, set of rooms, or building where books may be read or borrowed.”

Following this definition, a library offers a lot of information, represented in different forms, physically (as books, periodicals, etc.) and electronically (e-books, databases, and more). The library itself provides access to these materials for users. Access means, for instance, places for reading (tables, chairs, etc.) or hardware to consume information that is provided electronically (screen, e-book reader, and more). In fact, there is a strong relationship between users and information.

Especially in research libraries (in-depth collection for one or several topics), new knowledge is created by using existing information or knowledge that was created by people in earlier times. Furthermore, the main purpose of a

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library is the provision of material collected from various sources all over the world.

Other authors (for instance, Pam Sandlian Smith and Bill Ptacek) see much more than a collection of books or an information-providing institution in a library. In TEDx talks (Smith, 2013), (Ptacek, 2016), they expressed their views on (future) libraries. They see them not only as a place to spend time but as a concept where communities are build and a room where creativity can boom. Especially, they emphasise the connections between *users and information* and *users and users*. In fact, in a library, users communicate across time and space with other users. These libraries act as mediators between users and information (Schreck, 2017). Further on, its purposes, respectively, its cultural roles are

1. **Selection:** Definition of collections, for instance, selecting the genre(s) of content for the library
2. **Acquisition:** Acquisition of physical (and electronic) objects from various sources
3. **Description:** Provision of catalogues and indexes for material available
4. **Access:** Provision of shelves etc. and schemes for lending
5. **Preservation:** Care of media and provision of a controlled environment for objects to preserve them

These cultural roles have not changed over time (Francis et al., 2018). Depending on the type of library, these purposes differ in their emphasis. The most important (and well-known) types of libraries are:

- **Academic libraries:** Located on university campuses
- **National libraries:** National repositories of information
- **Public lending libraries:** Offer lending to members
- **Reference libraries:** Offer a possibility for reading within the library but no lending
- **Research libraries:** Focus on one or several subjects in-depth
- **Children's libraries:** Meant for younger readers
- **Digital libraries:** House digital resources and provide preservation for them

2. Libraries

As most of the libraries are free to visit, and lending is rather cheap, the question arises, how libraries – its employees, material, housing, etc. – are financed. Following (Plassmann et al., 2006), libraries are financed mostly by private sponsors (who get their money from donations and contributions), federal and state governments, and churches. Libraries owned by companies are, of course, financed by them or by public research funding.

In the last decades, digital libraries gained popularity. It is not easy to define what a digital library is. According to (Techopedia.com, 2018), they

”consist of a collection of digital resources that may have existed only in digital form, or have been converted from another form to digital. These resources are generally stored in a broad range of formats and can be accessed by users over a computer network.”

This definition is very broad. Almost any content that is stored in a repository like a database or a file archive can be seen as a digital library (Schreck, 2017). For instance, textual repositories containing (born-digital or digitalised) books. Further, social media sites which contain (non-public) messages, links but also non-textual elements like images, audio, and videos. Other examples are big data archives containing images, 3D objects, and data produced by measurement instruments. In this work, the focus is on digital libraries in form of repositories containing electronic books and papers.

2.2. Historical Development

The following paragraphs are based mostly on an article that describes the history of libraries in the Encyclopedia Britannica (Francis et al., 2018). Very early forms of libraries arose in the first half of the 3rd millennium BC. In Nippur, Babylonia rooms containing clay tablets were found. Similar discoveries were made in Egypt (2nd millennium BC). An archive containing about 25.000 clay tablets was created by collecting them from various temples by Ashurbanipal, the last of the great kings of Assyria. During history, many collections and records were destroyed when a government fell or rulers were replaced, for instance, in China.

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In the western world, first libraries arose in Greece and Alexandria during the 4th century BC. The schools of Plato and the Peripatetic school (founded by Aristoteles) created collections of (scientific) books to facilitate researching. Aristoteles' library formed the basis for the library of Alexandria, the greatest library in the antiquity.

In the following centuries, many other libraries were established in other parts of the world, for instance, in Rome, Byzantium, Baghdad, and Spain. In the 2nd century AD, as monastic communities were built, the role of books became more important. There was a strict obligation to copy scriptures, chronicles, and philosophical writings for preservation. The importance of reading and studying was recognised. Books were lent to other monasteries and to secular public. These monasteries can be seen as an early form of public libraries. After universities were founded, students extended existing libraries by adding lecture notes they have made. At this time, books were very expensive and restricted to wealthy people. In the following centuries, private book collections gained more popularity, also supported by the invention of the printing press by Gutenberg in 1440.

During the period of Reformation and religious wars, monastic libraries came to an end. Many contents were destroyed. However, Martin Luther did believe in the idea of libraries and therefore many "modern" libraries were set up on the basis of monastic collections. During the 17th and 18th centuries, collections grew rapidly, especially in the fields of history and philosophy. Some became the core of today's national libraries. By this continuous extension, it became necessary to re-think the organisation of a library. For instance, chaining books to their cases (see Figure 2.1) was no longer practised. Instead, books got lined up as we know it from today. As the growth of libraries was fast and rather desultory, problems in managing (administration, services, cataloguing) arose.

In the middle of the 19th century, these problems were solved and the idea had been established that community libraries should be available and therefore financed by publicity. Back in the late 19th century, Paul Otlet and Henry La Fontaine had an idea to gather all human knowledge to make it accessible for everyone in order to bring peace on Earth (Magalhães and Beiguelman, 2014). Vannevar Bush extended this idea by using (newer) technologies. Already in 1945, he described a machine that can be used by

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Figure 2.1.: Chained books in a library

individuals to store all their books, records, and communications. Additionally, fast access to it is given with special attention to flexibility (Bush, 1945). It was named *Memex* (short for **M**emory **E**xtender) and influenced early versions of hypertext systems that finally led to the World Wide Web (Davies, 2011). See Figure 2.2¹ for an illustration of Memex.

In 1956, the Ford Foundation in collaboration with the Council on Library Resources of Washington D.C. assigned a special task to Joseph Carl Robnett Licklider. The challenge was to analyse how libraries can be improved with future technologies based on the idea of Memex (Licklider, 1965). Nine years later, Licklider published a book named *Libraries of the Future* in which he described an architecture for libraries including computers and networks. By using them, humans can get access to knowledge by exploiting information search and retrieval techniques.

Early forms of digitalised libraries were established in form of electronic card catalogues, so-called OPACs (Online Public Access Catalogues). They replaced traditional card catalogues in the early 1980s. Also, OPACs encouraged coordination and communication between libraries by offering data of resources (books, etc.) available mutually.

¹<https://boingboing.net/2015/02/09/darpas-memex-for-searching-t.html>

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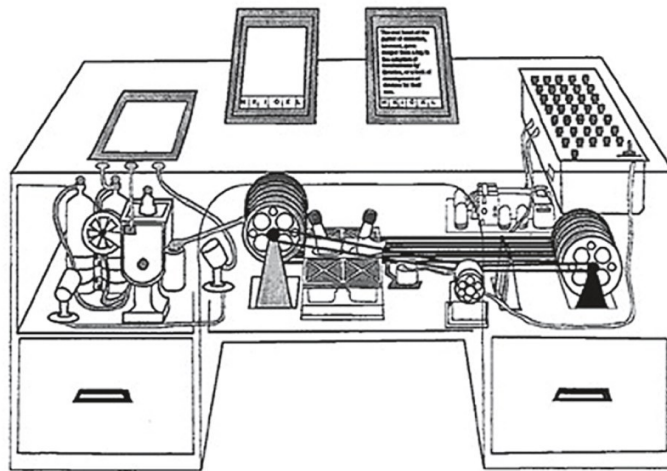


Figure 2.2.: Illustration of Memex

In the 1970s, an idea arose to transmit information via telephone and television networks (Maurer, 2015). In Germany and Austria, such a system was named *Bildschirmtext (BTX)*. Computers owned by the Post Office (located on different places) were combined, televisions were extended with a decoder and finally connected to the telephone network via modems. With a keyboard, the possibility to retrieve text and images but also sending emails and accessing programs– similar to the World Wide Web – was given. Such a device was introduced in 1982 at the University of Technology, Graz – it was named *MUPID (Mehrzweck Universell Programmierbarer Intelligenter Decoder)*. The whole system can be seen as a form of a digital library by serving data to users. A critical issue is that BTX had page charges: before retrieving a paper you were told it cost 1 Cent, and would show you your current account. With the small amount, the payment was not a problem, but it assured the survival of encyclopaedias like Meyers, Brockhaus, Britannica, Larousse etc. that disappeared since the World Wide Web. Inventors were not aware of the importance of page charges back then. Nowadays, most reading offers are financed by revenues of advertisements.

In 1994, US federal funds announced to support digital libraries financially with the amount of 24.4 million USD, split up to six American universities. That financial support resulted in an improvement of the popularity of digital libraries (Besser, 2004).

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In the 2000s, the term *Library 2.0* that is related to the term *Web 2.0* emerged (Maness, 2006). Authors suggested how to use Web 2.0 in librarianship by not only focus on individual applications like wikis, blogs, and chats but also on management and employees in libraries (Bargmann and Tremml, 2007). Anyway, different interpretations of the term *Library 2.0* exist (Holmberg et al., 2009). An example developed by (Maness, 2006) is

“the application of interactive, collaborative, and multi-media web-based technologies to web-based library services and collections.”

In a user study, 29 participants (all employees of libraries) were asked to put their definition of a *Library 2.0* into writing (Holmberg et al., 2009). Further on, using co-word analysis, a definition was conducted by the authors:

“*Library 2.0* is a change in interaction between users and libraries in a new culture of participation catalysed by social web technologies.”

Taking these examples, *Library 2.0* can be related to interactivity and web technologies. Anyway, it was found that the acceptance of the term is generally menial and social networks do not concur in the idea of libraries (Nesta and Mi, 2011). They proposed the term *Library III* where libraries must regain their leadership in the development of new tools for an invention of intellectual properties by providing access to information and its connections. Google forced that direction by cooperating with libraries to digitise their stocks (Google, 2018c). See section Google Books in chapter Digitalisation for more information on that project.

2.3. Comparison

With the invention of new information technologies, our communication, information provision, and hence our whole life has changed drastically during the last years. The number of Internet users increased permanently. For 2018, 3.66 billion users are estimated, for the year 2021, more than 4.4 billion Internet users are predicted (eMarketer, 2017). In Austria, about 89% of all

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households had access to the Internet in 2017 (Eurostat, 2018). Also, mobile use increases broadly. For 2019, more than 3.22 billion mobile Internet users are predicted who access the Internet from laptops, netbooks, smartphones, tablets, etc. (AP, 2015). This huge numbers of Internet availability and mobile use are a significant reason why digitalisation gains more and more popularity. Access to information is nowadays possible for a major part of the population. Therefore, exchange of information (text, audio, and video via email, messenger, or social networks) became way easier for manhood. Further, increasing transfer rates make their contribution.

In this section, traditional content is compared to digital content. With traditional content is meant books, papers, compact discs, and others. Thus, information that is available physically only and can't be modified that easy (read-only memory). With digital content is meant any information that is stored on digital devices and that can be changed with ease. For instance, files on hard disks, flash drives, and secure digital.

Both have their advantages but also disadvantages. Anyway, this work focusses on the benefits of the use of digital content. That is also strongly connected to a lot of research to solve major issues. An example is the long-term preservation of essential human knowledge.

2.3.1. Traditional Content versus Digital Content

In the following, a list of advantages of digital content is given. It includes availability, needs for space, accessibility, enrichment of content, techniques for information search and retrieval, time effort, administration effort, and preservation. There is no guarantee on completeness nor the long-term validity of that list.

1. Availability

Due to the facts that were presented before, digital content can be accessed over the Internet very easily if provided. It is available at any time (24 hours a day, 7 days a week), it can be accessed from any place in the world by anyone having a device with a connection to the Internet. That is (mostly) not related to high costs nowadays. As the same content can be provided by

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different servers on the Web, reliability is given. For instance, Google stores each piece of data at least on two servers (Google, 2012a).

2. Space for storage

Digital content needs very little space compared to content stored physically. For instance, a book with 300 pages having about 2000 characters on each page needs about $15 \times 10 \times 3$ centimetres of space in form of a book. A solid-state-drive with even lower dimensions offers 1 Terabyte of memory which is storage for about 1.67 million books with the specified values (assuming a book consumes $300 \text{ pages} \times 2 \text{ Kilobytes} = 600 \text{ Kilobytes}$).

3. Accessibility

Also, a huge advantage of digital content is that it is copyable easier and faster than physical content like books. Effectively, a digital book can be accessed by a large number of readers at the same time as for publishers it is an ease to supply a copy of it via the Internet. Contrary, a book has to be printed and sent to the receiver which takes way more time and effort to do so.

4. Enrichment of content

Advantages supplied by digitisation can lead to endless possibilities in digital libraries and digital content. For instance, by a provision of images in higher resolutions, a user can use zoom functionalities on a digital device to explore illustrations way better than possible in a traditional book.

Also, cross referencing could enhance user experience significantly. By provision of digital references to other parts of the book (or library or even information received from the Internet), users might be encouraged to visit these references (or referenced sources) as it is easier than browsing through a traditional book or library. Furthermore, external content like an explanation of a term could be included and shown to users if they desire. The inclusion of parts of documents into other documents by reference is called transclusion (Lee, Lutteroth, and Weber, 2010). For instance, Wikipedia recently added a similar feature to their articles to make navigation through Wikipedia easier for users. They show page previews to avoid the burden to open a new page for linked articles and subsequent navigation back

2. Libraries

Rick Astley

From Wikipedia, the free encyclopedia

Richard Paul Astley (born 6 February 1966) is an English singer, songwriter and radio personality. His 1987 song "[Never Gonna Give You Up](#)" was a No. 1 hit single in 25 countries and won Single.^{[1][2]} By the sold approximately Astley made a com phenomenon when "You Up" became in "rickrolling".^[6] Astle users at the MTV E 2016 album *50 det*

"**Never Gonna Give You Up**" is a song recorded by British singer and songwriter Rick Astley, released as a single on 27 July 1987. It was written and produced by Stock Aitken Waterman. The song was released as the first single from his debut album, *Whenever You Need Somebody* (1987). The song was

Figure 2.3.: Illustration of page preview for the song *Never Gonna Give You Up* in the Wikipedia article of *Rick Astley*

to the original (Vasileva, 2018). Figure 2.3 illustrates a page preview for the song *Never Gonna Give You Up* on the Wikipedia article of *Rick Astley*. Also, Amazon includes explanations of "difficult" words in their e-books if desired. This form of cross references is a basis for one improvement that is suggested in chapter Suggested Extensions for Existing Software.

Furthermore, by the provision of animated graphics using GIF (Graphics Interchange Format), dynamic processes can be illustrated space-saving. An example can be an animation of a physical process. This form of illustration might be way easier to handle for the human brain than a lot of consecutive images illustrated on several subsequent (physical) pages in a book.

Further, content can be enriched by readers in form of annotations, comments, and bookmarks. These can also be shared to other readers. For instance, on social media platforms like Facebook. That approach is called *social reading* and is analysed in greater detail in section Social Reading in chapter Critical Analysis.

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Figure 2.4.: Visualisation of the distribution of a keyword within three documents. *A*, *B*, and *C* represent the documents, *dark grey bars* represent the length of a document (in number words), and *red dots* indicate the position of the search term within a document

5. Information search and retrieval

Obviously, it is easier to search in digital content than in (non-indexed) physical material. It is possible to sift through thousands of digital books and libraries within seconds. Further, a logical combination of search terms, similar search terms, integration of synonyms, etc. can be used in searching. Representation of search results is possible using digitalisation. For instance, highlighting of search terms, the overall count of results found, or a visualisation of the distribution of a keyword within documents (or library). The latter is visualised in Figure 2.4, a slightly modified graphics from (Glatz, 2015). This makes it easier for users to determine which parts of the document might be interesting for them.

6. Time for acquisition, browsing, and searching

Digital content is faster to acquire for a reader than physical content. Users can access a digital library from their mobile devices that are mostly connected to the Internet. They might download content for offline use or share it through several devices (tablets, laptops, computers, smartphones) using cloud storage as well. Contrary, for a physical book, users have to visit a library and carry it with them. Also, sharing is not possible in a convenient way.

Using a digital device, browsing through multiple books is pleasanter than through physical books. For instance, switching between opened PDF

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(Portable Document Format) documents on a computer is quite easy and needs less space than several books aligned on a desk. Also, the recovery process brings advantages as most PDF viewers support easy re-opening of closed documents including automatic scrolling to the last visited position.

7. Administration of content

Digital content is easier to modify. For instance, if mistakes are found they can be corrected and upgraded versions can be distributed without the burden of high costs. This is especially important in the context of education in order to ensure correct content. Thus, for digital information providers, it is easier to supply content that is up-to-date. Furthermore, version history can be included and therefore, changes are easier traceable. In chapter Suggested Extensions for Existing Software that idea is explained in more detail.

8. Preservation

On the first sight, preservation of digital content seems easier than a preservation of physical books. This is only correct in a limited sense. Digital content can be spread across different devices faster. Thus, content might not be lost that easy. Though, with long-term preservation, problems arise that do not apply for physical books.

The evolution of devices and file formats (and hence software) is rather fast. Usually, they get outdated within a few years. Especially, when a file format receives an update. Then, software that reads that file format needs an update as well. Users who update to newer software might have to convert their existing files to the new version – the old format might not be supported anymore. That might have side effects, for instance, existing graphics are not supported in the new format. Consequently, they get lost or evoke errors. To address such issues, a user could keep the old version of the software (and hence the old file format). Anyway, the user's device might need an update of its operating system that does not support the old software anymore. To further address that issue, a user could keep the old version of the operating system. That could potentially reveal some further side effects like security issues – the device would not be usable without risks for users. Anyway, there must be a reason why a file format, software,

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or an operating system receives an update. Then, users could keep old devices for reading outdated file formats but also the lifetime of hardware is limited. If it breaks there might not be an adequate substitution for it in the future. To address that issue, software (and an older operating system) could be emulated on newer devices. Actually, there exist a lot of sophisticated software that supports easy handling of emulation, either operating systems or software. Still, their software underlies constant changes of formats, hardware, etc. Thus, there is no guarantee that content created today can be read in 30 years. Actually, there is software which is not supported on Windows 10 but was supported 10 years ago on Windows XP, for instance, device drivers.

Also, the hardware that store content is highly volatile and short-lived. Following (Schasche, 2018), CDs, DVDs, and USB flash drives have a lifetime of about 30 years and solid-state-drives keep out between five and ten years, dependent on usage. The only (theoretically!) infinite storage type in sense of lifetime is cloud-based.

A concrete example of preservation issues is given by Maurer (Maurer, 2017). He had major efforts to recover graphics that were stored on outdated storage media in outdated formats. Although, with quite some effort and the acquisition of special hardware it was possible to access these graphics created 30 years earlier, but probably would have not been possible 10 years later.

As the amount of stored data increases significantly, it might not be possible to preserve all data existing. Therefore, it has to be decided which data to preserve. That is not trivial. Information that is considered useless nowadays might be of general interest in the future. To point it out, digital content might cause much loss of data.

Contrary, physical objects (as books) can be kept without decay for several centuries if conditions (air temperature, air humidity, etc.) are optimal and the material is valuable. Actually, stone tablets have the longest known lifetime. Of course, these may not be of interest for preservation in the immediate future. Anyway, long-term preservation is a huge field of research and should be of public interest. Though, exploring that topic goes beyond the scope of this work.

2. Libraries

9. Machine processing

Digitised content can be processed by the usage of machines and is, therefore, faster than processing by humans. For instance, administration, search and retrieval, and distribution for preservation can be made faster. Further, big data analytics is an aspect to be considered. As technological progress in form of increasing computing power and development of sophisticated software libraries for analytics took place, and creation of massive amounts of data is rather easy, big data became popular a few years ago (Konstantinova, 2014). Not only content of a book can be analysed but also user behaviour in form of their interests. Another example might be language analytics to retrieve the meaning of a text. Anyway, this analytics might be available in the future but not nowadays.

10. Costs

As a consequence of digitisation, content can be supplied with lower costs than for physical objects. By comparing a ship of a physical book from the United States of America to Europe and a digital transfer from and to the same locations, it is obvious that latter is cheaper (and faster!). Further, almost all costs for reproduction are saved. On the contrary, costs for security issues, determination of copyright ownership, and optional copy protection are increased by digitalisation. Recruiting of experts or use of high-quality services is needed (Schawel and Billing, 2018).

3. Digitalisation

Digitalisation is a broad concept. Principally, it is the process of transferring analogous signals into digital data by using an analogue-to-digital converter. In this chapter, the focus is mainly on the digitalisation of books and text. It is explained how that process takes place on a large scale. In that area, many challenges arise. For instance, the process of digitising involves a great deal of expense and time. Further, digitising companies are concerned with huge copyright issues. Scanning errors and language issues are further problems to be dealt with. All these challenges are described in more detail within the next sections. Also, some successful projects are elucidated. In particular, *Google Books*, *Internet Archive*, *Project Gutenberg*, and *Gallica*.

Nowadays, digitising has reached an advanced stage. Almost everything related to humankind can also be related to digital objects. It starts by the wide and frequent use of smartphones, goes via any transports of goods and people that are strongly connected to digital information, and ends with the profound relation of people's jobs to digitalisation in form of work at a computer. Current terms disclosing the huge impact of that topic are, for instance, *Internet of things*¹, *Industry 4.0*², *Home automation*³, and *Autonomous car*⁴. Fields of application for digitalisation, not only in a company, are rambling. Processes can be accelerated, sources of errors avoided, costs reduced, throughput increased, and extensions and renewal pushed (Schawel and Billing, 2018). Anyway, these topics are only briefly touched in this thesis.

¹https://en.wikipedia.org/wiki/Internet_of_things

²https://en.wikipedia.org/wiki/Industry_4.0

³https://en.wikipedia.org/wiki/Home_automation

⁴https://en.wikipedia.org/wiki/Autonomous_car

3. Digitalisation

3.1. Methods to Digitise

As mentioned, digitalisation is a transformation of analogous signals into digital data. Depending on an analogous format, that process is defined and performed in different ways. In this section, some methods are elucidated.

For instance, a sound is transferred into electronic shafts which are measured and saved as digital values. Further, to avoid tremendous files sizes, these data is compressed by using lossless and/or lossy algorithms. Depending on the compression algorithm, these data can be stored in different files formats. *MP3 (MPEG Audio Layer III)* is one of the most-used file formats for lossy audio data compression that offers 90% of data reduction with still "acceptable" results (Corbett, 2012). *FLAC (Free Lossless Audio Codec)* is an example of a lossy file format (Xiph.Org Foundation, 2018).

