EVALUATING THE TASK-TECHNOLOGY FIT OF E-READERS IN THE SOUTH AFRICAN SECONDARY SCHOOL ENVIRONMENT

by

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ABSTRACT

The purpose of this research was to evaluate the task-technology fit of e-book readers in the South African secondary school environment. Many information system performance models put a large focus on the user's intention to use the system. For educational e-book reader evaluations this is different, as learners are not always given a choice between e-books and printed books.

A case study of the EduReader, a popular South African e-reader used in secondary schools, was presented to highlight the current technology characteristics of this e-reader. Learners who use the e-book reader in South African schools were interviewed. The interview data and the case study were used to identify the task requirements of secondary school learners and the technology characteristics of the EduReader e-reader.

Task requirements were identified from interview transcripts using process and descriptive coding across the data set. The resulting model shows a set of the technology characteristics of the EduReader e-reader and the task requirements of its users, identifying the gaps in the e-book reader's technology characteristics.

A model was presented that shows the fit between task requirements and technology characteristics as a precursor of e-book utilisation in South African secondary schools. This model can be reused by researchers in a generic fashion to determine the task-technology fit of other e-book readers in South African secondary schools.

As a practical contribution this dissertation presented a set of task-technology fit guidelines in the form of 30 true/false statements that e-book developers/designers can apply when developing an e-book reader for the South African secondary educational sector. The guidelines are categorised per task requirement identified in this dissertation and developers can exclude sections which are not applicable to the application they develop.

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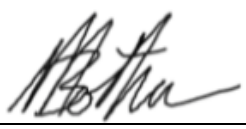

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CHAPTER 1: INTRODUCTION

1.1 BACKGROUND

The Department of Education in South Africa has faced several challenges in delivering textbooks to school learners in recent years (Chisholm, 2012). Many of the logistical problems that hamper the delivery of textbooks to learners could be overcome using digital textbooks. E-books are currently already gaining traction as the medium of choice in educational institutions across South Africa, replacing traditional printed textbooks in both private and public schools.

An e-book can be defined as a "digital object with textual and/or other content, which arises as a result of integrating the familiar concept of a book with features that can be provided in an electronic environment" (Vassiliou and Rowley, 2008). Three components are required to read an e-book: the e-reader hardware, the e-reader software and the e-book file (Cavanaugh, 2002). The hardware refers to the device that displays the e-book. This can be a dedicated e-reader such as the Amazon Kindle, or a multipurpose device such as a desktop PC. The software is the application running on the hardware that renders the e-book to display on the device. This application typically offers more functionality than simply rendering the book content such as highlights, annotations and printing. The e-book file is the content of the book stored in a format the application can render. Modern e-books should not simply be a paper behind glass product but should be designed to enhance the user's experience (Shin, 2014). This will require e-readers to adapt and keep up with these changes. As the functionality of e-readers improves (integrating features such as annotations, collaboration, interactive summaries and dictionary functionality) the interface becomes more complex, which again leads to usability problems with the e-reader.

The use of electronic textbooks (e-textbooks) is different from that of recreational e-books as readers engage with these e-books in a different manner. E-textbooks should focus on the "additional goals of learning, even memorizing, portions of the text" (Daniel and Woody, 2013, p. 18), where fictional e-books are purely read for pleasure. The difference in usage can be observed in the basic functionality of the e-book such as navigation, where readers typically do not navigate e-textbooks in the same linear fashion as they would in recreational e-books (Pollari-Malmi *et al.*, 2017) or in more advanced features such highlights and annotations (Gu, Wu and Xu, 2015). In order for e-textbooks to be utilised it needs to

differentiate itself from a recreational e-book by adding functions that assist readers in the construction of new knowledge and skills (Chiu, Cheung and Lau, 2017).

The use of e-books has been discussed by multiple authors (Cavanaugh, 2002; Shelburne, 2009; Felvégi and Matthew, 2012; Wilson, D'Ambra and Drummond, 2014) with both advantages and disadvantages related to e-book use being identified by the authors. E-books offer multiple advantages when compared to their printed counterparts. These include weight, timeliness of delivery, ease of navigation, the functionalities of bookmarking and annotations, in-text translation, digital rights management and cost (DRM) (Wilson and Landoni, 2003; Beer and Wagner, 2011; Browne and Coe, 2012; Lim and Hew, 2014). E-books can also increase the accessibility of content to learners as multiple books can be stored on the same device and can be accessed at any time and place (Rao, 2003; Felvégi and Matthew, 2012). A variety of devices such as dedicated e-readers, personal computers and tablets can be used to read e-books (MacWilliam, 2013).

Apart from the advantages offered by e-books, there are also many challenges in the delivery of e-books to learners in an educational context. Some of which include: format (proprietary ownership), platform hosting and maintenance costs, local content production, connectivity and infrastructure, and staff expertise (Rao, 2004; Anuradha and Usha, 2006; Dlodlo and Foko, 2012; Gu, Wu and Xu, 2015). E-book readers that do not offer navigation options such as search and a table of contents have been found to discourage use and as a result have lower utilisation than printed textbooks (Wilson and Landoni, 2003; Gregory, 2008; Shelburne, 2009). The technology on which e-books are read also introduces new challenges to the use of e-books, especially for educational purposes. Multi-purpose devices add distractions as other applications such as messaging and social media pushes notifications to the user (Daniel and Woody, 2013; MacWilliam, 2013). When technical issues with the device or the platform on which the e-books are read, exist, users may be unable to use the e-book for its intended purpose while waiting for technical support (Gu, Wu and Xu, 2015).

Apart from the advantages and challenges related to e-books, the utilisation of e-book readers is still problematic and requires further research (Grenina, 2012; Richardson and Mahmood, 2012; Hsiao and Chen, 2015). As an e-book can be considered a computer system, many of the usability methods used to evaluate application interfaces can also be

used to evaluate e-book usability. When evaluated within the educational environment, this approach comes with a caveat. The goals of educational reading are different from those of recreational reading and should be taken into account when conducting usability studies on e-books in the educational environment.

A well-known information systems usability theory, the task-technology fit (TTF) theory will be used as a theoretical framework for this study. TTF theory as it applies to information systems was first introduced by Dale Goodhue (1995). Later that same year Goodhue and Thompson (1995) presented the TTF theory as a model to measure the performance and effectiveness of individuals as users of computer systems. The TTF construct in the theory refers to 'the degree to which technology assists an individual in performing his or her portfolio of tasks', (Goodhue & Thompson, 1995: 216). The TTF theory draws from the work done by Vessey (1991) on cognitive fit where the importance of the fit between the problem representation and the required tasks to solve a problem is highlighted. As utilisation of e-book readers is the focus of this dissertation, the TTF theory is best suited to determine the resulting factors, as its core theme is that utilisation and performance impacts are a result of technology that is well suited to the task requirements (Goodhue and Thompson, 1995; Zigurs and Buckland, 1998; Furneaux, 2012).

The TTF theory has been widely used by researchers in both Information Science and other disciplines (Furneaux, 2012) and TTF is also one of the most used theories in predicting individual performance in Information Systems research and has in this regard been used as the framework of choice by various authors (Zigurs and Buckland, 1998; Dishaw and Strong, 1999; D'Ambra and Rice, 2001; D'Ambra and Wilson, 2004; McGill and Klobas, 2009). In a systematic review done by Furneaux (2012) he categorises the use of TTF by such authors into three broad categories. Firstly, the theory is applied to understand the adoption of information systems using survey-based data collection instruments on the individual level. Secondly, the theory is manipulated in various experiments to determine the role 'fit' plays in the outcomes of various tasks. The last category of research identified by Furneaux focuses on the advancement and meta-analysis of TTF related theory by conceptual and review-oriented articles. This dissertation will focus on the first identified category, by attempting to gain a better understating of the adoption of e-book readers in secondary schools in South Africa.

TTF and similar frameworks like the Technology Acceptance Model (TAM) rely on quantitative data to gather conclusions. This dependency on quantitative data can be considered a disadvantage of the TTF framework as in doing this, the assumption is made that the correct tasks are being targeted by the computer system. While using qualitative data collection methods alongside the TTF model to predict user performance, Goette (2000) found that computer systems were used for tasks they were not developed for while computer systems developed for the given tasks existed. If the study done by Goette (2000) only employed the traditional Lickert-scale questionnaire, this crucial part of information would not have been discovered.