To digitise an image, an (image) scanner can be used. Generally, it is a device that works optically by recording the colour value of each pixel of an image using a sensor. That value gets transformed into digital. The more precisely the sensor works the higher the resolution gets. Consequently, more data is created. Finally, that information is extended by positions and stored in a file. Equally to audio, a compression algorithm might be applied to decrease file sizes. Generally, different file formats exist. Lossless formats are *PNG (Portable Network Graphics)* and *BMP (Bitmap)*, lossy formats are *JPEG* and *GIF (Graphics Interchange Format)*.

To digitise a book, a similar procedure is applied. Pages are scanned consecutive, images are created and then stored in a file. For instance, in a PDF file. When digitising content of a library, usually a huge number of books has to be scanned. If desired, non-destructive scanning is applied. That means books are not disbanded for the scanning process. Therefore, machines were invented that facilitate this process. Some devices exist that need manual page flipping. For instance, Book Scanner Spirit Advance A3+⁵. Contrary, Linear Book Scanner⁶ is a device that also supports the flipping of pages. It was a project by Google and is under Apache License 2.0 (Google, 2012b).

⁵https://youtu.be/iAmrch_1f2U

⁶<https://linearbookscanner.org>

3. Digitalisation

Alternatively, books can be disbound, scanned, and subsequently rebound. This process is called destructive scanning.

Optionally, software for optical character recognition is applied to extract text in form of characters. That offers the possibility to search within the book using information search and retrieval technologies. Another advantage is a decrease in space for storage. A drawback of that approach is the loss of formatting, images, and diagrams. Also, falsely detected words might result in unsolvable errors in the document. To address that issue, a trade-off can be used by storing original image scans and providing text as metadata (word and position on the image) to offer a search function. Google Books⁷ make use of that technology, identifiable by using the search function on a book (tested on August 25, 2018). Search terms are highlighted in yellow within the text.

3.2. Challenges and Issues

With the digitalisation of books some challenges arise. First, the process is related to high costs and high time effort. Further, huge copyright issues emerge by the provision of a digital version of a book that is not in the public domain. For instance, Google Books had to deal with that kind of issue a lot (Meyer, 2015). Also, unseen scanning errors might appear.

1. High costs

Costs for digitalisation rely on different factors. Kyle (Kyle, 2015) mentioned seven key factors that have an influence. These are

- Format of material

Costs highly depend on the given format as different equipment has to be used. For instance, for a simple book, scans can be done faster than for loose pages or letters with variable size that might have to be scanned manually. Further, scanners that support automatic flipping might not support very tiny or extra large formats or thick paper. Then, they have to be scanned manually.

⁷<https://books.google.com>

3. Digitalisation

- **Condition of material**

The more fragile material is the higher the costs. That is because a scanner has to take lots of care to preserve the material. Some material might also need manual scanning which also results in an increase in costs.

- **Volume of (similar) material**

If a collection contains a high number of similar specimens, less effort has to be invested in adjusting scanners. Hence, costs per book decrease. Contrary, intermixed material increase costs.

- **Location where digitalisation takes place**

There are two options where the process for digitalisation can be done. On the site of the books (scanner has to be transported to the material) or on the site of the scanner (material has to be transported to the scanner). This must be decided individually for each collection.

- **Resolution**

The higher the resolution of digital content is aimed at the costlier is a scan. Usually, 300 dpi (dots per inch) are sufficient. Exceptions can be photographs and negatives that might be needed in a higher resolution.

- **Creation of metadata**

Additionally, it is mostly required to extract metadata (name of books, author(s), etc.) of the material (books and optionally pages of books). That needs additional effort. For instance, OCR technology (Optical Character Recognition technology) can be used which further increases costs. If proofreading is applied costs increase even more.

- **Export format(s)**

Costs depend on the export format(s). For instance, image formats (JPEG, PNG, TIFF, etc.) are associated with lower costs than text-based formats (TXT, PDF etc.) as for the latter additional OCR technology must be applied. That can increase costs significantly.

In 2010, a study to evaluate the costs for digitalisation Europe's cultural heritage was commissioned by the European Commission (Poole, 2010).

3. Digitalisation

Their defined steps for digitalisation included capital costs, preparation, selection, unbinding, scanning, OCR conversion, PDF conversion, and simple metadata creation. The author distinguished between the digitalisation of libraries, museums, archives, and audiovisual material. Restricted to libraries, he estimated costs for the digitalisation of an *eligible* book between 124 € and 170.50 €, considering in-house digitalisation. By outsourcing that process, he estimated between 73.15 € and 103.50 €. Considering a public-private partnership (like Google with the Austrian National Library) such costs can be reduced to between 55.15 € and 66.50 € per book, he goes on. That results in overall costs (mean-values) of 11.76 billion € (in-house), 7.08 billion € (outsourced), and 4.79 billion € (public-private), assuming a total number of 59 to 95 million books (with 1.47 to 2.36 billion pages) to digitise, duplicates are already deducted (Poole, 2010).

Furthermore, costs arise from obtaining permissions to digitise copyrighted material. That is also related to costs to find rightsholders for books (Band, 2009). For example, that can be either an author, a publisher or a third party.

2. Time effort

Time effort is strongly related to costs. Usually, the longer it takes to digitise a single page the higher the costs. It is hard to do an exact time estimation for a whole collection of material to be digitised.

Assuming the lower amount of books mentioned above, 59 million books (having 1.47 billion pages) to be digitised. Even if that process can be automated to a wide extent by offering a machine that scans pages very fast and supports automatic flipping, it is very time-consuming. Machines exist that achieve high-speed digitalisation at over 250 pages per minute (Noguchi et al., 2014). This number can be reached only if the material is well-conditioned which is normally not the case in libraries as they might also contain ancient material that has to be treated with great care. Thus, it would take about 11 years (requiring that the scanner works permanently) to digitise all pages for a single scanner of that type. That is only a time-estimation with perfect conditions having no interruptions – hence highly unrealistic. Furthermore, time to set-up the scanner, switching books, impact of the format and condition of the material, and export-formats are neglected. To

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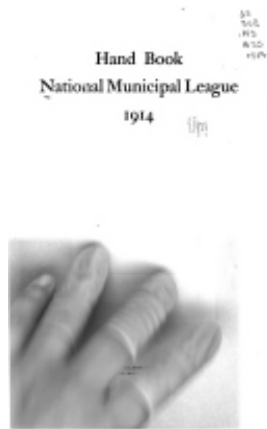


Figure 3.1.: Scanning error on a cover of a digitised book

point it out, digitising a large collection of books (for instance, a whole library) takes lots of time including side-effects like fragile material and defect scanners to be considered.

3. Scanning errors

Considering millions of items to be scanned, errors occur inevitably. Different types of errors exist. For instance, human errors but also errors during an OCR process. An example of an obvious mistake that was done by a human during a scanning process can be seen in Figure 3.1 (Google, 2016). OCR errors might also occur. A well-known example is a confusion between the *long s* and the *f* in historical writings if the condition of the material is rather bad, see Figure 3.2. By the application of automatic spellcheckers, these types of errors might be found though. However, scanning errors may also bias research results (Traub, Van Ossenbruggen, and Hardman, 2015).

4. Copyright issues

In digitalisation, it comes to the point to deal with the copyright of the material. Especially, if digitised material is meant to be published. It is a hard challenge to firstly, find out who is the rightholder for each book, and secondly to obtain rights to digitise. Google had to deal with lots of copyright infringements to finally negotiate a settlement, see the next section. Notice that dependent on the law of a country when copyright

3. Digitalisation



Figure 3.2.: Normal s versus Long s

expires. In Austria, a copyright protection lasts 70 years after the death of the last surviving co-author (in literary, artist works, and musical art) or 50 years from taking/publishing of a photo (Dürager, 2018).

3.3. Scanning Projects

There exist several projects on scanning physical books to provide it as an e-book or for preservation issues. In this section, some major projects are elucidated. Mostly, their websites are used as a source of information.

3.3.1. Google Books

Google Books describe Book Search similar to web search (Google, 2018a). By entering a search term, it tries to find a book with content containing that term. Further, a user can browse books online, buy books, or borrow them from the library. Google obtains books from two different sources, via the Partner Program and the Library Project. That announcement dates back in 2004 (Google, 2004).

Following (Google, 2018b), Google Books' Partner Program offers a way to promote books of publishers for free. Customers have to send their books (or upload its digital version) and Google adds it to their index. For searchers, a preview of a book is given to "give them a taste" while in the background the whole book is stored on the servers. Extracts are

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added by links to bookstores, online retailers, or publisher's online store to give users the possibility to buy a book. Furthermore, Google offers online reports including statistics about clicks, selling, etc. without any costs for publishers.

Following (Google, 2018c), Google's Library Project has the purpose to build a searchable online catalogue of the world's books. Therefore, Google is partnering with libraries to digitise their stock of books. For instance, Google digitised 600.000 historic books that were created between the 16th and 19th century and made them available for free (Kaiser, 2012). That approach is especially useful for books that are rare, out of print, or unavailable. Books are displayed differently depending on their license. If a book is in public domain it is displayed fully and can be downloaded. Otherwise, a limited view, some snippets where the search term appears are shown, along with a few sentences of context, or no preview is provided at all. Anyway, links for retailers are displayed. Examples of the different views are given here (tested on September 22, 2018): Full View⁸, Limited Preview⁹, Snippet View¹⁰, and No Preview Available¹¹. Due to their lengths, links were shortened.

In the early days of the Library Project, Google had to deal with copyright infringements because they scanned millions of copyrighted items without any permission of authors or publishers (Meyer, 2015), (Band, 2009). Google defended their action by arguing within the fair-use privilege (Band, 2009). In October 2008, three years of litigation, they announced a settlement of the lawsuit that allowed them to sell access to the full text of millions of books under the agreement to make payments totalling \$125 million (Google, 2008). In further consequence, Google offered a way for authors to claim or exclude books that were already scanned and published (Google, 2018c). It is not possible to determine the popularity of Google Books specifically. On Alexa, a site to estimate a website's popularity, Google is ranked as number 1 globally (Alexa, 2018c). Anyway, it is not possible to retrieve the rank for Google Books in particular as it is a subdomain of *google.com* and Alexa groups them together. For the definition of the calculation of global ranks see appendix C.

⁸<https://bit.ly/2xr1Zrh>

⁹<https://bit.ly/2QRb2HA>

¹⁰<https://bit.ly/2xCGL6k>

¹¹<https://bit.ly/2QR6dhl>

3. Digitalisation

3.3.2. Internet Archive

Internet Archive¹² is a non-profit project to offer a digital library containing Internet sites and other cultural artefacts (Internet Archive, 2018). Currently, they provide 279 billion web pages, 11 million books and texts, and much more other digital material occupying more than 30 Petabytes of space. They work with thousands of partners but anyone can participate by uploading material. In 2005, the Internet Archive began to digitise books. Today they scan more than 1000 books per day in 28 locations all over the world. Writings in the public domain can be downloaded for free, modern books can be borrowed through their Open Library¹³. On Alexa, *archive.org* is ranked as number 276 globally (Alexa, 2018a) (retrieved on September 30, 2018).

3.3.3. Project Gutenberg

Project Gutenberg¹⁴ was invented by Michael Hart and is an effort to foster the creation and distribution of e-books (Hart, 2004). Following the project's main page (Project Gutenberg, 2018), they offer more than 57.000 books free of charge. Their focus lies on older material that is already out of copyright. As it is a volunteer project, anyone can participate by supplying digitised books that are in the public domain in the United States. They offer online-reading (simple HTML with stylesheet) and a way to download scanned books in different file formats. On Alexa, *gutenberg.org* is ranked as number 5.363 globally (Alexa, 2018d) (retrieved on September 30, 2018).

3.3.4. Gallica

Gallica¹⁵ is the digital library of the *Bibliothèque nationale de France*, the National Library of France, and was founded in 1997 (Gallica, 2018a). It contains almost 5 million documents, including 625.000 books (Gallica,

¹²<https://archive.org>

¹³<https://openlibrary.org>

¹⁴<https://gutenberg.org>

¹⁵<https://gallica.bnf.fr>

3. Digitalisation

2018b). They digitise documents on their own but also include (or reference) digital content from partners. Every week thousands of documents are added. On Alexa, *bnf.fr* (the website of the National Library of France where Gallica is hosted) is ranked as number 10.656 globally (Alexa, 2018b) (retrieved on September 30, 2018).

4. Critical Analysis

In this chapter, an overview of current providers of digital books (born-digital or digitised books) and their offers (hard- and software) is given. It is distinguished between providers of e-books, their software, and associated devices and providers of online-reading offers. The latter are web applications that support reading a book in a web browser. The purpose is to point out the current status to derive possible enhancements and improvements that are described in the next chapter.

A huge part of this chapter are e-books. First, an overview of currently prevalent file formats for e-books is given. These include EPUB (Electronic Publication), AZW (Kindle File Format), and PDF (Portable Document Format). Also, some statistics on e-books, devices, and the use of it is elucidated to give a motivation on that research. Subsequently, devices for reading e-books are analysed. Examples are *Amazon Kindle*, *Tolino*, and *Sony* that are widely used, for instance, in Germany (Buchreport, 2014). It turns out that Amazon Kindle has the most sophisticated approach in their software. They offer functions that are not supported on other devices. Examples are Word Wise, X-Ray, and social reading functions.

Ongoing, software for reading e-books either on mobile devices or PCs is analysed. The distinction is based on the operating system. Thus, software for mobile devices are apps that run on Android-based operating systems or iOS. Contrary, with software for PCs, is meant software for the operating systems Windows, Linux, and macOS. Other operating systems are neglected due to their tiny market share. However, Amazon Kindle with their different software packages for mobile devices and PCs is ahead with regards to offered functions and implementation of these and additional adjustments. Other software offers basic adjustments but nothing groundbreaking.

4. Critical Analysis

Further, offers for online-reading is analysed. Again, different providers are illustrated and tested on their functions for reading. Here, also Amazon Kindle has advanced features. They support many adjustments for text. Although, compared to their software on e-book readers and their Android app, many functions are missing. Examples are Word Wise, X-Ray, a dictionary, and ways to translate a text. In fact, they only offer functions to adjust a text. Austria-Forum has features available that make reading experience unique. For some books they offer two versions (scanned and OCR-scanned version or digital and translated version). These can be viewed in parallel. Worth a note, other providers offer scanned versions of books. For instance, Google Books, Austria-Forum, Open Library, and Europeana Collections.

Lastly, social reading functions are analysed. Social reading is a participation of other readers within digital content in form of annotations, reviews, and others (Cordón-García et al., 2013). Social reading did not achieve a breakthrough in the digital world. In fact, many approaches failed. Here, some of them are listed.

4.1. E-Books

This section is split up into three different parts. First, an overview of file formats that are currently used for e-books is given. For instance, EPUB is one of the most used formats. In a nutshell, it is a website within an archive. Thus, its layout is not fixed which has some positive implications. The font size of an EPUB can be adapted by software without influencing image sizes. Contrary, PDF has a fixed layout.

In the second part, several (portable) devices are analysed that are created especially for reading e-books. These are so-called e-book readers (or short e-readers) and have main advantages compared to other mobile devices like smartphones and PCs. One of them is its display technology that is very battery-saving and eye-friendly. Well-known providers are Amazon Kindle and Tolino.

The third part contains information about software to organise and read e-books on computers and also on smartphones and tablets with the operating

4. Critical Analysis

system Android. iOS apps are not analysed because they are rather similar to their Android versions. Others are neglected due to their tiny market share. *Calibre* is a free tool for PCs for reading, converting, and distributing e-books to e-book readers and other devices. Further, *Amazon Kindle* is an application for reading e-books on PC and on mobile devices (smartphones, tablets) that offers more or less the same functionality as given on Amazon Kindle devices. Also, Google offers an Android app for reading e-books, named *Google Play Books*. In the appendix A.2, a table with apps that are available in *Google Play Store* is given. There is no guarantee on completeness nor the long-term validity of that list.

4.1.1. Statistics

E-books had an increase in turnover during the last years. In the first half of 2018, the turnover was 6.1% in the market for books in Germany, compared to a turnover of 0.5% back in 2010 (Börsenverein des Deutschen Buchhandels, 2018c). In 2018, the turnover of the e-book market worldwide was about 11 billion € (Statista, 2018b). The highest numbers come from USA (4.8 billion €), Japan (1.2 billion €), and China (1 billion €). Further, in 2022, more than 12 billion € of turnover is predicted worldwide. While in 2010 1.9 million e-books were sold in Germany that number increased to 29.1 million in 2017 (Börsenverein des Deutschen Buchhandels, 2018a).

In 2018, more than 540 million people used e-books which is a market penetration of 10.5% (Statista, 2018b). Further, in 2022, more than 621 million users (11.8% market penetration) are predicted. Most of the users are between 25 and 34 years old (34.5%), followed by 35-44 years old (24.5%), 18-24 years old (18.1%), and 45-54 years old (16.7%) (Statista, 2018b). Following these statistics, the capability for e-books is still growing. This is also underpinned by a decrease in prices for e-books during the last years in Germany (Börsenverein des Deutschen Buchhandels, 2018b).

For reading e-books, different devices can be used. A study in Germany conducted that people use e-book readers primarily (67%), followed by smartphones (39%), tablets (29%), laptops (26%), and desktop PCs (8%) in 2017 (Bitkom, 2017). The same study revealed a use of only 27% back in

4. Critical Analysis

2014. Their numbers increased at the expense of laptops and desktop PCs. A similar study found out almost the same numbers except for higher values for tablets (49% usage for e-books) (Statista, 2018a).

In Germany (in 2017), most stated reasons for reading e-books were its permanent availability (86%), no extra space needed (69%), low weight (67%), access across devices (62%), and fast acquisition of new books (60%) (Bitkom, 2018). Another indicator is a high percentage of *reader-households* (households that actually read books) that have an e-book reader available. In Germany (in 2016), 37% of reader-households had exactly one e-book reader, 10% even more than one, and 9% plan to purchase one (Statista, 2018c). In 2016, about 9.3 million people had an e-book reader in Germany and a further 2.2 million plan to buy one during the next 2 years (Allensbach, 2016). Compared to 2013, there was an increase of 3.7 million users of e-book readers. These numbers show that there has been a huge increase in the use of e-book readers during the last few years.

In the United States, numbers are promising as well. In 2015, 26% of all households had at least one e-book reader, for 2020, 28% are predicted (eMarketer, 2016). Devices for reading deviate, compared to Germany. In the United States (2017), 61% prefer tablets, 54% use e-book readers, 40% smartphones, 22% laptops, and 15% used a PC for reading e-books (Statista Survey, 2017b).

In the United States (in 2017), 34% of reader-households had exactly one e-book reader, 30% even more than one, and 6% planned to purchase one (Statista Survey, 2017a). Further, the United States has the highest share of sold e-books of total book sales with 42%, followed by United Kingdom (34%), Canada (34%), Australia (28%), and New Zealand (20%) (AuthorEarnings, 2017). Consumers in the United States that read books or newspapers declared that they will read print products but also e-books (51%), they will *still* read print products but also electronic versions (23%), and in the future, they will only read e-books and other electronic versions (9%) (Statista Survey, 2017c). Following this study, only 16% will refuse to buy e-books, e-newspapers, or e-magazines.

4. Critical Analysis

4.1.2. File Formats

In the following, a list of file formats that can be used to store e-books or readable content is given. Its current versions are elucidated, effective in December 2018. There is no guarantee on completeness nor the long-term validity of that list.

- **Electronic Publication (.EPUB and .EPUB3)**

EPUB is a standard for digital publications and web-based documents that is distributed by the International Digital Publishing Forum (IDPF, 2018). Further, firstly it was standardised in 2007, the current version is EPUB 3.1, published in January 2017. EPUB is standardised as an archive file that contains enhanced web content (HTML, CSS, images, and other resources) and metadata for single-file distribution. Basically, it is a website within an archive (ePub Zone, 2018). Thus, font size and resolution of images, do not depend on the actual display size as they can be set relatively. That is contrary to PDF files that have a fixed layout (Wagner, 2018b). EPUB also supports MathML and embedded JavaScript (Kern, 2013). For the container, a ZIP-based packaging is used. The archive must contain a META-INF directory that optionally contains an encryption file (that holds encryption information on all content), a rights-management file (that contains digital rights management information – also called DRM), and a digital signatures file (that contains digital signatures for container and all content) (IDPF, 2018). It is recommended by the standard that the content should be stored in a directory that is at the same level as the META-INF directory. In subsection Software for Reading, software is analysed that can display the EPUB file format. It can be read by all well-known e-book readers except for Amazon Kindle devices (Wagner, 2018b).

- **Mobi (.MOBI and .KF8)**

Mobipocket was a sub-company of Amazon that created the file format MOBI and Mobipocket Reader software for PDAs (Personal Digital Assistants) and mobile phones. The file format supports bookmarking, JavaScript, notes, DRM, and other features (Fischer, 2018). In 2016, Mobipocket turned off their website and its servers (Hoffelder, 2016).

4. Critical Analysis

Its predecessor, KF8 (Kindle Format 8) supports more scopes for design. For instance, floating images, embedded fonts, and vector graphics resulting in almost the same features that are supported by EPUB (Wagner, 2018b). Although, KF8 does not support MathML and embedded JavaScript (Kern, 2013).

- **Kindle File Format (.AZW and .AZW3)**

A Kindle file contains either a MOBI file (.AZW) or a KF8 file (.AZW3). DRM is supported and these files are sold by Amazon only as the standard is not open (Wagner, 2018b). Thus, it only can be read by Kindle software fully as they can implement the whole standard. Calibre also supports to convert e-books to the Kindle File Format but they cannot guarantee full support.

- **Portable Document Format (.PDF)**

PDF (standardised in version 2.0) is a file format developed by Adobe since the 1990s to display documents containing, among others, (formatted) text, images, interactive elements, and 3D objects independent of hardware, operating system, and application software (International Organization for Standardization, 2017). The following information in this paragraph is based on (Wagner, 2018b). PDF is not a specific e-book format but a format with a fixed layout that means font size, line distance, margins, and the arrangement of images are fixed. Thus, if a user wants to enlarge or reduce the font size with a PDF reader, all content gets enlarged or reduced. Most PDF files are optimised for DIN A4 size while e-book readers usually have smaller display sizes. Therefore, on an e-book reader, users either have small text or see just an extract of the whole page. Although, PDFs can be adapted to different display sizes. In most cases, it is not recommended to read them on e-book readers. Further, PDF files with copy protection are not compatible with Amazon Kindle. Anyway, PDFs are easy to create (open standard) and can be an accurate copy of a real book including formatting and graphics which is often not supported in web-based formats like EPUB and AZW.