1.2 PURPOSE OF THIS STUDY

The purpose of this research is to evaluate the task-technology fit of e-book readers in the South African secondary school environment. The construct of Task-technology fit, as a precursor to utilisation (Goodhue and Thompson, 1995), a component of the technology-to-performance chain (TPC) model (Goodhue and Thompson, 1995) will be used as the theoretical model that forms the basis of this research.

Many information system performance models put a large focus on the user's intention to use the system. For educational e-book reader evaluations this is different, as learners are not always given a choice between e-books and printed books. The EduReader application, which will be discussed in detail in chapter 4, is part of a larger e-learning platform used in South African schools. In most cases, schools using this platform discontinued printed textbook usage completely from their environment and all learners are required to use e-books.

There is not a large amount of research done on the application of the TTF construct in the e-learning domain (McGill and Hobbs, 2008) and this dissertation aims to add to that body of knowledge. The use of e-book readers differs across environments, with major variances in use between recreational and educational reading. Even when taking only the educational environments into consideration, there are differences in how e-books are used by academics (D'Ambra, Wilson and Akter, 2013), tertiary students (Lai and Ulhas, 2012) and school learners (Felvégi and Matthew, 2012).

Taking the above into consideration, the way we evaluate the utilisation of e-books in an educational environment should differ as well. As the task requirements differ between the various usage scenarios, the technology characteristics should match it. This study aims to provide a measuring tool for one such environment, namely the environment of secondary school learners. The desired outcome of this study is to present a reusable task-technology fit model for e-books in secondary school educational environments. The methods followed in this research to determine the model can we adapted to determine TTF models in other studies targeting a different environment. As usability models such as TTF usually follows the positivist research paradigm, this interpretative study could provide interpretivist researchers with the tools needed to conduct research on existing models.

The scope of this study is limited to that of South African secondary schools that have been making use of e-books for more than 1 academic year. The scope does not allow for mixed-use schools, where some learners use e-books and other use printed textbooks. This allows the study to focus on the fit element of e-books rather than adoption and intention to use e-books. Lastly, the scope is limited to secondary schools in Gauteng, South Africa, as these schools are geographically accessible to the researcher.

1.3 PROBLEM STATEMENT

For e-books to be accepted as a replacement of traditional printed textbooks in an educational environment, it needs to improve on the capabilities which printed textbooks offer learners and educators. The improved functionality is presented to the learner by an underlying computer system called the e-book reader (e-reader) (Lim, Song and Lee, 2012).

The utilisation of the e-book reader is a critical component of the performance impact an e-book will have on the learner. Although making use of e-readers for fictional reading is common (Browne and Coe, 2012), users will in many cases not consider an e-reader for educational purposes due to the lack of functionality such as thesauri, dictionaries and advanced searching capabilities (Wilson and Landoni, 2003).

There is a need for a set of technology characteristics for e-reader developers/designers which focusses on educational use, to ensure the product they develop has high utilisation. To develop an e-reader that supports educational use, developers need to understand the tasks associated with e-book usage in an educational environment. Therefore, the objective

set out for this research is to define a set of clear guidelines that designers and developers of e-book reader applications can follow to ensure that the application fits the tasks to be executed. As a by-product of this object, a set of task and technology characteristics of e-book readers will be presented to the reader.

Previous studies have attempted to address this problem, but these attempts had shortcomings which prevented the model from being reused in a more general educational context. A methodology for evaluating electronic textbooks was presented by Wilson and Landoni (2001) but this methodology focused on the evaluation phase rather than on presenting a set of design guidelines. Lim, Song and Lee, (2012) developed a set of design principles based on the usability attributes of learnability, efficiency, effectiveness and satisfaction. Their research focused on the students' perceived usability and not the performance impact it had on their learning ability. Both the studies were completed on desktop-based e-readers, and not on mobile e-readers.