4. Critical Analysis

- Others

There exist several more file formats that can be used to store content. These are not widely spread (anymore) or not used for e-books (anymore). If not stated otherwise, their information is based on (Fischerländer, 2015):

- *Product Representation Compact* (.PRC), a predecessor of MOBI that can be displayed by Amazon Kindle devices if unencrypted.
- *Microsoft Lit* (.LIT), developed by Microsoft with support for unencrypted and decrypted e-books. Its usage was folded in 2011 by Microsoft (Donath, 2011).
- *Microsoft Compiled HTML Help* (.CHM), a predecessor of the file format LIT, consisting a collection of compiled HTML files (Sharpened Productions, 2018).
- *Sony eBooks* (.LRF, .LRX), a format for Sony’s e-book readers that was popular back in the days. At the end of 2009, Sony switched to EPUB format.
- *Palm Media eReader* (.PDB), a format developed for Palm Handheld Organizer. Viewers for this format still exist.
- *Text files* (.TXT), a format for ASCII text without styling, tables, graphics, etc.
- *HTML* (.HTML, .HTM), a format that is basis for more complex e-book formats (like EPUB, MOBI, and AZW). Although, it can be used on its own as an e-book format.
- *Microsoft Word* (.DOC, .DOCX), a format popular for rich text documents with the possibility to modify the content. Anyway, it can be used to store e-books as well. Although, that is not very common due to modification by users.
- *DjVu* (.DJVU, .DJV), a format for images of scanned documents, digital documents, and photographs with high resolution (djvu.org, 2019).
- *Comic-Book-Format* (.CBZ, .CBR), a format developed to view comic-based e-books. Kobo’s e-book reader can read that format.
- *FictionBook* (.FB2), an XML-based format that describes elements of a book by tags (FictionBook, 2006).

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- *Rich Text Format* (.RTF), a proprietary file format to store text and images created by Microsoft (Colorado State University, 2010).

4.1.3. Devices for Reading

There are some companies that offer (along with their e-books) devices for reading e-books. These devices are either e-book readers or tablets. E-book readers have huge advantages. Their display is very battery-saving and eye-friendly. Due to its high resolution, it is similar to a real book. They make use of a technology called *Electronic Paper* which reflects light as normal books do. Consequently, especially outdoors, reflection is not a problem when reading on e-book readers. Contrary, most of the devices do not support colour. This technology has been commercialised by the company *E Ink Corporation*, among others. Amazon Kindle, Tolino, and Kobo make use of (different) E Ink technology (Wagner, 2018a), (Wagner, 2018c), (Wagner, 2018d). In 2016, the E Ink Corporation introduced a colourful version of their display with 150 dpi (Kuhlmann, 2016).

These devices do not necessarily need a backlight and therefore have very little battery-use. In fact, they just consume energy if the display changes. Some e-book readers support up to 8000 times flipping with one charge. Anyway, a possibly available module for Wifi and/or 3G/4G consumes energy though.

E-book readers from Amazon and Tolino are developed mostly for reading e-books but they also offer access to the Internet (via Wifi or optionally via cellular network technology like 3G and 4G) with reduced versions of web browsers. Anyway, for looking up some information they might be sufficient. For surfing through the Web, they are not practical. Therefore, they have a limited application area beside reading e-books.

In 2014, Amazon Kindle was the most used e-book reader in Germany with a market share of 43%, followed by Tolino (12%), Sony (11%), and Trekstor devices (11%) (Buchreport, 2014). In 2014, Sony announced that they will not bring a new e-book reader on the retail customer market anymore (Haupt, 2014a). In 2017, Sony still had a market share of 4% (Statista, 2018a). Anyway,

4. Critical Analysis

they still have digital paper products in their stock. For instance, Sony DPT-CP1¹ which was released in 2018. Anyway, Amazon Kindle is the market leader. A study in 2017 underpinned Kindle's supremacy even more. In Germany, they had a market share of 63%, followed by Tolino devices (16%), and Apple iBook App (6%) (Statista, 2018a). Latter is rather a software to be used on tablets or smartphones. At a great distance, Sony Reader (4%), TrekStor (4%), and Kobo Reader (2%) are following. In the United States (in 2017), Kindle has a market share of 72%, followed by Nook (10% market share), Sony Reader (2% market share), and Kobo Reader (1%) (Statista Survey, 2017d).

Due to their market share in Germany (2017), Amazon Kindle and Tolino are analysed here in greater detail. Further, devices from Kobo, Sony, Trekstor, and Nook are mentioned here with some details. Note that specifications for some devices are listed in the appendix A.1.

As mentioned, e-book readers have limited applications besides reading and maintaining e-books. Readers might like this feature due to no direct distractions compared to smartphones and tablets (incoming calls, notifications, etc.). Anyway, that is when tablets are coming into play. They have bigger displays than smartphones and can also be used for reading. Their main advantage is their flexibility in software (especially open-source operating systems) and colourful displays. On the other hand, they do not have an eye-friendly display and way more energy consumption.

Anyway, e-book readers can be manipulated in the way that, for instance, an open-source operating system like Android is installed. Then, conventional software for mobile devices (smartphones, tablets) can be installed. Anyway, software for reading e-books (also on tablets) is analysed in subsection Software for Reading.

- Amazon Kindle

Amazon is a vendor for several series of e-book readers. Their latest versions are Kindle 8 (2016), Kindle Paperwhite 4 (2018), Kindle Voyage (2014), and Kindle Oasis 2 (2017). Kindle 8 is on an entry level, Paperwhite is a middle-class device, and Voyage and Oasis are for premium users. That reflects mostly in the hardware of the devices

¹<https://www.sony.com/electronics/digital-paper-notepads/dpt-series>

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(for instance, display and manufacturing) and consequently in price. Note that Kindle Voyage was taken out of the product range in August 2018 (El-Heliebi, 2018a). Figure 4.1 shows a photo of a Kindle Paperwhite device.

All of them make use of the E Ink technology. While Kindle 8 has a 6 inches display *without* backlight, Paperwhite and Voyage have a 6 inches display with backlight. Oasis has a 7 inches display with backlight. Further, the latter has the highest resolution. The brightness of the backlight can be adjusted on these devices. All devices support Wifi. Therefore, e-books can be downloaded and stored in the library. Voyage and Oasis have free 3G optionally, Paperwhite offers free 4G optionally. Kindle 8 and Voyage offer 4 GB storage, for Paperwhite 4 and Oasis 8 GB and 32 GB versions exist. Kindle Paperwhite 4 and Kindle Oasis 2 are waterproof. All devices have a web browser pre-installed. See Table A.1 in the appendix A.1 for their specifications.

Its software offers adjustments for the font (change size and type), line distance, and margin distance. With Paperwhite 3, Amazon introduced automatic hyphenation. Highlighting text is supported. Further, notes can be added, bookmarks can be set, terms can be searched on Wikipedia, and also translated into different languages. For the latter, a connection to the Internet is required. Their software supports a function called *X-Ray*. With that, terms can be highlighted and the software finds its occurrences within the book. That also works for persons that are mentioned in a book.

Amazon Kindle offers a function called *Word Wise*. It is a special feature for reading convenience and learning a language. Hints are shown for words that might not be familiar to the reader. For instance, "difficult" words are augmented with its definition. Different levels for the number of hints are available. Currently, this feature is available in English only.

Further, social reading elements are offered. Following (Goegelien, 2018), text can be highlighted and shared (or recommended) via a social network. It is also possible to publish self-written notes for other readers. Best-liked notes from other readers are shown by default.

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Furthermore, Amazon can be linked to Goodreads² which is a platform that offers social reading elements. More about social reading can be found in section Social Reading.

As PDF files are supported, they can be opened as well. Contrary to flexible layout formats like EPUB, MOBI, and AZW, adjustments for font and others are not supported but a zooming function is implemented. What distinguishes Amazon Kindle devices to other devices also, is its bond to its own file format (AZW) and the disapproval to the open file format EPUB. That file format is not supported. Amazon offers (cloud) synchronisation through all devices (Kindle, PC, smartphone, tablet) since their 3rd generation (Amazon, 2018c). Software for PC, smartphones, and through a web browser exist (Kindle Cloud Reader), see previous and next sections. Currently (2018), they have an offer called *Kindle unlimited* where any number of e-books can be downloaded from Amazon's store by paying just a monthly fee of 9,99 €. Anyway, a registration on Amazon is required to download e-books.

- Tolino

Tolino devices are developed by Thalia and Weltbild. They are distributed online or in more than 2000 bookstores in Germany³. Their latest versions are Shine 3 HD (2018), Vision 4 HD (2016), and Epos (2017). Shine 3 HD and Vision 4 HD are middle-class e-book readers, Epos is for premium users. Similar to Kindle, that reflects mostly in the hardware of the devices (display and manufacturing) and consequently in price. Figure 4.2 shows a photo of a Tolino Vision device.

All of the devices make use of E Ink technology *with* backlight. Shine 3 HD and Vision 4 HD devices have a 6 inches display, Epos devices have a 7,8 inches display. The brightness of the backlight is adjustable on all devices. All devices support EPUB, PDF, and TXT files and all devices have Wifi but no 3G/4G module. Vision 4 HD and Epos are waterproof. All devices have a web browser. Tolino also offers a web reader application for reading ebooks within a web

²<https://www.goodreads.com/amazon>

³<https://mytolino.at/shops/>

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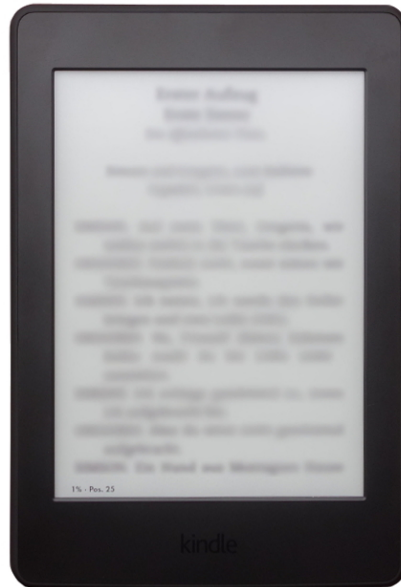


Figure 4.1.: Photo of an Amazon Kindle Paperwhite (by elektronische-buecher.net)

browser⁴ and apps for smartphones and tablets. See Table A.2 in the appendix A.1 for specifications of Tolino Shine 3 HD, Tolino Vision 4 HD, and Tolino Epos.

Its software offers adjustments for the font (change size and type), line distance, margin distance, and alignment. Text can be highlighted, notes can be added, bookmarks can be set, and text can be translated or looked up in a dictionary that has to be installed manually. Contrary to Amazon Kindle, Tolinos software does not support a function like X-Ray or Word Wise. In 2018, Thalia invested in Skoobe, a flat rate vendor for e-books (Haupt, 2018a). Thus, it is probable that a counterpart to Kindle unlimited can be offered on Tolino devices soon.

- Others

- *Kobo*

Kobo has several types of e-book readers in the offer. They have

⁴<https://mytolino.at/tolino-webreader/>

4. Critical Analysis

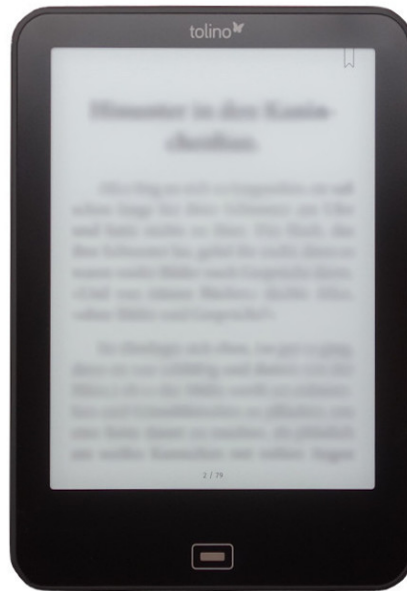


Figure 4.2.: Photo of a Tolino Vision (by elektronische-buecher.net)

a rather small market share in Germany (2017) of 2%. All their devices are based on E Ink technology. Kobo Aura H2O is dust-proof and waterproof. A wide range of file formats is supported, EPUB, PDF, MOBI, TXT, RTF, HTML, CBR, and CBZ. The following is based on a review by allesebook.de (El-Heliebi, 2018b). Its software supports functionalities for flipping (also via a slider to navigate within a book), adjustments for the font (change type and size), line distance, margin distance, and alignment. Anyway, no automatic hyphenation is supported. Further, a search functionality (to search within the book) is available, text can be highlighted (and marked), notes can be added/edited/deleted, and several dictionaries are installed. Moreover, a web browser can be used to look up words on Google or Wikipedia. See Table A.3 in the appendix A.1 for specifications of Aura One, Aura Edition 2, and Aura H2O Edition 2.

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– *Sony Reader*

Sony offered devices that also make use of E Ink technology. In 2014, Sony decided to not bring a new e-book reader on the retail customer market anymore (Haupt, 2014a). The following is based on a review by allesebook.de (El-Heliebi, 2018c). Sony Reader PRS-T3 is the last version of the series of e-book readers. EPUB, PDF, TXT, and FB2 files can be read. AZW is not supported. Its software supports adjustments for the font type and size and automatic hyphenation. Text can be highlighted and notes can be added/edited/deleted. Highlighted text can be sent to Evernote or Facebook and searched on Google and Wikipedia. Searching within the book is supported and several dictionaries are installed. In 2018, Sony released digital paper (Sony DPT-CP1) that only supports PDF files (Sony, 2018). See Table A.4 in the appendix A.1 for specifications of Sony Reader PRS-T3 and Sony DPT-CP1.

– *Trekstor*

Trekstor is a former vendor of e-book readers. In 2014, they had a share in the market of 11% (Buchreport, 2014). Trekstor eBook Reader 3.0 is a device with a colour TFT/LCD display. The following is based on a review by allesebook.de (El-Heliebi, 2018d). Its software supports adjustments for the font size, font colour, and background colour. Further, a zoom functionality is available and bookmarks can be set. Anyway, there is no way to change the font type nor line and margin distance. Moreover, text cannot be highlighted or marked and no dictionary is available. The devices support a text-reflow-function for PDF files. Further, EPUB, TXT, and FB2 file formats are supported. Due to its TFT/LCD display, it has a very poor battery life service (about 3 hours of reading without charging). See Table A.4 in the appendix A.1 for specifications of Trekstor E-Book Reader 3.0.

– *Nook*

Barnes & Nobels offer e-book readers with E Ink technology. Nook GlowLight 3 was released in 2017. The following is based on a review by allesebook.de (Kozlowski, 2017). EPUB and PDF file formats are supported. Its software is based on Android although

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it prevents accessing a web browser. Anyway, adjustment for font type, font size, font thickness, and margins are available. Further, zooming is possible and text can be highlighted, copied and pasted into a note. Also, a dictionary is available. See Table A.4 in the appendix A.1 for specifications of Nook GlowLight 3. It is worth a note that there is an active modding-community⁵ that deals with ways to customise/improve Nook devices.

4.1.4. Software for Reading

In this section, software for reading e-books is analysed. It is distinguished between software for mobile devices like smartphones and tablets and software for computers like PCs and laptops. Actually, the software is not dependent on the device type but rather on the operating system. Therefore, smartphones or tablets could have installed a Windows-based operating system (like Microsoft Surface). Contrary, a PC could have installed an Android-based operating system which is mostly used for smartphones and tablets. Anyway, in this thesis, software is divided into software for mobile devices (meaning Android, iOS) and software for computers (meaning Windows, Linux, macOS). For devices designed especially for e-books, see previous subsection Devices for Reading. Nevertheless, an Android-based operating system could be installed on an e-book reader as well.

A lot of software for mobile devices exist. For instance, a search for "e-book reader" in Google Play Store returns about 100 different apps. Most of them are actually meant to open e-books in different formats. Some of them are only viewers that support PDF files. In the appendix A.2, a table with all e-book reader apps in Google Play Store is given. Anyway, it is impossible to analyse every single one of them. In this thesis, a restriction to selected apps in the Google Play Store was done. In particular, *Kindle for Android*, *Google Play Books*, and *ReadEra* are analysed in greater detail. Further, *Tolino*, *Kobo Books*, and *eReader Prestigio: Leser* are mentioned with some details as well.

⁵<https://forum.xda-developers.com/nook-touch>

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It turns out that Amazon Kindle for Android has the most sophisticated concept for users. Functions like Word Wise, X-Ray, and social reading are unique in the reading market. Also, these functions are implemented very well. Other apps are quite solid. They offer adjustments for the text (font type, font size, etc.) that are also well integrated.

When it comes to software for PCs, not that many software tools exist that allow reading e-books. Further, existing software is not well implemented in comparison to their mobile counterpart. *Kindle* is an example. In fact, *Calibre*, *Kindle for PC*, *EBook Reader*, *Adobe Digital Editions* are analysed in greater detail. Further, *Bookviser Reader*, *Freda*, and *Gonvisor* are mentioned with some details. The latter seems to be rather unsupported in the last few years. In general, software for PCs cannot keep up with software for mobile devices. This might be an indicator that reading e-books shifts to e-book readers and other mobile devices primarily. Actually, statistics underpin that perception (Bitkom, 2017).

Software for Mobile Devices

In this subsection, software for reading e-books on smartphones and tablets is analysed. In the smartphone market (2nd quarter in 2018), Android had a share of 88%, followed by iOS with 11,9% (Gartner, 2018). In the tablet market (2nd quarter in 2018), Android had a share of 58%, followed by iOS (28%) and Windows (14%) (Strategy Analytics, 2018). Thus, the focus in this analysis is on apps for the operating systems Android because iOS apps are rather similar and offer mostly the same functions. For e-book software running on Windows, see the next subsection. Others (for instance, Blackberry, Symbian, and Bada) are neglected due to their very tiny market share nowadays.

In Google Play Store, a huge number of e-book reader apps exist. In this section, only a few of them are analysed. The selection is based on ratings, the number of downloads, and provider. For instance, providers for e-book readers such as Amazon also offer apps for smartphones and tablets. These are also evaluated to compare their functionalities to the software on other platforms (computers and e-book readers). In the appendix A.2, a table with all apps (results for search term "e-book reader") in Google's Play Store is

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given. It consists of the name, publisher, supported file formats, number of downloads, costs, ads shown, and rating. Note that there is no guarantee on completeness nor the long-term validity of that list.

- **Kindle for Android**

Amazon's Kindle for Android requires to create an Amazon account. After the creation (or login with an existing account) the personal library is shown. In the beginning, users are asked to specify their interests. According to these, they retrieve recommended books. Only books that are available in their store can be read. Also, free books are available. For each book, metadata available and current reading progress is shown. The personal library (all books and the current reading position) is synchronised through all devices on a regular basis. In Google Play Store, it has more than 100 million downloads, the average rating is 4,2 out of 5 stars.

Generally, books can be read in full-screen. By tapping on the screen during reading, further options appear to make adjustments, see Figure 4.3. Metadata can be displayed, a search within the book can be made, and the font type, font size, brightness, background colour, margins, line spacing, alignment, and multi-column can be adjusted. The currently read book can be recommended (a text with the download link on Amazon is generated that can be shared), flashcards (note cards that includes a word or definition to test the memory for key terms and concepts (Amazon, 2018b)) can be viewed, and bookmarks can be set. Further, a link to Kindle Store is available. The current progress can be shared (a text including current progress in percentage is generated including a download link for the book on Amazon) and *Word Runner* is available. *Word Runner* is a technology to help users to read faster by displaying one word at a time in the centre of the page where the eyes are already focused (Amazon, 2018a). In the centre of the screenshot (see Figure 4.3), three pages are shown (usually previous, current, and next) unless users swipe to left or right. Then, they can jump back easily as the currently read page is highlighted (see "Back to 79" in Figure 4.3). At the bottom, current reading progress is shown. Further, a slider is available to navigate through the book. Orientation switches with the general orientation of the device but can also be fixed. Actually, that option is hard to

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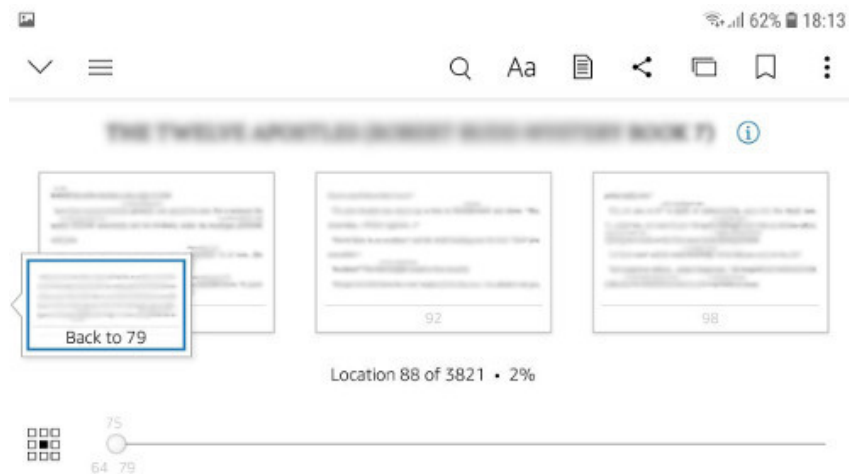


Figure 4.3.: Screenshot of Kindle on Android with several options available

find. Only if Word Wise (a function to be analysed in the next paragraph) is deactivated, it is even possible to switch between locked and unlocked screen by tapping on the lower right corner. If the screen is unlocked it is also possible to zoom in and zoom out. Then, the font size updates accordingly.

Amazon's Kindle for Android has also the *Word Wise* function in the offer. Basically, it is a special feature for reading convenience and learning a language. As mentioned in subsection Devices for Reading, it is functionality to show hints for words that might not be familiar to the reader. "Difficult" words are augmented with its definition. Five different levels for the number of hints are available. Figure 4.4 shows a screenshot with the Word Wise function. Currently, it is available in English only.

Additionally, in Kindle for Android, words can be highlighted, marked (in different colours), notes can be added, a search can be performed (within the book or on the web), shared, and copied. Further, the definition of the word in the dictionary, its entry on Wikipedia (if available), and a translation (using Bing Translator) are shown. If Word Wise is activated, an additional definition from Word Wise is given. Figure 4.5 shows a screenshot with the highlighted word "When".

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Figure 4.4.: Screenshot of Kindle on Android with function Word Wise

- Google Play Books

Google itself has an app in their Play Store that allows reading e-books. A library for e-books is available which is combined with their online store for e-books and audiobooks. Thus, a Google account is required to use the app. Very similar to Kindle for Android, only books that are sourced from their store can be read. Anyway, free books are available. For each book, metadata available and current reading progress is shown. In Google Play Store, it has more than 1 billion downloads, the average rating is 3,9 out of 5 stars.

Generally, books can be read in full-screen. By tapping the screen during reading, further options appear. These are the possibility to search within the book, show table of contents, adapt text appearance, and a context menu that offers "original view", metadata of the book, a button to share the book, a button to add a bookmark, a button to let the book be read aloud, and some more preferences. These are synchronisation of notes, highlighted text, and bookmarks on Google Drive, an offline dictionary, settings for youth protection, automatic or fixed orientation, flipping via volume buttons, 3D effect for flipping, and options to enable notifications for new books of the author, new books in series read, and books of personal interests. Further, the name of the chapter, current page and at the bottom, the reading progress (a

4. Critical Analysis

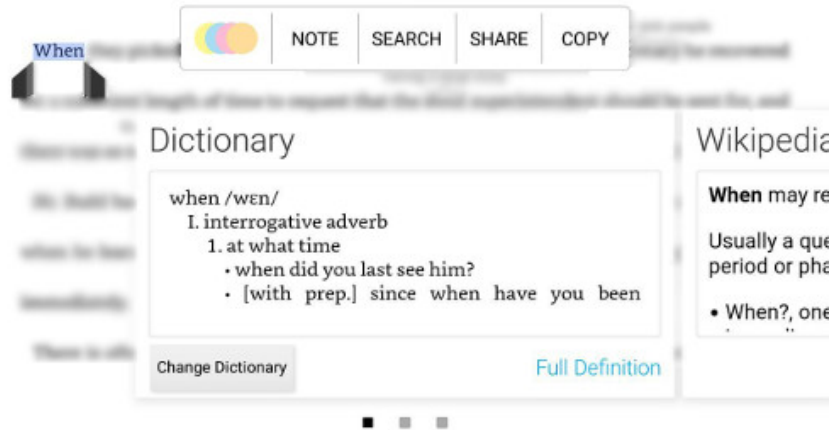


Figure 4.5.: Screenshot of Kindle for Android with a highlighted word

slider) is shown. With that slider, the position within the book can be changed. Anyway, the current position is still displayed as a miniature for easily jumping back to the current position. See Figure 4.6 for a screenshot. In 2016, Google introduced *Bubble Zoom* which is a technology to jump and zoom between bubbles in comics in the correct order using machine learning technologies to improve reading behaviour especially for comic fans (Hartrell, 2016).

Many adjustments for the text appearance are available. The font type, font size, line distance, and alignment can be changed. Further, the general theme (three exist) can be changed. Brightness can be adapted and a night mode is available. Within the viewer, it can be zoomed and text can be highlighted by tapping for a short while on a word. Then, a menu pops up to allow adding a note, translate it (using an in-app version of Google Translate⁶), search it within the book or on the web, or mark it with a colour. Additionally, if a word was highlighted, a field pops up that gives its definition or the definition of its stem. Mostly, the source of the definition is stated. Although, that feature does not work consistently. See Figure 4.7 for a screenshot where the word "Besides" was highlighted.

⁶<https://translate.google.com>

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Figure 4.6.: Screenshot of Google Play Books with several options available

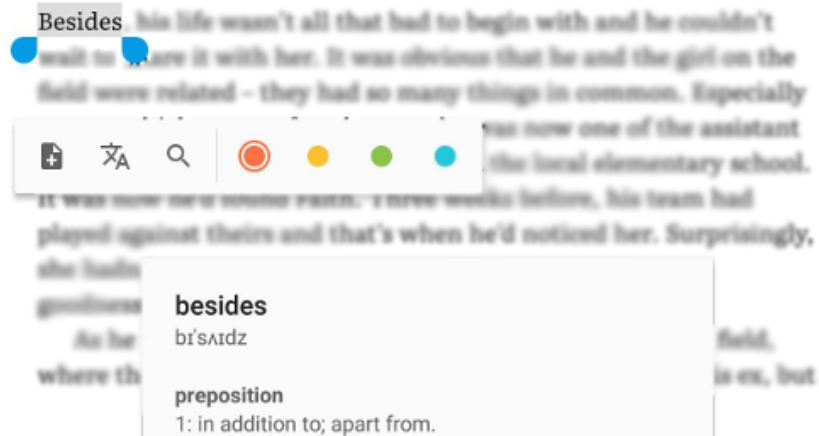


Figure 4.7.: Screenshot of Google Play Books with a highlighted word and its options available

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- **ReadEra**

ReadEra is an Android app that supports several e-book formats (EPUB, PDF, DOC, DOCX, RTF, TXT, FB2, MOBI, DJVU, and CHM). It is published by Readera LLC, free, and does not contain ads. E-books can be added to a reading list which is like a personal library. For each book, metadata available and current reading progress is shown. In Google Play Store, it has more than 1 million downloads, the average rating is 4,8 out of 5 stars.

The viewer offers several customisations for the text. Flipping can be switched between vertical and horizontal, the colour mode can be switched between day, night, sepia, and console, nine different fonts types are available, and font size can be adjusted. Additionally, the brightness can be modified via a slider. Also, the font-weight, line distance, and text alignment can be adjusted. Page margins can be switched on or off. These adjustments can be made for all supported file formats except PDF and DJVU. Further, the table of contents can be shown and bookmarks (with notes) can be set. Text can be highlighted, copied, and shared but there is no search functionality available which is a huge disadvantage. Orientation switches with the general orientation of the device but can also be fixed. Generally, books can be read in full-screen. By tapping the screen during reading, some metadata and the reading progress is shown, see Figure 4.8.

- **Others**

Some more Android apps for reading e-books are analysed. *Tolino*, *Kobo Books*, and *eReader Prestigio: Leser* are mentioned here. All of them have rather similar functionalities like in-app stores, text adjustments, and augmentations for text (highlighting text in different colours and adding notes). Optionally, they offer registration and if users are logged in, the current reading positions are synchronised through other devices.

– *Tolino*

Tolino offers, beside their e-book reader devices an app for Android for reading their e-books. PDF and EPUB formats but also audiobooks are supported. In Google Play Store, it has more than 100.000 downloads, the average rating is 4,4 out of 5 stars.

4. Critical Analysis

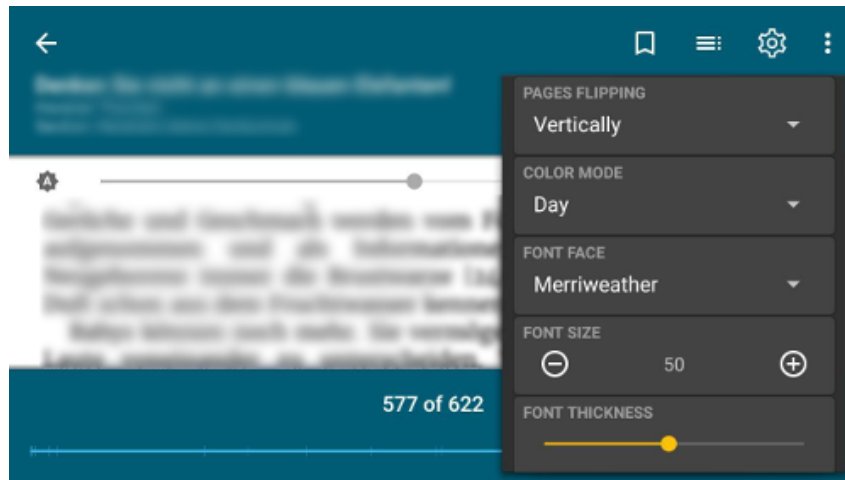


Figure 4.8.: Screenshot of ReadEra app showing metadata, progress, and preferences

On the first use of the app, users have to specify their country. Dependent on country, they have to choose a bookseller. In Austria, two are available. In Germany, one of eight suppliers must be chosen. Then, registration can be done. Although, it is not necessary. Books can be downloaded in the store of the chosen bookseller which is available in-app. The store shows (per item) a summary, ratings, comments by other users and the media, and similar items.

Their viewer for e-books is very similar to Amazon Kindle's version for Android. Main functions like zooming, highlighting, text and brightness adjustments, search functionality, and bookmarks are supported. Also, text can be highlighted, marked, and a note can be added. Further, a slider to navigate through a book is available. Contrary to Kindle's app, X-Ray, a dictionary, translations, or functions to support learning a foreign language (like Word Wise) are not available.

– *Kobo Books*

Similar to Tolino, Kobo also offers an app for Android for reading e-books. They only support e-books that are downloaded from their store. In Google Play Store, it has more than 10 million

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downloads, the average rating is 4,2 out of 5 stars. On the first use, a user can search in the store or choose presented books (top-50 e-books and top free e-books). Further, users can create an account or log in via a Google or Facebook account. Books can be downloaded in the in-app store. Very similar to Tolino, it shows (per item) a summary, ratings, comments by other users, and similar items.

Also, their viewer is rather similar to the app mentioned previously. Functions like zooming, highlighting, text and brightness adjustments, search functionality, bookmarks, and to show the table of contents are available. Text can be marked, a note can be added, and also a dictionary (Wikipedia's entry and a non-sourced explanation of the word) can be used.

– *eReader Prestigio: Leser*

This Android app supports not only downloading e-books via an in-app store (registration is required to download) but also opening files stored on the device. The store contains only free books that are published on Project Gutenberg⁷, see also subsection Project Gutenberg. Several file formats are supported (EPUB, DOC, PDF, HTML, TXT, etc.). In Google Play Store, it has more than 10 million downloads, the average rating is 4,6 out of 5 stars. On the first use, the storage of the device can be sniffed to find supported files.

In general, their viewer is similar to viewers already mentioned. Only their animation when flipping a page is noteworthy. Dependent on the position of a swipe is done on the screen, the flipping is animated differently, comparable to a real book though. Text can be marked, notes can be added, and highlighted text can be translated (default browser is opened with Google Translation). Within the app, look and feel is designed to be "as real as possible" but with augmented technologies for text and so on.

⁷<https://gutenberg.org>

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Software for Computers

There exist some software for reading e-books on conventional computers or laptops that have installed either Windows, Linux, or macOS. In this subsection, a few of them are analysed. Anyway, there is no guarantee on completeness nor the long-term validity of that list.

- Calibre

Calibre is an open-source tool for reading, converting, and maintaining e-books and it is available for Windows, Linux, and macOS (Goyal, 2018). E-books can be added to Calibre, their metadata can be edited (manually or automatically via a download from external sources), and e-books can be converted to other formats. Supported export formats are EPUB, AZW3, MOBI, DOCX, LIT, LRF, PDB, PDF, TXT, ZIP, and others. They offer a demo video that explains several functions of Calibre on their website⁸.

Further, an e-books viewer is also integrated and news can be fetched, read, and stored as an e-book. Calibre also supports the download of e-books from external sources like Amazon, Kobo, archive.org, ebook.com, and many more. Figure 4.9 shows the view of Calibre version 3.33.1 that was created by Kovid Goyal. Calibre's e-book viewer is shown in Figure 4.10 and is split up into three parts, search functionality (1), toolbox (2), and content (3) numbered accordingly in the figure.

Search functionality (1) offers possibilities to change the position within a book, jump to a reference number, use a search field to search for a term within the book, and a button to switch between a paged and flowed mode that has an effect on scrolling behaviour.

Toolbox (2) contains buttons to open another file (multiple instances are possible), copy selected text to the clipboard, increase/decrease font size, show/hide table of contents, switch to full screen, flip to previous or next page, add bookmarks, open preferences, show/hide metadata, load a different theme, and to print the book. Within the preferences, users can customise the view even more. For instance,

⁸<https://calibre-ebook.com/demo>

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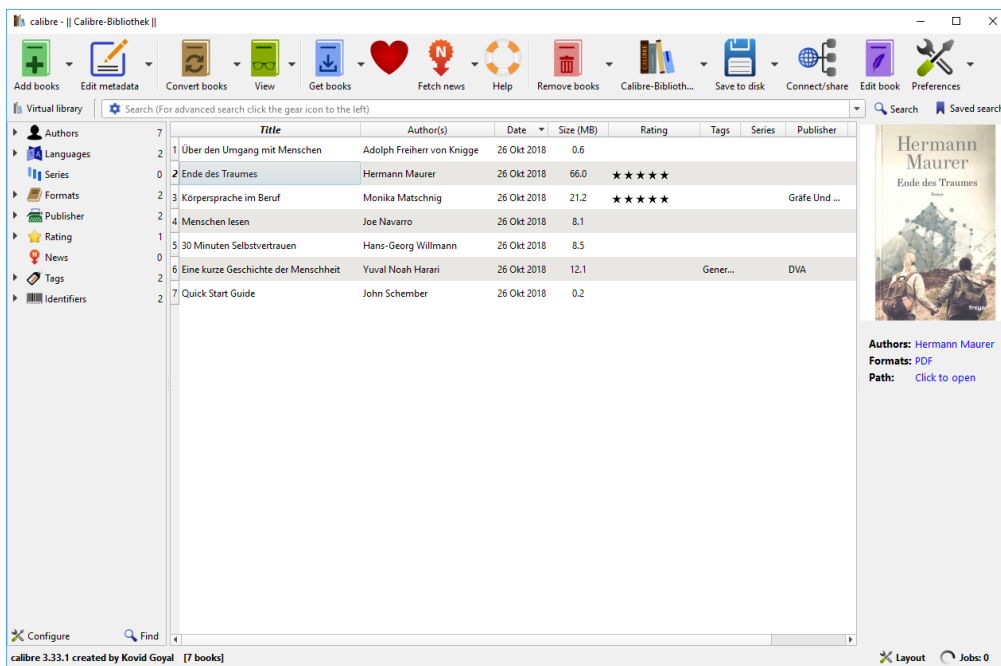


Figure 4.9.: Overview of Calibre software for managing and reading e-books

4. Critical Analysis

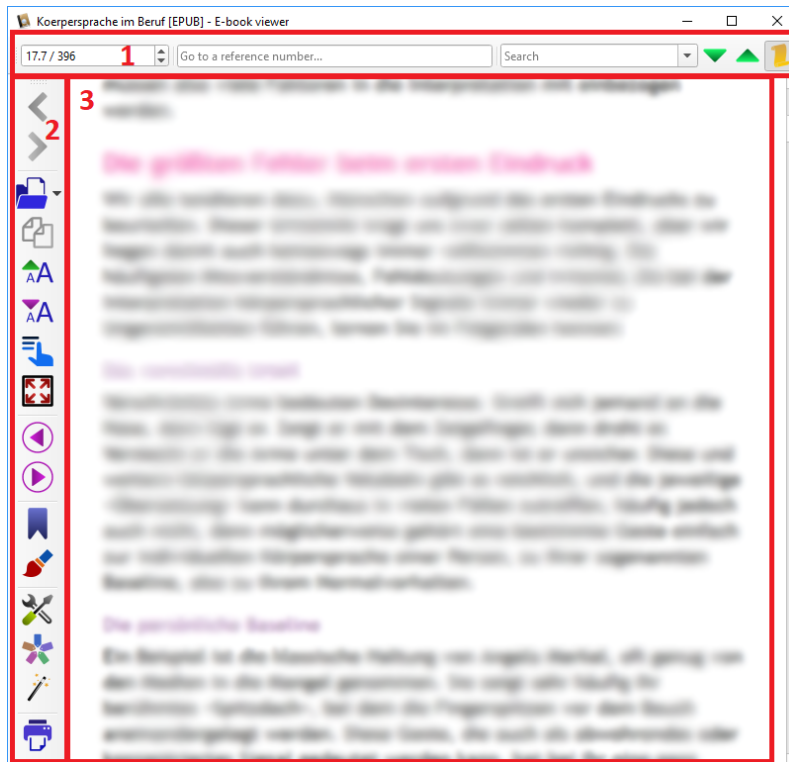


Figure 4.10.: Viewer of Calibre software

CSS can be used to individually style the content of a book. Further, toolbox (2) can be shifted to other places within the viewer.

Content (3) represents the actual content of the book including the possibility to highlight text. Via right-click, users can copy highlighted text, search for it online (default browser with the default search engine is opened), search for it in a dictionary (default browser with a search on wiktionary.org is opened), and further occurrence can be searched. Further, a word can be "inspected". Then, an HTML source code viewer is opened. If a non-web-based book is opened (for instance, PDF) it gets translated into HTML anyway.

- Kindle for PC

Besides Amazon Kindle devices and Amazon's web application (Kindle Cloud Reader), users can read their downloaded e-books with a

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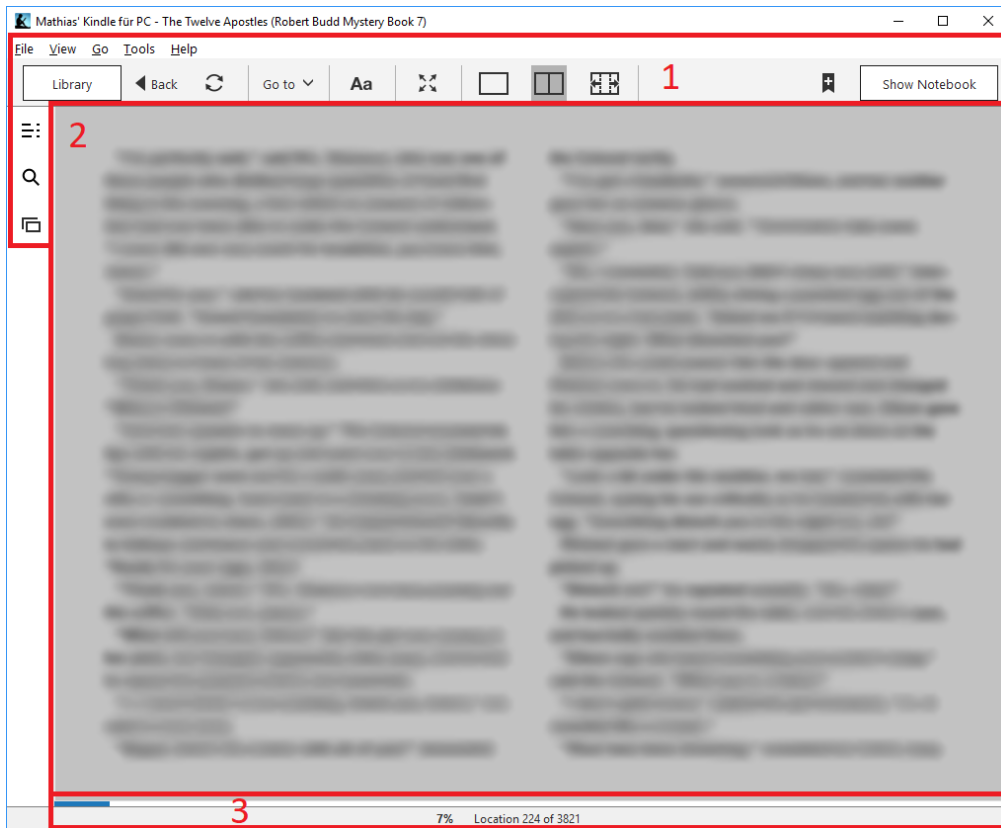


Figure 4.11.: Amazon Kindle for PC software

software named *Kindle for PC*. Consequently, it is required to create an Amazon account to download e-books. User's personal library is synchronised through all devices. Thus, they can access their e-books through the software. Kindle for PC's view is shown in Figure 4.11 and it is split up into three parts, toolbox (1), content (2), and navigation (3), highlighted in Figure 4.11. It is similar to Amazon's web application for their e-books, see subsection Amazon.

Toolbox (1) contains a menu bar for file operations, customisation for the view, links to important parts of the book (cover, table of contents, etc.), tools (set bookmarks, synchronise between devices manually, etc.), and help. Below the menu bar, some options that are also available in the menu bar are available for faster access. These are buttons to

4. Critical Analysis

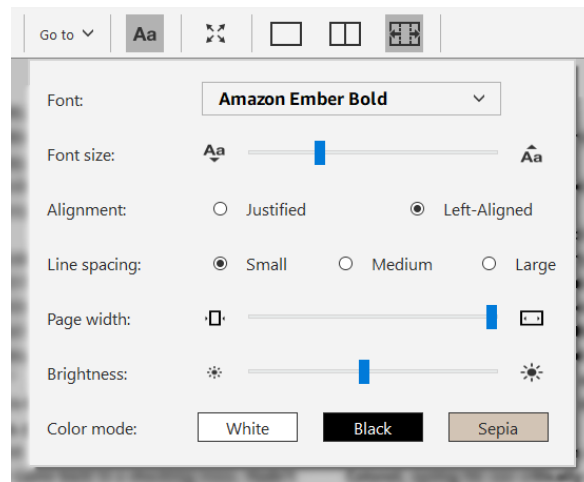


Figure 4.12.: Customisation of the view in Amazon Kindle for PC software

switch to library view (then, all e-books available are shown), skip back, synchronise current position to all devices, open goto options (cover, table of contents, beginning, and page or location), customise the view. Figure 4.12 illustrates the options available. Users can change the font (eleven fonts are available), increase and decrease font size, switch alignment types (justified and left-aligned are available), adapt line spacing (small, medium, large), configure page width, modify brightness, and switch between three different colour modes (white, black, and sepia). Further, buttons to switch to full-screen and switch between single-column mode, two-column mode, and auto-fit mode are available. On the right-hand side, a bookmark can be set for the current page, and notes and highlights can be shown or hidden. On the left-hand side, users can show the table of contents, open search menu to search within the book, and show/hide flashcards (these are note cards that include a word or definition to test a user's memory for key terms and concepts (Amazon, 2018b)).

Content (2) represents the actual content of the book. Like in the web application, it is possible to highlight text. That is done either by highlighting some words or right-click on a single word. Then, a context menu pops up, see Figure 4.13. Users can categorise the highlighted text in four different colours, add a note to it, copy it, or

4. Critical Analysis

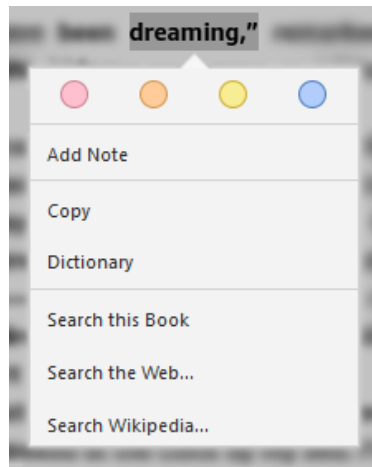


Figure 4.13.: Context menu for text in Amazon Kindle for PC software

look it up in the dictionary (that is downloaded on the first use) to see its definition. Further, selected words can be searched within the book, on the Web (default browser with the default search engine is opened), or on Wikipedia.

Figure 4.14 illustrates the entry of the highlighted word "dreaming" in the Oxford Dictionary of English. Using the gear on the right-hand side, users can choose different dictionaries (for instance, other languages). For instance, the New Oxford American Dictionary, Duden, and others are available. Alternatively, the dictionary can be opened by double-click on a single word. Further, users can click on "Full Definition" at the bottom. Then, the corresponding dictionary is opened in the current view.

Navigation (3) is similar to its representation in the web application. It shows the current position within the document (percentage and current line position). With a slider, it is possible to jump to other positions and by clicking the arrow button on the left-hand side, users can jump to the previous position.