Wilson, D'Ambra, & Drummond (2014) presented a study on task-technology fit (TTF) in an academic setting by collecting quantitative data. Since this article, the setting has changed, and technology has advanced. Mobile devices have become more common and affordable and e-book reading software on both dedicated and multipurpose devices has improved. Taking notes in the margin or printing pages from such software are common features in current e-book readers, thus the technology characteristics need to be re-evaluated. This research will identify task and technology characteristics by collecting qualitative data instead of reusing tasks and technology characteristics identified by previous research.

A multifaceted approach is needed to address this problem. Firstly, the researcher will evaluate existing literature on e-book usage and usability to construct a data collection instrument that will not only guide the respondents but also allow them to freely elaborate on the daily tasks they perform on their e-books. Secondly, the researcher will use this instrument during information gathering interviews to collect qualitative data by means of open-ended questions to identify the tasks users perform in an e-book environment. Finally, the task and technology characteristics will be evaluated to determine the fit between the technology and the tasks with the aim of presenting both researchers and developers with a reusable set of guidelines to use when evaluating the fit between e-book readers and the tasks related to these readers in a South African context.

1.4 RESEARCH QUESTIONS

The main question this research will attempt to answer is: How can a fit between the task requirements and technological characteristics of e-book readers be assured in the South African secondary school environment? To answer the main question, the following sub-questions have been identified:

- What are the task characteristics of an e-book reader in the South African secondary school environment?
- What are the technology characteristics of an e-book reader in the South African secondary school environment?
- What guidelines should developers follow to create e-book readers that are fit for the South African secondary school environment?

1.5 CONCLUSION

This chapter presented an introduction to the study. In this chapter, the use of e-books in education as well as the usability studies that have been done in this environment was discussed. The problem statement, a need for design guidelines for e-book application developers was explored and the author presented examples of similar studies done in this domain. Finally, the main and sub research questions were listed.

CHAPTER 2: LITERATURE REVIEW

2.1 INTRODUCTION

The purpose of this literature review is to review the existing body of knowledge on e-books and the use of e-books in education. Important definitions will be defined and justified within this chapter. Examples of the various e-book formats will be provided and the strengths and weaknesses of each of these will be discussed. Sources for literature will include South African and international journals, conference proceedings and mainstream media.

As e-books in education, specifically in South Africa, is a young research topic, limited research has been done on this subject. Due to this limitation, examples and evidence to establish a reasoning will mainly come from studies done in other countries. If South African examples or evidence such as the studies by Dlodlo & Foko (2012) and Chisholm (2012) do exist, it will get preference.

The theoretical framework used in this dissertation will be introduced by presenting its definition, components and limitations. The theoretical model's use in previous studies focusing on e-book use and similar disciplines will be discussed. The theoretical framework will be compared to similar frameworks and the decision of its use will be justified.

Finally, educational tasks will be discussed, and two categories of educational tasks will be presented. The educational tasks performed in e-book reading applications identified in the literature will be summarised in this chapter.

2.2 E-BOOKS

Defining an e-book

The term e-book is ambiguous as used in literature, therefore a historical view of the term will be provided.

Some authors use 'e-book' to describe the mobile, physical device to display electronic documents (Lemken, 1999). Wilson and Landoni (2001:2) noted that the term e-book as used in literature refers to "hardware, software and content" and suggested the following three-part definition of the term e-book:

1. hardware devices used to read e-books

2. e-book reader software used to read a variety of proprietary formats of e-book
3. web books which are accessible via the web either for free or for a price, or which can be borrowed within certain time limits.

Rao (2003:258) identified the confusion in e-book definitions and provided the following definition: “Text in digital form, or a book converted into digital form, or digital reading material, or a book in a computer file format, or an electronic file of words and images displayed on a desktop, note-book computer, or a portable device, or formatted for display on dedicated e-book readers”. This definition made the important distinction between the “text” and the “e-book reader”.

Vassiliou and Rowley (2008:363) suggested the following two-part definition for an e-book because of many definitions becoming outdated or focusing on a specific platform or technology:

- “An e-book is a digital object with textual and/or other content, which arises because of integrating the familiar concept of a book with features that can be provided in an electronic environment. “
- “E-books typically have in-use features such as search and cross reference functions, hypertext links, bookmarks, annotations, highlights, multimedia objects and interactive tools.”