- Icecream EBook Reader

Icecream EBook Reader is a software to manage and view e-books in different formats (EPUB, MOBI, TXT, PDF, CBZ, CBR, ZIP, FB2, and 7Z – a compressed archive format). Both, a free and a pro version exist. The

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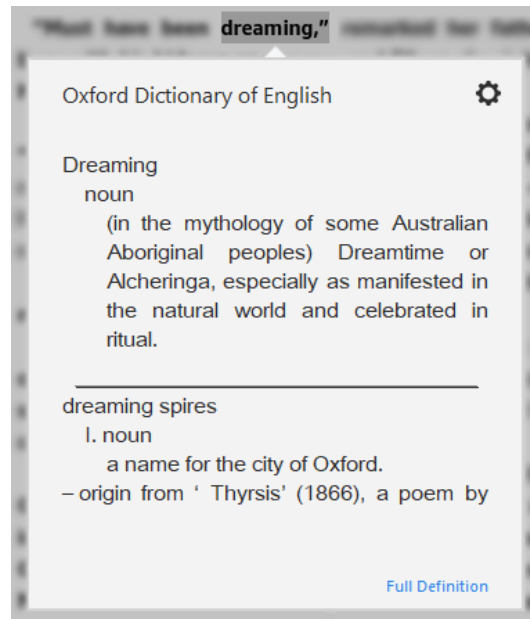


Figure 4.14.: Dictionary entry for a selected word in Amazon Kindle for PC software

pro version has some additional features. According to their software, these are reading in full-screen, copy text, add notes, add e-books in a bulk to the personal library, edit metadata, and create custom libraries. Although, some of the features were available occasionally while testing anyway. Figure 4.15 shows a screenshot of the software. It is split up into three parts, toolbox (1), content (2), and footer (3).

Toolbox (1) shows buttons to switch to the personal library (all books are shown in a list), show/hide the table of contents, show notes, and a search field is available to search for a text or page number. Further, some adjustments for the content can be made. Buttons for full-screen, to show table of contents (a second one), add a page to bookmarks, to show notes (a second one), to adjust font size and line spacing, to switch view mode (one-side and two-side modes are available), and to switch current theme (day, night, and sepia are available).

Content (2) represents the actual content of the book, a navigation slider, and some features like notes. When text is highlighted a context menu appears, see Figure 4.16. Text can be copied, a note can be

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Figure 4.15.: Icecream eBook Reader software

4. Critical Analysis

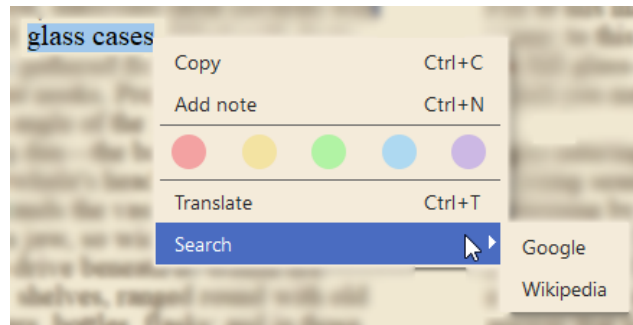


Figure 4.16.: Context menu for text in Icecream eBook Reader software

added (only in pro version), highlight colour can be chosen, it can be translated (default browser with Google Translate is opened), and searched on Google or Wikipedia (default browser is opened). That feature is rather similar to Amazon Kindle for PC's, see Figure 4.13 for their context menu. Furthermore, users can jump to different positions within the book using a slider below the content. Name of the chapter and page number are shown.

Footer (3) contains information about a book like its title, reading progress in per cent, current page number, and number of pages. Further, buttons to upgrade to the pro version of the software, to print the book, to open help, and to open settings are shown. Latter offers some additional adjustments for the text. A page turn effect can be activated, text alignment can be set (original, left, right, centre, or justify), and the theme can be switched. Within the theme, font type, font size, font colour, background colour, and colour of the "workground" can be modified.

- Adobe Digital Editions

Adobe Digital Editions is a tool to manage and view e-books in different formats (EPUB, PDF – MOBI and AZW are not supported). Figure 4.17 shows a screenshot of the software. It is split up into three parts, toolbox (1), content (2), and navigation (3).

Toolbox (1) contains buttons to switch to the personal library (all books are shown in a list), add a bookmark, show the table of contents, adapt the font size. Further, users can search for a text. Content (2)

4. Critical Analysis

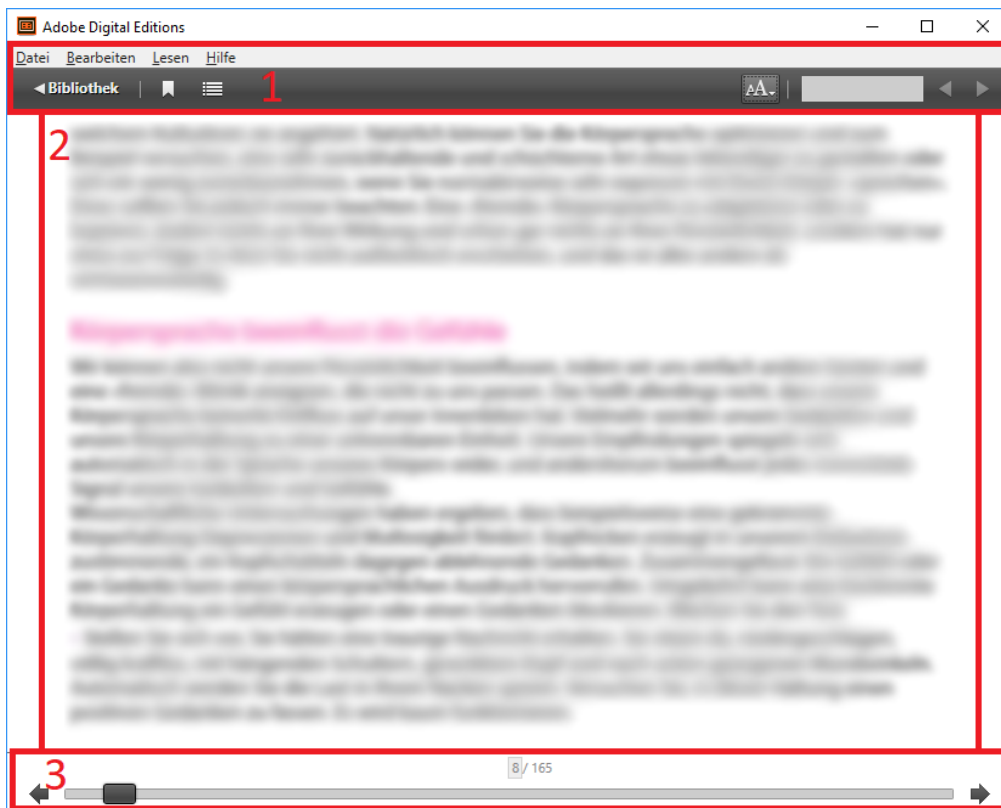


Figure 4.17.: Adobe Digital Editions software

4. Critical Analysis

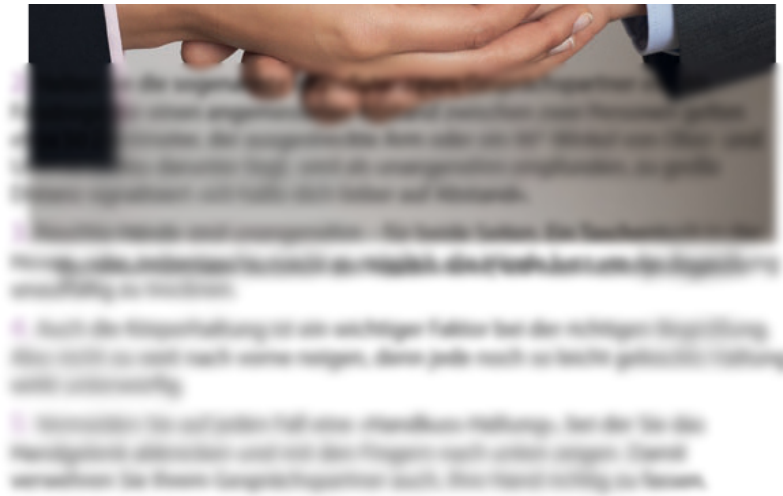


Figure 4.18.: Issue in Adobe Digital Editions software. Text and an image are overlapping.

represents the actual content of the book. Although, sometimes the software has problems in the presentation. For instance, an error might occur if a book contains images. Then, text and image might be overlapping, see Figure 4.18. Anyway, text can be highlighted and notes can be added, similar to Amazon Kindle for PC's software. Although, that function is not available for every book. Navigation (3) contains buttons for flipping and a slider to navigate through the book. It is also possible to jump to a site entering its number. Generally, functionalities for adjustments are very limited, especially compared to Amazon Kindle for PC's and Icecream EBook Reader's software.

- Others

There exist several other applications for PCs. Three more of them are analysed here. Further, Vivaldi is mentioned which is actually a web browser that offers a reader view for websites.

- *Bookviser Reader* is an e-book reader that supports EPUB, FB2, and TXT files. Anyway, the software offers an import of books that are stored locally. Further, access to online catalogues is given. The viewer itself offers some adjustments (font size, font type, and theme). Also, an animation is shown when a page is flipped.

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Although, handling is rather cumbersome.

- *Freda* is an e-book reader available for Windows and Android. The software supports EPUB, MOBI, FB2, HTML, and TXT files. Many adjustments can be made (font, background, spacing, etc.) and bookmarks, annotations, online-searching of highlighted text, and synchronising of books through multiple devices are supported. Further, a Calibre book library can be imported.
- *Gonvisor* is a free tool to view images and comic books. Therefore, it supports CBR, CBZ, CBA, CB7, CBT files which are all comic book formats. Further, archive file formats like ZIP, RAR, 7Z are supported.
- *Vivaldi* is actually a browser that offers a reader view for websites for reading articles without any distraction. Ads and pop-ups are pruned away (Vivaldi Technologies, 2018). Adjustments for font type, font size, line spacing, column width, and theme (bright, dark, and default browser theme) are available.

4.2. Online-Reading

There exist some websites that offer online-reading of books. In the following, some of them are analysed by illustrating their web application. Well-known examples are Google (with Google Books) and Amazon (with Kindle Cloud Reader). Further examples are Open Library, Austria-Forum, and Europeana Collections. Comparing these providers, it is clear that Amazon offers the most customisable reading experience for users.

Amazon requires to create an account to use their reading services. Amazon Kindle's web application is called *Kindle Cloud Reader* and allows users to adjust lots of settings like font size, font type, and background colour among others. Further, users can mark a word or more with custom notes. A user's personal library can be synchronised through all devices (Amazon Kindle e-book reader, Kindle for PC software, and Kindle's smartphone

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apps) to open the latest position within the book automatically. Although, sometimes that functionality is not flawless to use.

Google Books is an online-reading supplier that is publicly available for free. Dependent on copyright, they offer a full or a restricted insight into a book. Google partners with several libraries to digitise their stock (see chapter Digitalisation). Thus, a lot of digitised books are available. In their web application, users cannot highlight any text. Further, their tools for adjustment are very limited compared to Amazon Kindle's. It seems that Google does not have the intention to extent online-reading anymore due to a lack of updates in the last years (Rosenberg, 2017).

Contrary, Austria-Forum offers a web application that gives users a good overview of the book by displaying a preview section. Further, its search functionality has an innovative approach as it highlights the search term not only within the current pages but also in the preview section. Unfortunately, some books are scanned but its content is not indexed and thus the search mechanism does not retrieve any results. Consequently, no adjustments like individual font size and font type are given.

Two more web applications are analysed, Open Library and Europeana Collections. Both cannot keep up with the applications of Amazon, Google, and Austria-Forum. Anyway, basic needs for reading a book in the web browser are given. For instance, minor adjustments in the view and search functionalities.

4.2.1. Amazon

Amazon⁹ offers a way for reading e-books that were downloaded in their store via a web interface – in a so-called Kindle Cloud Reader. To download e-books, registration is required. Their web application is only available as a desktop version. On mobile devices, users are forwarded to the Kindle store. Anyway, the current position within the book is synchronised through all devices. In particular, it is possible to read an e-book on an Amazon Kindle

⁹<https://read.amazon.com>

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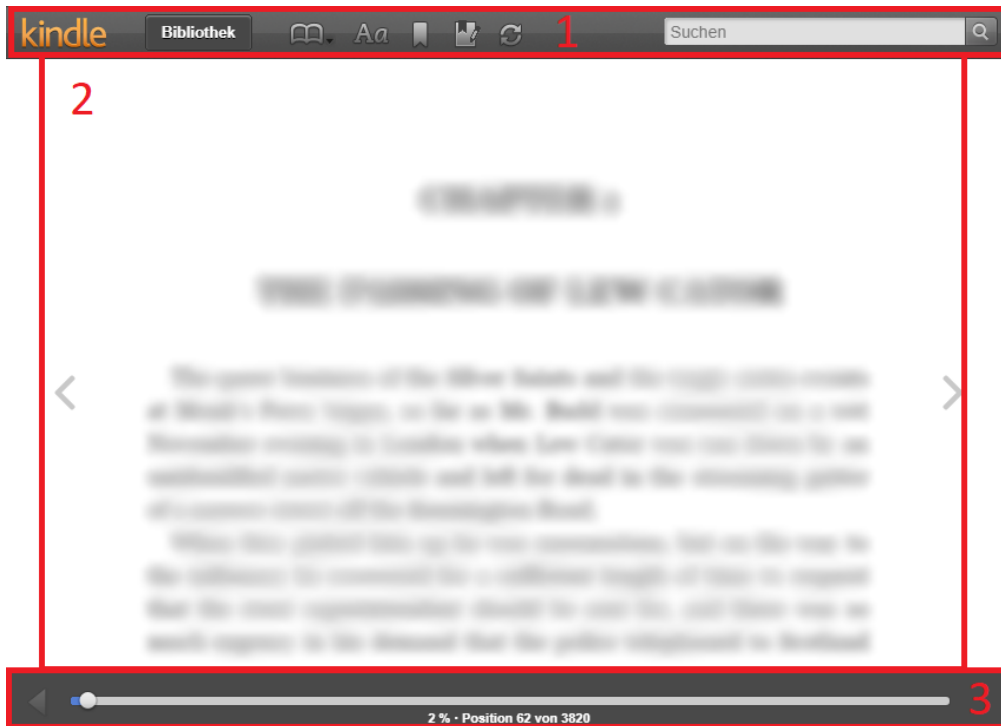


Figure 4.19.: Amazon Kindle Cloud Reader in the browser

device, using Kindle for PC software, with Kindle Cloud Reader, or in an app for smartphones and tablets.

Figure 4.19 shows a screenshot of Kindle Cloud Reader. It is split up into three parts, toolbox (1), content (2), and navigation (3), highlighted in Figure 4.19.

Toolbox (1) contains buttons to access the personal library, jump to either cover, table of contents, start, and a specific position within the book. Further options are an adjustment of the font size, font type, frame, colour mode, switch between single or two-column page mode, to set a bookmark, show/hide notes and marks, and to synchronise between devices manually. Finally, a search field is shown to search within the book. By clicking into the content (2), toolbox (1) and navigation (3) are hidden.

Content (2) represents the actual content of the book. On each side, buttons

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appear when hovering with the mouse to flip the page. By using the mouse wheel or arrow buttons on the keyboard, pages are flipped as well. There is no possibility to switch to flow mode, pages are always flipped. Further, users can highlight text via double-click. They can also mark text (text gets highlighted in yellow) and add text to notes. If a note is added, the corresponding text is highlighted automatically. Also, notes and highlighted text is synchronised through all devices.

Navigation (3) shows the current reading progress, in percentage and current line position. With a slider, it is possible to jump to other parts in the book. The current position is not saved or displayed. Thus, it might be cumbersome to navigate back to the actual position unless its position is known.

4.2.2. Google Books

Google Books¹⁰ offers books to be read online. If the site is opened on a mobile device, the desktop version of it is presented. Dependent on copyright, they offer a full view, a limited view, or a snippet view, see subsection Google Books. Figure 4.20 illustrates a screenshot of a digitised book¹¹ that is freely available on Google Books. Their web application is split up into three parts, toolbox (1), about (2), content (3), numbered accordingly in Figure 4.20.

Toolbox (1) contains buttons to zoom in, zoom out, switch between one-page view, two-page view, or thumbnail view. Further, buttons to enable full-screen, snip-and-share-tool (rectangular parts of the book can be selected and shared via a link or embed, see Figure 4.21), share the book via a link or embed are available. Further, a book can be added to a personal library, it can be jumped to other chapters, and to the next or previous page. Finally, in a settings menu (at the right-hand side of Toolbox (1) in Figure 4.20), a book can be downloaded as a PDF file or in plaintext.

About (2) contains a link to download a book (a pop-up appears when hovering that gives information about formats available, see Figure 4.22), an image of the book cover, some review information, title and author, a text

¹⁰<https://books.google.com>

¹¹<https://books.google.at/books?id=SRkCAAAAQAAJ&hl=en&printsec=frontcover>

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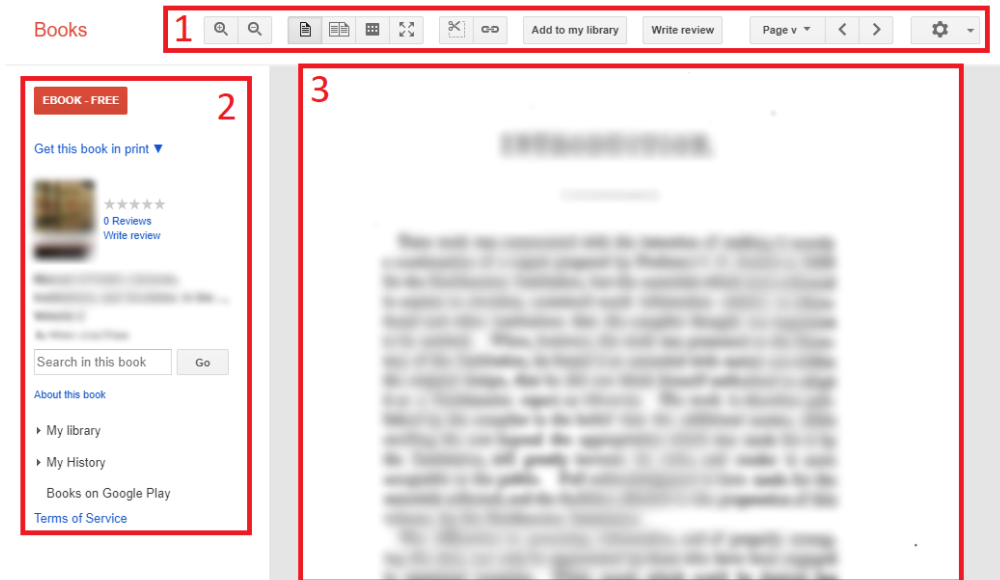


Figure 4.20.: Online-reading of a digitised book in Google Books.

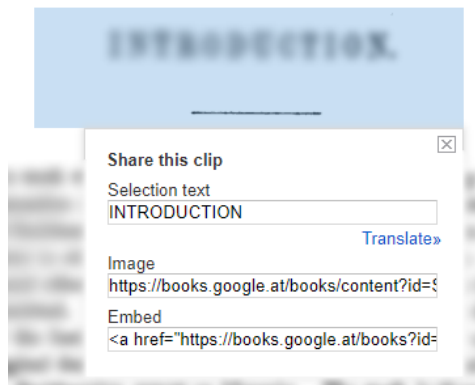


Figure 4.21.: Snip and share tool in Google Books

4. Critical Analysis

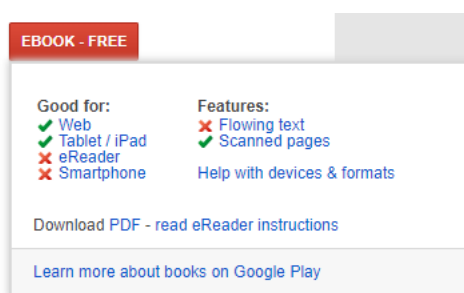


Figure 4.22.: Pop-up appears when hovering download button in Google Books

field to search within the book, a link to more information on the book, and links to other Google services.

Content (3) contains the (scanned) version of the book. There is no possibility to highlight text using the mouse. By using the mouse wheel, it is possible to scroll up and down. Alternatively, key up and key down can be used. Thus, the online version of Google Books behaves similarly to a PDF viewer. Also, in some digitised books, the table of contents is made up with links to the actual pages in the book.

4.2.3. Austria-Forum

Austria-Form¹² offers a section with more than 2.100 so-called Web-Books (Austria-Forum, 2018). These are digitised or born-digital books, magazines, and other material that can be read online for free. A mobile-friendly version of the website exists. A search function (at least metadata, for most items full-text) is supported. Figure 4.23 shows a screenshot of the web application for a handwritten cookbook¹³ that is available as digitised and OCR-scanned version on Austria-Forum. Their web application is split up into four parts, content (1), toolbox (2), search functionality (3), and preview (4), numbered accordingly in Figure 4.23.

The content (1) contains a book. It can be a digitised version, an OCR-scanned version, or both in parallel. Austria-Forum is the only site that

¹²<https://austria-forum.org>

¹³<https://austria-forum.org/web-books/handschriftlich00de1818kfu>

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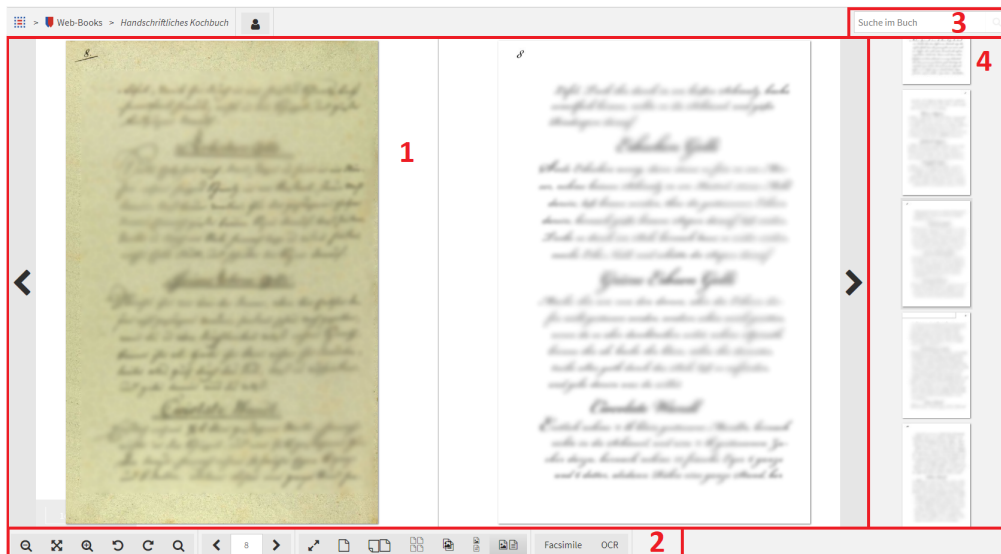


Figure 4.23.: Online-reading of book in digitised and OCR-scanned version in parallel in Austria-Forum

provides a reading experience with two versions in parallel, one above the other, or one overlaid on the other, see Figure 4.23. For some born-digital books¹⁴, Austria-Forum provides a translation of the book in the same way. It is possible to switch between the German version, the English version, or both versions in parallel, above, or overlaid, easily by a click. However, there is no possibility to highlight text using a mouse cursor but it is possible to drag the whole content.

Further, by using the mouse wheel it is possible to zoom in and out. At the bottom on the left-hand side, users get information about the real size (in centimetre) and percentage of zoom, see Figure 4.24. By using arrows on the left and right-hand side, pages are flipped. Consequently, preview (4) is updated accordingly.

Toolbox (2) contains buttons to zoom out, to size automatically, to zoom in, to rotate anticlockwise, to rotate clockwise, to use a magnifier (see Figure 4.25), to flip to the previous or next page (page number can be entered manually), to switch between one-page view, two-page view, or thumbnail view, and

¹⁴<https://austria-forum.org/web-books/exp00de2019isds>

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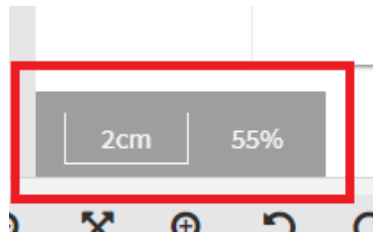


Figure 4.24.: Information about size and zoom percentage highlighted by a red rectangle in Austria-Forum

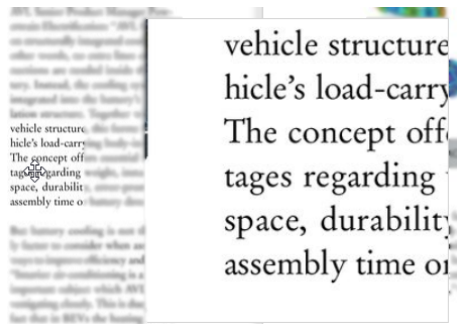


Figure 4.25.: Magnifier in Austria-Forum

enable full-screen. If a book has two versions (OCR-scan or translation), buttons to overlay, one above the other, and next to each other are shown. Consequently, buttons to switch between facsimile (original version) version and OCR-scanned version is given. Further, a link to the publisher is shown if available.

Figure 4.26 illustrates the search functionality (3) in Austria-Forum. After the search, the search term is written in red colour and snippet of context is shown (a). Further, the search term is framed on pages (b) and in the preview section (c). Moreover, pages that do not include the search term are greyed out. Preview (4) contains previews of the pages in the book. It is scrollable and thus it can be used to navigate through the whole book.

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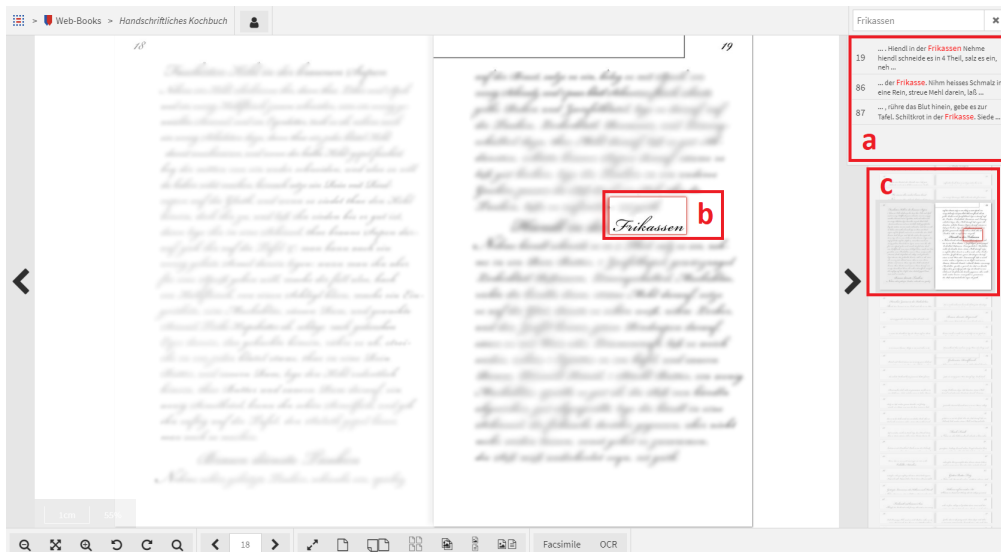


Figure 4.26.: Search functionality with search term “Frikassen” in Austria-Forum. Important parts are highlighted by red rectangles.

4.2.4. Open Library

Open Library¹⁵ offers access to digital content submitted to Internet Archive, see subsection Internet Archive for more information. Users can read books online by using a responsive web application. Also, a mobile-friendly version is available and well-implemented. Figure 4.27 shows a screenshot of a digitised book¹⁶ on Open Library. Their application is split up into three parts, header (1), content (2), and footer (3), numbered accordingly in Figure 4.27.

Header (1) contains the title of a book, a possibility to download it (as PDF, EPUB, plaintext, Daisy, or Kindle), a button to retrieve information on the book, a button to share it, and a field to search within the content. When using the search functionality, the term is highlighted. Further, in the footer, it is shown where the term occurs within the book including a little preview of the text containing the term, see Figure 4.28.

¹⁵<https://openlibrary.org>

¹⁶<https://archive.org/stream/b29978531>

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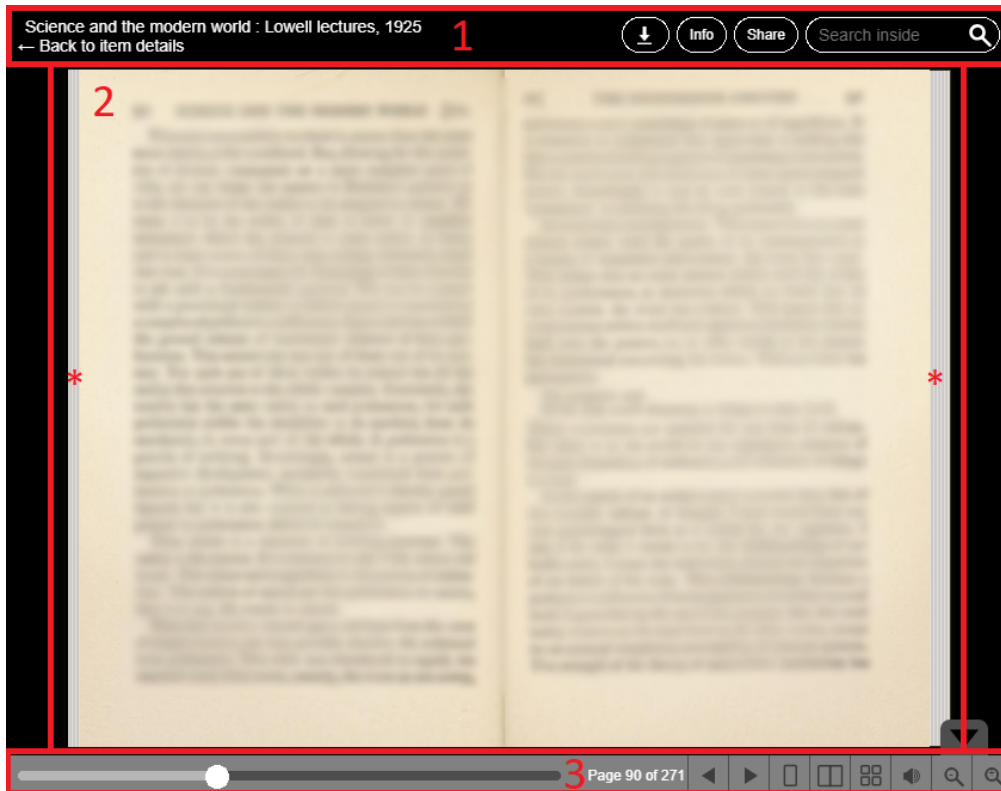


Figure 4.27.: Online-reading of a digitised book in Open Library

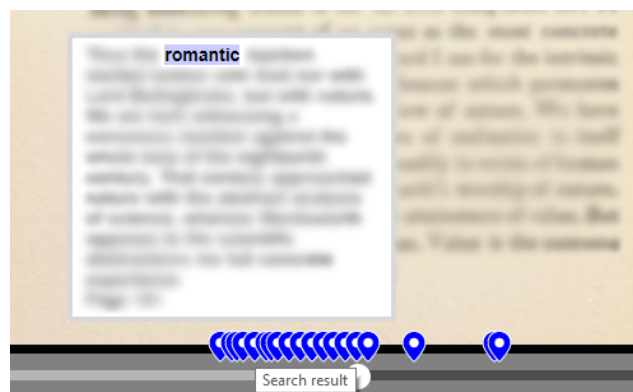


Figure 4.28.: Search functionality with search term "romantic" in Open Library

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Content (2) contains a scanned version of a book. There is no possibility to highlight text. On both sides, beside the content, a grey block is shown that displays parts of the body of a book (the progress of pages read of a book), similar when reading a real book, highlighted as stars in Figure 4.27. By clicking on the left or right page of a book, a flip to the previous (or next) page is triggered and displayed as an animation. The same behaviour is achieved by the use of key left and key up (previous pages) and key right and key down (next pages) on the keyboard. It is also possible to click on the body of the book. Then, the web application flips to the corresponding position within the book.

Footer (3) offers information on the current position within the book, gives the possibility to flip and change view to either one-page view, two-page view, or thumbnail view. Further, it is possible to read aloud the current page by a computer voice. By highlighting, it is shown which paragraph is currently read. Finally, buttons to zoom in and zoom out are provided.

4.2.5. Europeana Collections

Europeana Collections¹⁷ is a project that co-financed by the European Union. It provides access to over 58 million items that were digitised by European archives, libraries, and museums (Europeana Collections, 2018). A mobile-friendly version of the website exists. Although a zooming function is implemented, reading an e-book is rather cumbersome. They offer not only online-reading but also a possibility to download the material. It is also stated if or how the material is copyrighted. Figure 4.29 shows a screenshot of their web application for online-reading. It is split up into three parts, toolbox (1), content (2), and preview (3), numbered accordingly in Figure 4.29.

Toolbox (1) contains buttons to jump to the first page, the last page, to rotate clockwise, to rotate anticlockwise, to enable hand-tool, and to show properties of the document. Latter opens a field with metadata, see Figure 4.30. Further, buttons to search within the document and to flip to the previous and next page are shown. Moreover, current page number and overall page

¹⁷<https://www.europeana.eu>

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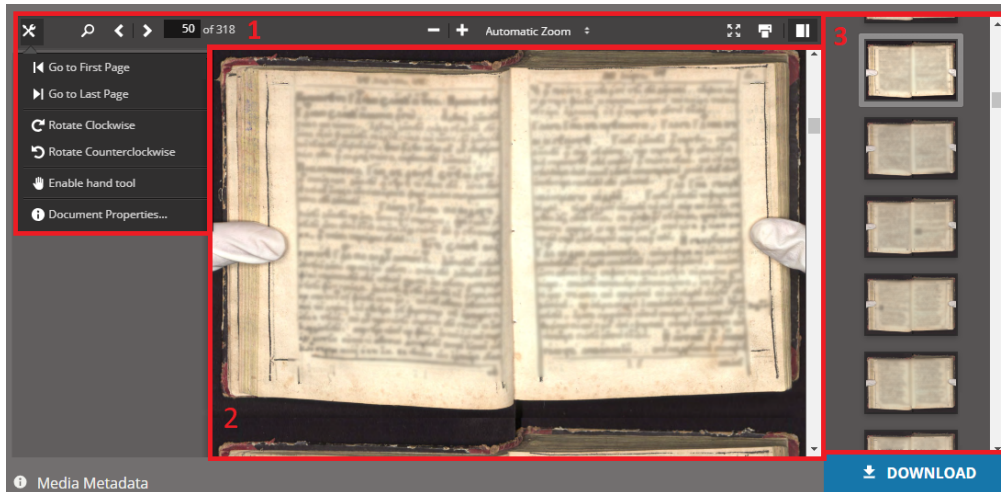


Figure 4.29.: Online-reading of a digitised book in European Collections

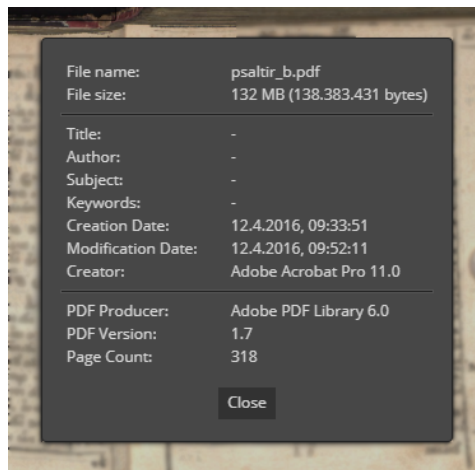


Figure 4.30.: Field with metadata of material in European Collections

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count are displayed. In the centre, users have the possibility to zoom in and out. On the right-hand side, buttons to switch to full-screen, to print the current content, and to toggle preview (4) are shown.

Content (2) contains a scanned version of a book. There is no possibility to highlight text. Preview (4) contains previews of the pages in a book. It is scrollable. Thus, it can be used to navigate through the whole book, similar to the preview (4) in Austria-Forum (see above). Finally, at the bottom on the right-hand side, a button to download the file is available.

4.2.6. Others

There exist many other websites that offer online-reading for e-books. For instance, manybooks.net, fictionpress.com, readanybook.com, bookrix.com, digitale-sammlungen.de, and baen.com. For an advanced list of websites that offer online-reading and/or download of e-books including their Alexa rank, see appendix B.

4.3. Social Reading

With digital content, new ways for interaction between a group of users emerge. One of them is social reading. Social reading is a readers participation within digital content in form of annotations, underlining, reviews, and ratings (Cordón-García et al., 2013). It also can be seen as a shift of book clubs in the digital world. Nowadays, different platforms are used for social reading. For instance, social networks, blogs, forums, and special sites created for this purpose only. These conversations are mostly put into writing and therefore are traceable and comprehensible for other readers.

While in book clubs readers have to meet at a certain place and on a certain time, participating in social reading is independent of that. Another implication is rather anonymous participation through the Internet while in book clubs readers discuss face-to-face. Also, several advantages of digital content apply. For instance, information search and retrieval technologies can be used to search for specific words, users, comments, and others.

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Further, the audience can be expanded by all means due to the wide range of people having access to the Internet. Another possibility might be direct contact between readers and the author of a book (Pleimling, 2012). An author could add comments to parts within the book belated.

Such online-communities might also have advantages for other parties. For instance, publishers could promote their offers by advertising their books, authors, and others (Pleimling, 2012). In fact, by using big data, data mining, and tracking technologies, personalised offers could be made. Of course, that is a controversial topic that will only be touched briefly in this thesis. Some more negative effects arise. Due to being rather anonymous, people might tend to be disrespectful or harmful to each other. In fact, Goodreads¹⁸, a social reading platform especially for Kindle users, had to deal with that kind of issues (Haupt, 2013). Also, false and misleading information could be spread easier such that social reading communities must be guided by moderators. In consequence, these discussions would lose the freedom of expression.

Many approaches to social reading had been taken place in the past, most of them failed. Amazon is one of the few that still offer social reading functions for their e-books on Kindle devices. Until 2016, they even had two different communities, Goodreads and Shelfari. Then, they decided to shut down the latter without a complete data transfer into Goodreads, receiving some criticism by the community (Haupt, 2016). Readmill was a startup company that offered apps for Android and iOS to discuss the content within e-books with other readers. Their company was sold in 2014 to Dropbox that scrubbed the project (Haupt, 2014b). Ongoing, Amazon also had an influence on the failed project due to their high market share and the restriction on e-books when they are DRM protected.

Another example is Sobook (*Social books*), a German startup company that had the intention to revolutionise reading e-books by offering a web-based interface for reading and commenting on books across multiple devices (Haupt, 2018b). According to their website¹⁹, the project got cancelled due to technology-based, sector-specific, and managerial mistakes.

¹⁸<https://www.goodreads.com>

¹⁹<https://sobooks.de>

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Further, the General Data Protection Regulation (GDPR) that became effective in the European Union in May 2018, was named as a reason. They also stated that some of their team members use their knowledge for a product in the field of education.

Dotdotdot was another startup company that offered social reading functions via an iOS app, web application, and browser plugin. They also shut down their services after a few years in service in 2015 because of less interest and decreasing needs for readers (Haupt, 2015).

All these cases show that social reading is only needed to a certain extent. Most readers might prefer reading their book or text on their own without any form of connection to other readers even if they would have advantages by using it. Indeed, by analysing social reading behaviours, science has never before seen insights in the reading process of people (Pleimling, 2012). Especially in the field of education, these insights would be very valuable to improve didactics and methodology.

4.4. Conclusion of the Analysis

In the previous sections, e-books, devices and software for reading e-books, and online-reading offers were analysed. In fact, the number of providers is incredibly huge. In this thesis, only a few of them were analysed. They were chosen in different aspects.

In short, Amazon Kindle with its software and devices is prevalent. They have the most sophisticated functions to improve reading convenience. Besides their almost perfect implementation of functions for adjustments, they provide tools that make them unique in the whole online market (devices, software, and online-reading). Word Wise, X-Ray, and social reading functions are only supported by Amazon Kindle. No other software is able to keep up with them. Its biggest disadvantage (from a user perspective) is its non-support for the open file format EPUB. Anyway, due to the strong connection of Amazon's devices and its store for books combined with Amazon's increasing market share within the last years, it seems that users want hardware, software, and content from a single source.

4. Critical Analysis

4.4.1. Devices for Reading

E-book readers have a very clear market share in favour of Amazon Kindle devices. In Germany (2017), they had a market share of 67% followed by Tolino with 16% (Statista, 2018a). It is clear that these two were analysed in greater detail. Amazon Kindle has several functions for the adjustment (font type, size, brightness, etc.). Also, Word Wise, X-Ray, and social reading functions are rather unique in the market. These are a step to more interaction and convenience for users. Although, social reading might not of interest in the future, as mentioned in section Social Reading. Anyway, a small share of users will use it though. Tolino has solid software with common adjustments for text. They do not offer anything special but what they have is rather profound. Other devices that were analysed are Kobo, Sony Reader, Trekstor, and Nook. As mentioned, these devices have a very tiny market share. All these devices do not have protruding functions in their software.

Kindle's biggest disadvantage (from a user's perspective) is its bond to Amazon's file format AZW. Most of the e-books downloaded in the store are in the formats AZW or MOBI. Besides these, PRC, PDF, HTML, and TXT files are supported. EPUB, the most used open format for e-books is not supported. It is very likely that this is on purpose. Probably, Amazon wants to bind their customers (especially for Kindle devices) to gain revenue by selling e-books. Tolino, Kobo, and others might have the same approach by connecting their devices to their online store for e-books. Contrary, they all support EPUB files. Thus, any source of e-books that delivers EPUB files fulfils for users. Due to the fact that AZW is not an open format, only Amazon itself can guarantee flawless support for it. Other tools like Calibre exist that support conversion to AZW. Although, they can not guarantee full support of it. This and their large selection of e-books might be an indicator for the increasing market share of Amazon during the last years. It seems that users want hardware, software, and content from a single source. Lastly, due to the connection between devices and online stores of their vendors, mostly born-digital content is read on e-book readers as these stores contain mainly born-digital or at least non-scanned versions of books.

4. Critical Analysis

4.4.2. Software for Reading

When it comes to software for reading e-books, it has to be made a difference between software for mobile devices (smartphones and tablets) and computers (PCs and laptops). A wealth of operating systems and software tools exist. Anyway, the analyses tried to focus on the most used and most promising solutions.

Regarding software for mobile devices, only Android apps were analysed. First, due to their share of 88% in the smartphone market (Gartner, 2018) and 58% in the tablets market (Strategy Analytics, 2018) they are prevalent. Second, iOS apps are rather similar to their Android counterpart and can, therefore, be neglected along with apps for other operating systems that have a very tiny market share. Anyway, there exist a huge number of apps in the Google Play Store and probably beyond. In this thesis, Amazon Kindle for Android, Tolino, and Kobo Books were chosen to have a comparison to the software on their e-book readers. Further, Google Play Books was chosen to their incredible number of downloads (+1 billion downloads). ReadEra was chosen because it is ad-free, free of charge, and due to its very good rating (4,8 out of 5 stars). Finally, eReader Prestigio: Leser was chosen due to the combination of its high number of downloads (+100 million downloads) and its good rating (4,6 out of 5 stars).

All current versions of the apps have good ways to adjust the content of an e-book. Examples are the flexibility in font size, font type, background colour, and brightness. Users can adapt them easily and flexible. Also, functions like a dictionary, notes, translations, synchronisations through several devices, and explanations of highlighted words are supported by many apps nowadays. Anyway, Amazon Kindle has the most sophisticated software on the market. They exceed their competitors by far. Functions like Word Wise (hints are shown for "difficult" words) or their social reading functions are predominant. Though, during the analysis, functions to synchronise through several devices did not work always in fullest satisfaction.

Regarding software for computers, not that many programs exist. This is due to the fact that these devices are not widely used for reading e-books anymore as mobile devices arrived. Statistics underpin that perception (Bitkom, 2017). Anyway, Calibre, software that not only allows reading e-books but

4. Critical Analysis

also managing them in form of conversion to other formats and sending e-books to devices has its place in the market. On mobile devices like smartphones, it would be more cumbersome to distribute e-books through several connected devices. At least nowadays, no software that supports this function exists or is widely known. Other software for reading e-books usually do not support as many functions as software for mobile devices from the same provider. Amazon Kindle is an example. Their version for PCs seems to receive way less attention compared to their version for Android. Lastly, due to the connection between these apps and online stores of their vendors, mostly born-digital content is read on e-book readers as these stores contain mainly born-digital or at least non-scanned versions of books.

4.4.3. Online-Reading Offers

When it comes to online-reading using a web-browser, several websites exist. Big players like Amazon (with Kindle Cloud Reader) and Google (with Google Books) have offers for reading online. Kindle Cloud Reader is available only in their desktop version. On mobile devices, users are forwarded to the Kindle store. Google Books does not have a mobile-friendly version of their web interface either. At least, it is possible to read books using the web browser on a mobile device. Then, the desktop version of the website is presented. Austria-Forum has at least a mobile-friendly website. Although, when using the zoom function, the text is not retrieved in a higher resolution. Thus, it is impossible to read books with small font size. Open Library has a mobile-friendly website that provides convenient reading by offering a zoom function and a switch to a one-page view if necessary. Europeana Collections also offers a mobile-friendly version of the website. A zoom function is available. Although it is rather cumbersome to use it. Consequently, it is hard to read a book on a mobile device.

Similar to the field of devices and software for reading, Amazon has sophisticated ways to present content. Their software has a convenient reading experience. Although, Kindle Cloud Reader has a very limited set of functions compared to their Android app or on Kindle devices. Namely, Word Wise, X-Ray, translations, and dictionaries are missing in the web version. It is very likely that online-reading via a web interface is not that widespread

4. Critical Analysis

in the area of Amazon Kindle. Worth a note, the synchronisation of the current reading position within a book was not always stable when tested. Austria-Forum sticks out with their parallel versions of books. It improves reading convenience especially for books written in a foreign language or if books contain OCR-scanning errors. Contrary to devices and software for reading e-books, analysed providers of online-reading have also (or mostly) scanned versions of books in their stock. This applies for all websites but Amazon Kindle that only supports e-books that were downloaded from their store.

4.5. Miscellaneous

A rather interesting observation is that during summer the Alexa rank of most e-book vendors drops. Examples are thalia.de, weltbild.de, buecher.de, and ebook.de, see Figure 4.31. All of them are rather popular in Germany. For an advanced list of websites that offer online-reading and/or download of e-books including their Alexa rank, see appendix B.

4. Critical Analysis



(a) Alexa Rank for thalia.de



(b) Alexa Rank for weltbild.de



(c) Alexa Rank for buecher.de



(d) Alexa Rank for ebook.de



(e) Alexa Rank for free-ebooks.net



(f) Alexa Rank for ebooks.com

Figure 4.31.: Alexa Traffic Ranks for six different e-book providers. All have the same pattern (bottom out reached during summer).

5. Suggested Extensions for Existing Software

In this chapter, several extensions for existing software are introduced. These include cross references & transclusion, user group, and user feedback & ratings. Cross references & transclusion are ways to link or include content from other sources. Readers of e-books are classified in so-called user groups that represent their current level of knowledge and experience, as well as their interests. It is vital to receive information from actual users. Thus, ways to get them via feedback methods are proposed.

In chapter Critical Analysis, many e-books, e-book readers, and websites that offer either these or web applications for reading online got analysed. It was concluded that Amazon Kindle has the most advanced approaches and functions for reading convenience. In particular, they offer Word Wise, X-Ray, and social reading functions besides many adjustments for the text that can be made.

To recap, Word Wise is a technology to augment "difficult" words with its definition or an explanation. X-Ray is technology to highlight a word (e.g. a noun) and all occurrences within an e-book are listed. That is rather practical to find the first occurrence of a character within a story. Social reading is discussed in greater detail in section Social Reading in the previous chapter. Basically, many readers across the Internet are participating by annotating, reviewing, or rating parts of a book. However, examples show that social reading is not widely used.

Anyway, some more extensions might be possible to improve reading convenience and open new ways in interconnection with other users and content. It is beyond this thesis to implement and evaluate these extensions. Here, several ideas are introduced and explained, to give the reader food for

5. Suggested Extensions for Existing Software

thoughts. These suggested extensions are designed to be applied especially in the field of learning and non-fiction. Its goal is to create a modular e-book that contains information that is depending on the actual reader. However, they can be applied in other genres as well. Although, they might not be practical or useful there.

Consequently, the starting point for these extensions is an already existing software to display e-books in EPUB format. With the EPUB format, the topic of DRM (digital rights management) is also covered. Functions for adapting font type, font size, and so on might be very useful but are not necessarily needed in the beginning.

5.1. Cross References & Transclusion

Firstly, approaches for cross referencing can be done to link users to similar content. This is already done on websites of course. Also, Austria-Forum offers books that contain cross references to other content within their website ¹. Further, that is already partly done in stores for e-books. Some stores (like Amazon's and Google Play Books) display similar books. For instance, similar can mean the same genre, same author, or same topic. Amazon displays right below the actual e-book a section named "Customers who bought this item also bought". At the bottom of the site, another three sections display reference content. Namely, "What other items do customers buy after viewing this item?", "Customers who viewed this item also viewed", and "Customers who viewed this item also viewed".

That approach could be changed in a way that reference links or even content could be shown within a book. The latter is called *transclusion*. It is similar to a call of a subprogramme in source code. The referenced content is taken from the source where it belongs to. It is then displayed. Austria-Forum make use of this technology on their website. They transclude images and parts of content from other pages of their site. The name of the source and a link to it can be added for further investigations. Possible copyright infringements may arise. Thus, it must always be made with

¹<https://austria-forum.org/web-books/austriaforum01de2015iicm>

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respect to the copyright. Further, it must be discussed if fair-use is an option. Google Books made use of that but had to negotiate a settlement, see subsection Google Books in chapter Digitalisation. Alternatively, open-source content could be taken. Another option would be an agreement with authors (or publishers).

Taking this approach, it has to be determined in which area it can be applied. For conventional e-books like fiction books, this approach might not be useful at all. Although, a possible application in this area could be a collection of extracts from different books of an author in form of an e-book. Non-fiction e-books might be more suitable for this idea. An example could be a collection of different opinions or facts from different authors about a historical event, a topic, or a public figure. Another application could be the field of learning and education. Subject matters could be based on different sources. All these are located on different servers and maintained by several authors. A positive side-effect is a variety of approaches to solving problems. Also, different views on a topic are given easily if a source is available. Of course, the sources must be trustworthy. That is an issue that must not be neglected. Another advantage is an easy update of content on the server side. Then, possible mistakes can be fixed easily. Authors may have a good connection to each other in form of exchanging views, ideas, and opinions. On the author's site, a tool to maintain the content must be used. This tool has to support functions like version control and clear authorship. Consequently, different authors see changes made by other authors when they are committed. Basically, similar tools as in the field of software technology can be used for maintaining, releasing, and distributing content. Following this thought, whole schoolbooks can be made up in form of e-books with that approach.

Also, from the technical perspective, that approach can be realised. In this thesis, all common e-book file formats were analysed. Some of them offer links to external sites or even inclusion of external content. For instance, one of the most used file formats for e-books is EPUB. As mentioned in section E-Books in chapter Critical Analysis, basically, it is a website inside an archive. Thus, all functions that are supported by HTML, CSS, and JavaScript can be used. These include loading external content from other sites.

Moreover, the user experience must be considered. Content must be dis-

5. Suggested Extensions for Existing Software

played in a way that it is understandable for its users. Thus, content strategy is needed. Content Strategy affects the connection between content and its users (Halvorson and Rach, 2012). For a first release, it would be sufficient to transform designs that are currently used in schoolbooks into digital. Anyway, in this thesis, only a brief outline of this is given.

5.2. User Groups

Moreover, the content of an e-book could be different depending on the user group of a reader. Readers could be grouped in order to their knowledge, experience, interest, or other domains, in form of different levels. Consequently, they only get content presented that corresponds to their group(s). Again, an application could be in the field of learning. Taking a subject matter, that does not contain different approaches to solve problems only but also different levels of problem descriptions. Advanced students receive more difficult or further tasks than others. Technically that is not a problem to implement it.

Anyway, it is harder to decide to which group a user belongs. That could be done manually (by a possible teacher or the user himself) or automatically by using a classification test or similar. Then, by solving tasks, users can be re-assigned to other user groups. For instance, a user could be classified in a knowledge level 1 and experience 2. Then, content is shown accordingly. That technique is not trivial at all. Many research has to be done to develop an approach that can be tested in the real world. Also, a tool for classification highly depends on the actual subject or topic.

5.3. User Feedback & Ratings

User feedback is required to improve the quality of content and to become acquainted with other opinions and approaches. However, this is not a new extension to current e-books and software. Anyway, to give feedback for learning tools is vital. Especially in the field of learning, thoughts and opinions of the actual users have to be considered to improve the quality of

5. Suggested Extensions for Existing Software

the content, didactics and methodology, and user experience. For users, it should be possible to give feedback at any time. That can be made in form of ratings for the content, short descriptions of errors, surveys, and easy bug reporting. It has to be discussed if the given feedback should be shown to the authority only or to other users as well.

Regarding feedback from users, several areas have to be considered. This thesis depicts types of user feedback based on (Morrison, 2018). They propose ten types of user feedback to avoid useless or false answers in consequence to build a better product. They were adapted to the needs of feedback for a modular e-book in the field of learning.

1. *How likely are they to recommend a modular e-book to a friend?*

By recommending a modular e-book, users put their reputation on the line. If users tell friends about it in case it is very unsatisfying or useless for them, they might not be trusted in the future. Thus, users would only suggest a modular e-book if they are really convinced of it. Consequently, this is an indicator of how satisfied or happy users are with it. For rating, a scale from one to ten (one expresses *very unlikely* and ten expresses *very likely*) could be used.

2. *What bugs or problems are they running into?*

To test a product against all kinds of bugs can be very time-consuming and it needs a lot of effort and resources. By collecting errors from users of a modular e-book that job is sourced out. Of course, basic tests must be implemented in advance, such as startup and functions like opening a book, highlighting text, and so on. Other problems might occur only if real users work with the software. If a bug is found by a user, it is highly important to provide an easy and quick way to deliver that error to the developers. For instance, this could be done by providing a screenshot functionality plus custom drawings and a short description.

3. *How happy are they with support?*

If errors or questions arise, support (that actually cares!) should be available. Consequently, users should be satisfied with the given support. A way to retrieve this information could be a one-question survey, simply with a

5. Suggested Extensions for Existing Software

text like "Please rate your experience with the support." and giving three answers like "Good", "Okay", and "Bad". The same applies as for the previous feedback. It should be possible to do it very easy and quick.

4. *Have they searched for alternatives since working with it?*

This feedback is important to uncover possible major issues in the current version. When users think about to leave (and perhaps never coming back) is an indicator that something is not what or how they actually want. Suggested questions might be if they searched for alternatives since they used a modular e-book. If so, what they were looking at other software that is missing in the current version. If users reveal what they looking for it can be decided if and what adoptions might be necessary.

5. *What are their results from using a modular e-book?*

Readers who use a modular e-book regularly must have a benefit from it. They save either time, money, effort, stress or it just brings them happiness. Anyway, these users must be found (for instance, check for high use times) and asked personally which functions or reasons attract them the most. They might give reasons that were not even planned to cover. If they agree their reasons could be published as ads to receive other users.

6. *How satisfied are they?*

Additional to the first question, users could be asked directly if they are satisfied by a modular e-book and its functions. Some users do not have the intention to recommend anything to anyone. Then, a direct question could be asked in-app after a user had some time to explore most of the functions. For rating, a scale from one to seven could be used.

7. *What do they think about a newly released feature?*

New features should be implemented well-considered. Before that, it should be checked if a feature would actually be used. For instance, a mechanism to check if readers actually use that function. A think-aloud test could be practical to retrieve information on how tasks are accomplished. It should contain basic tasks like opening a file, read a paragraph, and highlight text but also more advanced ones. For instance, adding a note to a specific chapter within the book and jumps within the e-book.

5. Suggested Extensions for Existing Software

8. *How much effort is it taking them to perform specific actions?*

Following the previous question, it should be focussed on the question of how much effort is needed to perform a task. To answer that question, think-aloud tests could be realised. Alternatively, users could be asked to rate effort after accomplishing a specific task.

9. *How often are they using this modular e-book?*

It is important to know how often and how long a modular e-book is used. If average use starts to drop there might be less demand for a modular e-book or a competitor. Contrary, if use increases that might be a good indicator for the moment. Anyway, to retrieve that information several ways exist. For instance, counting time that is actually spent on reading. Alternatively, counting number of logins or general interactions.

10. *What are they searching for and why?*

In general, users tend to not read any documentation of software. Consequently, the user experience must be improved in a way no questions are needed at all. Anyway, that is not possible to 100%. A FAQ (Frequently Asked Questions) page could be established. Further, a search field for functions could be integrated. It is possible to do search analytics to evaluate user demands to further improve the current version.

5.4. Requirements for Realisation

In this section, general requirements that are necessary to realise the introduced extensions above are addressed. As already mentioned, a starting point could be an existing software that already supports displaying an EPUB file. Then, a modular e-book can be implemented as an EPUB file. Technologies like the styling (CSS) and scripting (JavaScript) are included. Further, DRM (digital rights management) is also already covered by EPUB. Anyway, it is not foreseeable if (and then how) EPUB must be adapted to support further functionality that are not yet included.

5. Suggested Extensions for Existing Software

5.4.1. Cross References & Transclusion

When it comes to transclusion, several requirements are vital to be considered properly. Firstly, copyright issues must be clarified. Further, it must be dealt with the structuring of content (common thread), consistent wording and phrasing, modularity, (similar) text length, (similar) style, meta tags to describe the content, and connections to other content.

1. *Copyright Issues*

Obviously, a modular e-book must not contain copyrighted material unless its distributor is the owner or has the rights. Thus, content must originate from open-source, created by self, or rights must be bought. Depending on the field, this issue has to be treated.

2. *Structure of Content (Common Thread)*

Generally, the content of a modular e-book must be in a common structure. In the context of learning, that means there must be a common thread within a topic. Thus, a modular e-book must be "designed" in advance in a first version. To point it out, the table of contents of a modular e-book must be created by hand.

3. *Consistent Wording and Phrasing*

Especially in the field of learning, it is vital that wording and phrasing are consistent. Examples are synonym terms. One author might prefer different terms for the same things than another author. It is likely that a user is confused if synonym terms exchange through a book unless it is explicitly stated that an alternative approach is given. Anyway, also in non-fiction books consistent wording is required.

4. *Modularity*

To have content in a modular way is a key feature of the extensions suggested. In fact, the whole e-book is built up in a modular way. Thus, its parts are exchangeable easily. That is an important feature when it comes to different user groups. A consistent thread must be guaranteed though.

5. Suggested Extensions for Existing Software

5. *(Similar) Text Length*

Taking the concept of modularity and user groups, the corresponding length of the text should be rather similar. Exceptions are a deeper dive into a topic for a user group. For instance, a modular e-book about history in the 17th century that focusses on the role of Scandinavian countries. Then, parts of the e-book that contain information about that could be enlarged compared to other versions. Though, to decide the structure of an e-book is not trivial. In a first version that should be done manually.

6. *(Similar) Style*

The style of different parts of a modular e-book should be consistent. Not only wording and phrasing (as already mentioned) but also the number of pictures, type of pictures (basic illustrations, comic pictures, or photographs), and length of paragraphs should be consistent throughout the whole book. Text style is already covered by a common CSS style that can be adapted anyway if needed.

7. *Meta tags to Describe the Parts of Content*

The parts of the content should be described to easily derive its substance. For instance, meta tags could be used to describe it. Then, similar content could be found automatically by retrieving it from a database where all content is stored. In future work, automatic ways to obtain the meaning of a text could be used. This requires language analytic tools to be used. However, that is beyond this thesis.

8. *Connections to Other Content*

Subsequently, another application of meta tags is its use to connect parts of content. The goal should be to obtain a network of content, similar to the Google Knowledge Graph that is a knowledge base containing information about a person or object and connections to other elements in the Knowledge Graph.

5. Suggested Extensions for Existing Software

5.4.2. User Groups

User groups are another suggestion for an extension of current e-books. Although, to assess people according to their knowledge, experience, and interests is a hard task. As mentioned above, it could be done either manually by a teacher (only in the context of directed learning) or automatically by a test procedure that has to be conducted in the beginning. Of course, re-assigning should be available because of the change of skills or interest of users. This is rather advanced and not necessary in the first version of a modular e-book though.

5.4.3. User Feedback & Ratings

Regarding user feedback & ratings, it must be decided to which extent this should be implemented. For a first version, special focus should be on user feedback that is easy to give for users. For instance, a screenshot is easy to make and its transmission to developers rather convenient if an interface is provided.

Further, use case studies should be realised as well. For instance, some think-aloud tests should be realised that include basic functionalities and more advanced tasks. It is also vital to transmitting the idea of a modular e-book to users as simple as possible.

6. Summary & Future Work

Libraries and reading have a long story in our history. Early forms of libraries arose back in the first half of the 3rd millennium BC. Since then, a lot changed. For a long time, books and libraries were restricted to wealthy people. In the middle of the 19th century, the idea of a library, as we know it from today, arose. Decades later, first ideas and approaches came up to make all human knowledge available for everyone in the world to spread peace. Although it was not possible to implement these thoughts, they can be seen as an early idea of the Internet.

When the digital age finally arrived, its advantages were pointed out. These include constant availability of content (independent of time and location – as long as there is an Internet connection available), controllable accessibility, methods for information search and retrieval, easier administration of content, and distributed preservation. Consequently, many libraries tried to digitise their stock. This is very costly and time-consuming and therefore most libraries built up partnerships to third parties. One example is the Austrian Library that set-up a contract with Google Books. In fact, Google Books digitised (and still does) many books from various sources. Consequently, they had to deal with a lot of copyright infringements. Finally, they negotiated a settlement.

Nowadays, most books are published also in a digital version in form of an e-book or even only digital. The market of e-books in form of users is still growing. Nowadays, they reach out about 11% of all people that read. Several file formats for e-books exist. Wide use have EPUB (open standard) and AZW (Amazon's file format – no open standard). Both are designed for custom adjustment when they are displayed. Basically, they are a website inside an archive. Thus, they are text-based (including style) and can, therefore, be modified by software easily.

6. Summary & Future Work

Some companies like Amazon developed devices that are built for reading e-books, so-called e-book readers. They have a special display that is very battery-saving (only a change requires battery-use) and eye-friendly. Their software support some adjustments for the text (modify font type, font size, and many more) and also most sophisticated features like Word Wise (explanations for "difficult" words, X-Ray (to find every occurrence of a word within the e-book), and social reading functions. The latter is not used or needed by readers. Several start-up companies developed tools for social reading, all with little success.

Anyway, some software exists for reading e-books on mobile devices (like smartphones and tablets) and PCs. It turned out that the latter seems to be neglected by developers due to their decreasing use. For instance, software on mobile devices offer many more functions, software for PCs seem rather outdated. Most of the software for mobile devices and PCs are designed for born-digital content. Contrary, a wide range of providers of online-reading offer digitised content. In particular, most libraries and projects for digitisation have web-based interfaces for their digitised stock. Anyway, it turned out that Amazon has sophisticated techniques for adjustments and reading convenience and Austria-Forum offers viewing a book in different versions. Generally, there is room for improvement. In the appendix, specifications for current e-book readers, software for reading e-books on mobile devices or PCs, and a list of websites that offer e-books or web-based online-reading are given.

In this thesis, several extensions for existing software are presented. These are cross references & transclusion, user groups, and user feedback & ratings. All these are suggested to lead a goal: a modular e-book. That means an e-book that contains information depending on the user that reads it. Areas, it can be applied on, are the field of learning or non-fiction books.

Cross references & transclusion are ways to include (or at least link) existing content from other sources. Thus, information from various sources can be included. For instance, that leads to less administration effort in the field of learning. Content can be adapted on the server-side. A modular e-book retrieves this information when opened. Further, readers of a modular e-book are classified in user groups. They represent their current level of knowledge, experience, and interests. Depending on the user groups

6. Summary & Future Work

of a reader, some corresponding content is shown. This can be valuable, especially in the field of learning.

Technically, these approaches are not a problem at all. For instance, EPUB delivers functionality for reloading as they support techniques like HTML, CSS, and JavaScript. Finally, requirements for a realisation of a modular e-book are declared. These are the avoidance of copyright issues, a common thread within the book, consistent wording and phrasing, (similar) text length and style, a way to describe content in form of meta tags, and connections through the content.

Feedback from users is highly important to get to know issues or possible new functions. Further, by tracking users, most used functions can be derived and improved or perfected. However, several ways and forms to receive feedback from users are listed and described.

Some future work is to implement these approaches to finally receive a modular e-book for mobile devices. It is recommendable to use existing software and file formats. As already mentioned, EPUB seems to support all functions needed. Though, that must be checked in more detail to avoid a movement in the wrong direction. Further, a prototype (with minimum functionality) must be created and tested by real users.

Appendix

Appendix A.

Versions of Devices and Software

A.1. Versions of E-book Readers

In this section, several devices for reading e-books are listed with their properties. It is divided into four subsections, containing e-book readers from Amazon, Tolino, Kobo, Barnes & Noble, and former producers Trekstor and Sony (Haupt, 2014a). However, Trekstor and Sony are listed here because they both still had a market share of 4% in 2017 (Statista, 2018a).

A.1.1. Amazon

Amazon offers several Kindle e-book readers that are based on E Ink technology. They divide their lifecycle of e-book readers into *generations*. In each generation, different models are transferred into an updated version. Until 2018, ten generations had been released so far. Table A.1 lists the newest versions of Kindle, Kindle Paperwhite, Kinde Voyage, and Kindle Oasis with their specifications. Kindle was initially released in the 1st generation (2007), Kindle Paperwhite was introduced in the 5th generation (2012), Kindle Voyage in the 7th generation (2014), and Kindle Oasis in the 8th generation (2016). Note that Kindle Voyage was taken out of the product range in August 2018 (El-Heliebi, 2018a). In Germany (2017), Amazon Kindle had a market share of 63% (Statista, 2018a).

Appendix A. Versions of Devices and Software

Table A.1.: Specifications of Amazon e-book readers

Version	Kindle 8	Kindle Paperwhite 4	Kindle Voyage	Kindle Oasis 2
Display Type	E Ink	E Ink with backlight	E Ink with backlight	E Ink with backlight
Display Size	6 inches	6 inches	6 inches	7 inches
Resolution (pixel)	800 x 600	1072 x 1448	1072 x 1448	1264 x 1680
Metrics (mm)	115 x 160 x 9,1	116 x 167 x 8,2	115 x 162 x 7,6	142 x 160 x 8
Wifi	✓	✓	✓	✓
3G/4G	✗	optional	optional	optional
Weight	161 g	182 g 191 g with 4G	180 g 188 g with 3G	194 g
Waterproof	✗	✓	✗	✓
Storage	4 GB	8 GB / 32 GB	4 GB	8 GB / 32 GB
File Formats	AZW, MOBI, PRC, PDF, HTML, TXT	AZW, MOBI, PRC, PDF, HTML, TXT	AZW, MOBI, PRC, PDF, HTML, TXT	AZW, MOBI, PRC, PDF, HTML, TXT
Released	2016	2018	2014	2017
Price (2018)	69,99€	8 GB 119,99€ 32 GB 169,99 32 GB+4G 229,99€	189,99€ 3G 249,99€	8 GB 229,99€ 32 GB 259,99€ 32 GB+3G 319,99€

A.1.2. Tolino

Tolino has several e-book readers in the offer. Current versions (2018) are Shine 3 HD, Vision 4 HD, and Epos. Latter is a successor of Vision 4 HD. Table A.2 lists these versions with their specifications. In Germany (2017), Tolino had a market share of 16% (Statista, 2018a).

A.1.3. Kobo

Kobo has several e-book readers in the offer¹. Table A.3 lists three versions with their properties that are currently available on their website. In Germany (2017), Kobo had a market share of 2% (Statista, 2018a).

¹<https://us.kobobooks.com/collections/ereaders>

Appendix A. Versions of Devices and Software

Table A.2.: Specifications of Tolino e-book readers

Version	Shine 3 HD	Vision 4 HD	Epos
Display Type	E Ink with backlight	E Ink with backlight	E Ink with backlight
Display Size	6 inches	6 inches	7,8 inches
Resolution (pixel)	1072 x 1448	1072 x 1448	1404 x 1872
Metrics (mm)	110 x 156 x 8,4	114 x 163 x 8,1	140 x 209 x 8,2
Wifi	✓	✓	✓
3G/4G	✗	✗	✗
Weight	166 g	175 g	260 g
Waterproof	✗	✓	✓
E-book Formats	EPUB, PDF, TXT	EPUB, PDF, TXT	EPUB, PDF, TXT
Storage	8 GB	8 GB	8 GB
Released	2018	2016	2017
Price (2018)	99€	159€	229€

Table A.3.: Specifications of Kobo e-book readers

Version	Aura One	Aura Edition 2	Aura H2O Edition 2
Display Type	E Ink with backlight	E Ink with backlight	E Ink with backlight
Display Size	7,8 inches	6 inches	6,8 inches
Resolution (pixel)	1404 x 1872	768 x 1024	1080 x 1440
Metrics (mm)	138,5 x 195,1 x 6,9	113 x 159 x 8,5	129 x 172 x 8,8
Wifi	✓	✓	✓
3G/4G	✗	✗	✗
Weight	230 g	180 g	207 g
Waterproof	✗	✗	✓
E-book Formats	EPUB, PDF, MOBI, TXT, RTF, HTML, CBR, CBZ	EPUB, PDF, MOBI, TXT, RTF, HTML, CBR, CBZ	EPUB, PDF, MOBI, TXT, RTF, HTML, CBR, CBZ
Storage	8 GB	4 GB	8 GB
Released	2016	2016	2017
Price (2018)	229,99\$	119,99\$	179,99\$

Appendix A. Versions of Devices and Software

Table A.4.: Specifications of Sony Reader PRS-T₃, Sony DPT-CP₁, Trekstor E-Book Reader 3.0, and Nook GlowLight 3

Version	Sony Reader PRS-T ₃	Sony DPT-CP ₁	TrekStor E-book Reader 3.0	Nook GlowLight 3
Display Type	E Ink	E Ink	LCD/TFT	E Ink
Display Size	6 inches	10,3 inches	7 inches	6 inches
Resolution (pixel)	758 × 1024	1404 × 1872	480 × 800	1072 × 1448
Metrics (mm)	109 × 160 × 11,3	174 × 244 × 5,9	127 × 175 × 13	127 × 176 × 9,7
Wifi	✓	✓	✓	✓
3G/4G	✗	✗	✗	✗
Weight	200 g	240 g	358 g	190 g
Waterproof	✗	✗	✗	✗
E-book Formats	EPUB, PDF, TXT, FB2	PDF	EPUB, PDF, TXT, FB2	EPUB, PDF
Storage	2 GB	16 GB	2 GB	8 GB
Released	2011	2018	2011	2017
Price (2018)	not available	599,99\$	not available	119,99\$

A.1.4. Sony Reader, Sony Digital Paper, Trekstor, and Nook

In 2011, Sony and Trekstor offered e-book readers. Nowadays, Trekstore² do not sell or produce e-book readers anymore. In 2014, Sony announced that they will not bring a new e-book reader on the retail customer market anymore but they still have digital paper products in their stock (Haupt, 2014a). For instance, Sony DPT-CP₁ which was released in 2018³. In 2014, both, Sony and Trekstor still had a share in the market of 11% each (Buchreport, 2014). In 2017, Sony had a market share of 4% (Statista, 2018a).

Barnes & Noble offer several e-book readers. Nook GlowLight is a device that uses E Ink technology. Anyway, Nook devices are rather popular in the United States (10% market share in 2017 (Statista Survey, 2017d). Therefore, they are mentioned in Table A.4 with their properties.

²<http://www.trekstor.de/produkte.html>

³<https://www.sony.com/electronics/digital-paper-notepads/dpt-series>

A.2. Android Apps for Reading E-books

In Table A.5, Android apps in the Google Play Store that offer the possibility for reading e-books are listed. The table contains entries that were returned for the search term "ebook reader" and have more than 100.000 downloads. There is no guarantee on completeness nor the long-term validity of that list. In fact, many more apps exist outside of the Google Play Store. The entries in the table contain the name, current version, supported file formats, the number of downloads, containing ads, its average rating (out of 5 stars – 1 is worst, 5 is best), and costs for download. Entries are in alphabetic order.

Table A.5.: Android apps for reading e-books

Name	Publisher	File Formats	Downloads	Costs	Ads	Rating
1000000+ FREE EBooks.	GB Technology	not stated	+500.000	free	✓	3,9
4shared Reader	New IT Solutions	pdf, epub, fb2, djvu, html, doc, docx, pps, ppt, pptx, rtf, xls, xlsx, txt	+1 million	free	✓	4,6
50000 Free eBooks & AudioBooks	Oodles	not stated	+5 million	free	✓	4,2
Adobe Acrobat Reader	Adobe	pdf	+100 million	free	✗	4,3
Adobe Digital Editions	Adobe	pdf, epub, epub3	+1 million	free	✗	2,2
Aldiko Book Reader	Feedbooks	epub, pdf	+10 million	free	✓	4,2
Aldiko Classic	Feedbooks	epub, pdf	+100.000	free	✓	4,2
Aldiko Classic Premium	Feedbooks	epub, pdf	+100.000	13,99€	✗	4,0
All PDF Reader - PDF Converter & PDF Tools	Robert Londo	pdf	+100.000	free	✓	4,4
alle Dokumentenleser	The Apps Arena	doc, pdf, txt, ppt, rtf, xps, html, odt	+100.000	free	✓	4,3

Continued on next page

Appendix A. Versions of Devices and Software

Table A.5 – Continued from previous page

Name	Version	File Formats	Downloads	Costs	Ads	Rating
AlReader	Alan.Neverland	epub, fb2, fb3, fbz, txt, html, doc, docx, odt, rtf, mobi, prc, tcr, zip, gz	+5 million	free	✗	4,6
Arabic Reader	MaDev	epub, rtf, doc, html, fb2, mobi, txt	+100.000	free	✗	4,2
Astonishing Comic Reader	Aerilys	not stated	+500.000	free	✓	4,5
Azpen eReader	KNFB Reading Technology	not stated	+500.000	free	✗	3,5
Banglalink Bio Ghor	E. B. Solutions Pte. Ltd.	not stated	+100.000	free	✗	3,9
Blio eBooks	KNFB Reading Technology	epub, pdf	+100.000	free	✗	3,4
Bluefire Reader	Blufire Productions	epub, pdf	+1 million	free	✗	3,0
Bookari Free Ebook Reader	Mantano	epub, pdf	+1 million	free	✓	4,2
BookShout: eBook & Reading App	Rethink Books	not stated	+100.000	free	✓	3,9
Chm Reader X	jianwu	chm, html, txt	+100.000	free	✗	4,3
Cool Reader	Vadim Lopatin	epub, fb2, doc, txt, rtf, html, chm, tcr, pdb, prc, mobi, pml	+10 million	free	✗	4,5
Cool Reader GL	Vadim Lopatin	epub, fb2, doc, txt, rtf, html, chm, tcr, pdb, prc, mobi, pml	+100.000	free	✗	4,0
DAMS eBooks	Spayee: Online Course Selling Platform	not stated	+100.000	free	✗	3,9
DC Books	DC Books	not stated	+100.000	free	✗	3,3
Docx Reader	Gapp Studios	docx, ppt, pptx, xlsx, xls, rtf, pdf	+1 million	free	✓	3,9
E-Kitap Oku - Kitap Oku ücretsiz	Leca	not stated	+100.000	free	✓	4,5
EBookDroid - PDF & DJVU Reader	AK2	epub, fb2, xps, fb2, cbr, cbz, rtf, mobi, azw3	+5 million	free	✗	4,5
Ebook Reader	eBooks.com	epub, epub3	+5 million	free	✗	4,1

Continued on next page

Appendix A. Versions of Devices and Software

Table A.5 – Continued from previous page

Name	Version	File Formats	Downloads	Costs	Ads	Rating
eBook Reader Pro	GentleMan Dev Studio	epub, pdf, rtf, fb2, djvu, xps, cbz	+1 million	free	✓	4,1
Ebook Reader & Free ePub Books	Mobile_V5	epub, fb2, doc, txt, rtf, html, chm, tcr, pdb, prc, mobi, pml	+5 million	free	✓	4,2
EBook Reader & PDF Reader	Easyelife	epub, djvu, pdf, xps, fb2, cbr, cbz, rtf	+1 million	free	✓	4,3
Ebook & PDF Reader	mttcross	djvu, pdf, xps, fb2, epub, rtf, cbr, cbz	+1 million	free	✓	4,3
eBoox	MobiPups+	fb2, epub, doc, docx, mobi, txt, rtf, zip	+500.000	free	✗	4,9
ePUB Bücher Lese Supreader.com	s2Apps.com	epub, epub3	+500.000	free	✓	4,3
EPUB Reader	Michael Volz	epub	+100.000	free	✗	3,8
ePub Reader for Android	Graphilos Studio	epub	+1 million	free	✓	3,6
eReader Prestigio: Leser	Prestigio	epub, epub3, doc, fb2, zip, mobi, pdf, html, doc, djvu, rtf, txt	+10 million	free	✓	4,6
ezPDF Reader	Unidocs Inc.	pdf	+500.000	free	✓	4,3
ezPDF Reader Free Trial	Unidocs Inc.	pdf	+500.000	free	✗	3,8
Faithlife Ebooks	Faithlife	not stated	+100.000	free	✓	4,6
Free Book Reader	acerapps	not stated	+100.000	free	✓	3,4
Free Books - Read and Listen	Digital Press Publishing s.r.o.	not stated	+1 million	free	✓	4,2
Free Ebook Downloader	HackStarSJ	pdf, doc	+100.000	free	✓	4,2
Free eBooks - Classics	Freetop10ebooks.com	not stated	+100.000	free	✓	4,2
Free Love Story Books Reader	QC Fun	not stated	+100.000	free	✓	4,3
FBReader	FBReader.ORG Limited	epub, azw3, fb2, rtf, doc, html, txt	+10 million	free	✓	4,5
FBReader Premium	FBReader.ORG Limited	epub, azw3, fb2, rtf, doc, html, txt	+100.000	4,99€	✗	4,6
Foxit Mobile PDF - PDF Reader Editor	Foxit Software Inc.	pdf	+1 million	free	✗	4,5

Continued on next page

Appendix A. Versions of Devices and Software

Table A.5 – Continued from previous page

Name	Version	File Formats	Downloads	Costs	Ads	Rating
FullReader	ITENSE	fb2, epub, txt, pdf, doc, docx, cbr, cbz, rtf, djvu, html, mobi, xps, odt, rar, zip, 7z	+1 million	free	✓	4,4
Gitden Reader: EPUB3 & EPUB2	Gitden Inc.	epub, epub3	+100.000	free	✓	4,1
Google Play Books	Google LLC	not stated	+1 billion	free	✗	3,9
Google Docs	Google LLC	not stated	+500 million	free	✗	4,3
Grund PDF Reader	\$pp Labs	pdf	+1 million	free	✗	4,2
Kindle	Amazon Mobile LLC	azw, azw3, mobi	+100 million	free	✓	4,2
Kobo Books	Kobo Books	not stated	+10 million	free	✗	4,2
Kopykitab eReader & Test Prep	DigiBook Technologies	epub	+100.000	free	✗	4,0
Kostenlos bücher lesen	Unwrapped Apps	epub, fb2	+5 million	free	✓	3,3
Legimi - E-Books ohne Limit	Legimi	not stated	+1 million	free	✗	3,7
Libby	OverDrive, Inc.	not stated	+1 million	free	✓	4,1
Librera - Book Reader	Librera	pdf, epub, epub3, mobi, djvu, fb2, txt, rtf, azw, azw3, html, xps, cbr, cbz	+10 million	free	✓	4,0
Lithium: EPUB-Lese-App	FaultException	not stated	+1 million	free	✗	4,6
Manga Rock - Best Manga Reader	Not a Basement International	not stated	+1 million	free	✓	4,4
Media365 Book Reader	Media365 Inc	azw3, cbc, cbr, cbz, fb2, docx, mobi, txt	+5 million	free	✗	4,4
Microsoft Word	Microsoft Corporation	doc, docx, pdf, txt	+500 million	free	✗	4,5
MoboReader - Novels and Fiction Stories	Infinite Stories & Novels	not stated	+100.000	free	✓	4,4
Moon+ Reader	Moon+	epub, pdf, mobi, chm, cbr, cbz, umd, fb2, txt, html, zip, rar	+10 million	free	✓	4,4
Moon+ Reader Pro	Moon+	epub, pdf, mobi, chm, cbr, cbz, umd, fb2, txt, html, zip, rar	+500.000	4,99€	✗	4,6

Continued on next page

Appendix A. Versions of Devices and Software

Table A.5 – Continued from previous page

Name	Version	File Formats	Downloads	Costs	Ads	Rating
Onleihe	divibib GmbH	not stated	+500.000	free	✗	2,8
pdf eBook Reader	Pix Team	epub, pdf, mobi, txt, doc	+100.000	free	✓	4,3
PDF Reader	pickwick santa	pdf, djvu, xps, fb2, cbr, cbz, epub, rtf	+10 million	free	✓	4,4
PDF Reader	Moenwa	pdf	+100.000	free	✓	4,2
PDF Reader 2018	Mobiem	pdf	+1 million	free	✓	4,3
PDF Reader & PDF Editor	Locking Studio	pdf	+100.000	free	✓	3,9
PDF Reader - PDF Datei Öffnen und Lesen	MotiFit	pdf	+100.000	free	✓	4,2
PDF Reader - Document Manager & PDF Converter 2019	Little M Inc	pdf	+100.000	free	✓	4,2
PDF Reader für Android	Reader Tools	pdf	+5 million	free	✓	4,3
PDF Reader für Android 2018	Office Tech Inc.	pdf	+1 million	free	✓	4,2
PDF Reader Klassisch	Librera	pdf, epub, mobi, djvu, fb2, txt, rtf, azw, azw3, html, cbz, cbr	+1 million	free	✓	4,3
PDF Reader PDF File Viewer 2019	Docsoft Studio	pdf	+100.000	free	✓	4,6
PDF Reader - PDF Viewer 2019	Fodoo Software Inc.	pdf	+10 million	free	✓	4,5
PDF Reader & PDF Viewer Pro	Mobif Studio	pdf	+1 million	free	✓	4,0
PDF Reader - Scan, Edit & Share	Kdam Mobile Software Ltd.	pdf	+10 million	free	✓	4,3
PDF Reader Viewer	blue.swan.dev	pdf	+500.000	free	✓	4,2
PDF Viewer	Maple Media	pdf	+5 million	free	✓	4,1
PDF Viewer & Reader	Easy Inc.	pdf, xps, djvu, cbr, epub	+1 million	free	✓	4,5
PDF Viewer Kostenlos	Tapi LLC	epub, pdf, xps, djvu, cbr	+5 million	free	✓	4,4
PDF Viewer - eBook Reader	Guru Info Media	pdf	+100.000	free	✓	4,3

Continued on next page

Appendix A. Versions of Devices and Software

Table A.5 – Continued from previous page

Name	Version	File Formats	Downloads	Costs	Ads	Rating
PocketBook reader - EPUB, PDF, Audio-books	Obreey Product	pdf, epub, djvu, txt, fb2, chm, cbr, mobi, pdb, rtf, txt, html	+1 million	free	✗	4,3
ReadEra	Readera LLC	epub, pdf, doc, rtf, txt, fb2, djvu, mobi, chm	+1 million	free	✗	4,8
readfy	readfy	not stated	+100.000	free	✓	4,5
Reader: great reader (PDF, DJVU, CBR, CBZ)	Zed+	pdf, djvu, cbr, cbz	+500.000	free	✓	4,4
Schneller lesen	Novellectual	epub, txt	+1 million	free	✗	4,3
Sheiboi	Raven Systems Ltd	not stated	+100.000	free	✗	4,5
Skoobe	Skoobe GmbH	not stated	+500.000	free	✗	4,5
Techmaxebooks	Tech-Max Publications	not stated	+100.000	free	✗	3,1
Text Reader	Pavel Gudkov	fb2, rtf, html, txt, zip	+500.000	free	✗	3,9
Thalia - Meine App!	Thalia	not stated	+100.000	free	✗	4,5
tolino	Next Performance Germany GmbH	epub, pdf	+100.000	free	✓	4,4
Wattpad	Wattpad.com	not stated	+100 million	free	✓	4,6
Wooky - ebook reader	MobilBonus s.r.o.	not stated	+100.000	free	✗	4,2
WPS Office - Word, Docs, PDF Note, Slide & Sheet	Kingsoft Office Software Corporation Limited	doc, docx, wpt, xls,xlsx, csv, xml, pdf, ppt, pptx, txt, log	+100 million	free	✓	4,5
Xodo PDF Lesen und Editieren	Xodo Technologies Inc.	pdf	+5 million	free	✗	4,7

A.3. Versions of Software for PC Tested

In Table A.6, versions for e-book software tested are listed. Bookviser Reader and Freda are available through Microsoft Store only. The entries in the table contain the name, version, type of software, and supported operating systems.

Appendix A. Versions of Devices and Software

Table A.6.: Software for reading e-books

Software	Version	Type	Operating Systems
Calibre	3.33.1	open source	Windows, Linux, Mac
Kindle For PC	1.24.51068	free	Windows, Mac
Icecream Reader	5.19	free & pro	Windows
Adobe Digital Editions	4.5.9.184862	free	Windows, Mac
Bookviser Reader	6.8.1.0	free	Windows
Freda	not stated	free with ads	Windows, Android
Gonvisor	2.52.01	free	Windows

Appendix B.

Websites that Offer E-books or Web-based Online-Reading

In the following, a list of known websites that offer access to digital books is given. Access is granted either directly or via links to other suppliers. There is no guarantee on completeness nor the long-term validity of that list. In fact, many more sites exist. Some of them might be partly illegal or at least in a grey area due to copyright and related rights.

The entries in the table contain the URL, its Alexa rank (for its definition, see appendix C), access, support for reading online, possibility to download, and its amount (number of items as listed on their website). Entries are in alphabetic order. Note that Alexa rank does not reflect a site's number of users or downloads. Thus, a site with a lower rank might not be less important.

Table B.1.: Websites that offer e-books or online-reading

URL	Alexa	Access	Online	Download	Amount
24symbols.com	161.180	fee ¹	✗	✓	not stated
amazon.com/kindle-ebooks	unknown	fee	✓	✓	+5.5 million
austria-forum.org	175.495	public ²	✓	✗	+2.100
b-ok.cc	5124	public	✓	✓	+3.5 million
baen.com	130.028	free ³	✓	✓	not stated
beam-shop.de	552.362	fee	✗	✓	not stated
bookboon.com	17.394	fee	✗	✓	not stated
bookrix.com	64.025	public	✓	✓	not stated

Continued on next page

Appendix B. Websites that Offer E-books or Web-based Online-Reading

Table B.1 – Continued from previous page

URL	Alexa	Access	Online	Download	Amount
books.google.com	unknown	public	✓	✓	not stated
bookyards.com	169.531	public	✗	✓	+7.400
buecher.de	14.819	public	✗	✓	not stated
childrenslibrary.org	183.458	free	✓	✗	not stated
digitale-sammlungen.de	86.917	public	✓	✓	+2.3 million
digital.library.upenn.edu/books/	2.436	public	✗	✓	+2 million
ebook.de	62.482	public	✗	✓	not stated
ebooks.com	44.874	fee	✗	✓	+1.4 million
ebookstore.me	277.672	free	✓	✓	not stated
europaena.eu	68.457	public	✓	✓	+58 million
ebooksforfree.net	262.073	public	✗	✓	not stated
feedbooks.com	72.211	fee	✗	✓	not stated
fictionpress.com	52.697	public	✓	✗	+1 million
free-ebooks.net	14.766	free	✗	✓	+1 million
freebookspot.es	23.750	public	✗	✓	not stated
freecomputerbooks.com	113.451	public	✗	✓	not stated
freetechbooks.com	125.929	public	✗	✓	+1.200
goodreads.com	411	fee	✗	✓	2.3 million
greenteapress.com	77.429	public	✓	✓	not stated
gutenberg.org	5.223	public	✓	✓	+57.000
gutenberg.spiegel.de	unknown	public	✓	✗	+9.600
itunes.apple.com/us/genre/books	unknown	fee	✓	✓	not stated
ibookpile.net	135.361	free	✗	✓	not stated
issuu.com	875	free	✓	✓	not stated
kobo.com	6.805	fee	✗	✓	not stated
legimi.de	1.211.880	fee	✗	✓	100.000
lehmanns.de	118.335	fee	✗	✓	not stated
link.springer.com	470	fee	✗	✓	+10 million
manybooks.net	33.918	free	✓	✓	+50.000
millsandboon.co.uk	285.356	fee	✓	✓	not stated
mobileread.com	31.931	free	✗	✓	not stated
onleihe.de	36.662	free	✗	✓	not stated
openlibrary.org	10.018	free	✓	✓	not stated
pdfbooksworld.com	240.749	free	✓	✓	not stated
pdfdrive.com	3.002	public	✗	✓	+54 million
pdforigin.org	135.090	public	✗	✓	not stated
play.google.com/store/books	unknown	fee	✗	✓	not stated
pragprog.com	89.820	fee	✗	✓	not stated
pressreader.com	5.923	fee	✓	✗	not stated
readanybook.com	59.016	public	✓	✗	not stated

Continued on next page

Appendix B. Websites that Offer E-books or Web-based Online-Reading

Table B.1 – Continued from previous page

URL	Alexa	Access	Online	Download	Amount
readfy.com	542.888	fee	X	✓	+100.000
readly.com	70.457	fee	X	✓	not stated
scribd.com	190	fee	X	✓	not stated
search.onb.ac.at	115.899	free	X	✓	+600.000
skoobe.de	957.124	fee	X	✓	+200.000
smashwords.com	22.669	fee	X	✓	+500.000
thalia.at	46.834	fee	X	✓	not stated
topfreebook.org	344.934	public	X	✓	not stated
weltbild.de	16.535	fee	X	✓	+3 million
whsmith.co.uk	47.690	fee	X	✓	not stated
xinxii.com	330.508	fee	X	✓	+41.000

¹ Registration required, books mostly fee-based

² Publicly available, books mostly for free

³ Registration required, books mostly for free

Appendix C.

Definition of Alexa Rank

Alexa Rank is defined as (Alexa, 2018e)

“Rank is calculated using a combination of average daily visitors and pageviews to a site over the past 3 months. The site with the highest combination of visitors and pageviews is ranked #1. It is updated daily.”

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- Alexa (2018c). *google.com Traffic Statistics*. URL: <https://www.alexacom/siteinfo/google.com> (visited on 09/30/2018) (cit. on p. 24).
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