E-books can further be defined as electronic files, roughly the length of a book, that contains words and images and is formatted to display on electronic devices referred to as e-book readers (Dlodlo and Foko, 2012).

For this study, the above two-part definition (Vassiliou and Rowley, 2008:363) will be used as the definition of an e-book. ‘Device’ will refer to the hardware on which an e-book is read, this may refer to a desktop/laptop computer, a smartphone, a tablet or a dedicated e-reader device. These devices commonly have other applications loaded on to them and are not solely dedicated to reading (MacWilliam, 2013). ‘E-reader’ will refer to the e-book reading application/software, typically unrelated to the hardware and downloadable from a website or app-store.

Defining an e-textbook

E-textbooks can be considered a variant of e-books that focus on the "additional goals of learning, even memorizing, portions of the text" (Daniel and Woody, 2013, p. 18). The way in which e-textbooks are read differs from recreational e-books. Recreational textbooks are read in a linear narrative structure, whereas e-textbooks typically follow a hierarchical structure (Daniel and Willingham, 2012; Pollari-Malmi *et al.*, 2017).

The difference in reading outcomes has an influence on the functionality users expect from an e-book reader when reading recreational e-books or e-textbooks. In order for e-textbooks to be utilised, it needs to differentiate itself from a recreational e-book by adding functions that assist readers in the construction of new knowledge and skills (Chiu, Cheung and Lau, 2017). These functions are usually not embedded in the e-book itself, but in the e-book reader used to read the e-book.

As this dissertation focuses on e-textbooks, the term e-book will refer to textbooks and not to recreational e-books.

Advantages of e-books for users

The format characteristics of e-books offer certain advantages over printed books (Beer and Wagner, 2011). For educational users, the ability to carry one device with all the required textbooks already available in the e-reader's library decreases the weight of the educational content they need to carry to a large extent.

E-books allow improved navigation of the content by making use of the functionality that technologies such as web browsers have brought on. Users can, in addition to traditional paging, use hyperlinks and the e-reader's search functionality to cross reference and quickly locate content within the e-book (Wilson and Landoni, 2003; Browne and Coe, 2012).

There is a large variety of e-books available to download at no cost to the user from websites such as Project Gutenberg (Lim and Hew, 2014). Such websites convert books that are in the public domain, or of which the copyright has expired, to digital format. Initiatives like this make e-books more accessible to users whom would otherwise have to get hold of the physical copies of the books.

E-books offer users the ability to overcome language barriers by allowing users to translate parts of text or use the readers built-in interactive dictionary to define phrases. E-books also offer a range of accessibility features for disabled users. Text-to-speech allows a section of text to be read to the user without any additional hardware requirements. E-book readers also offer users the ability to change font properties, such as size, colour and type (Rao, 2003).

E-books are readable on a variety of devices such as smartphones, tablets, laptops and dedicated reading devices. The latter has more recently been replaced with multi-use devices such as the former (MacWilliam, 2013). The capability of the hardware allows e-books to have multimedia functionality, which will enable e-books to become more than just paper behind glass (Lemken, 1999). Multimedia content that can form part of an e-book includes images, animation and video, sounds, games and assessments (Longa and Mich, 2013).

Kiriakova *et al.* (2010) found that students considered e-book readers more fun and interesting than traditional books. This can be attributed to the role technology and mobile devices play in the lives of people within that demographic range. Students work with devices such as tablets and notebooks daily to do a number of tasks and they find the reading of e-books on these devices to be practical and convenient.

Challenges for users using e-books

E-books have increased reading time, which can be attributed to the distractions the device provides such as e-mail, social media or game notifications (Daniel and Woody, 2013). According to a study done by MacWillaim (2013), these distractions exist for both e-books and printed books where a smartphone or tablet is close by, but e-book users were more inclined to engage with other applications on the device.

Although e-reading applications are free in many cases, a device such as a laptop, tablet or smartphone is expensive (Rao, 2004; Anuradha and Usha, 2006). The cost of hardware added to the cost of the e-books may discourage institutions to recommend the use of e-books.

Hyperlinked text from the table of contents and an in-book search functionality are some of e-books' biggest advantages, but it can become a challenge to users when implemented incorrectly (Shelburne, 2009). Studies have found that users are less likely to use e-books if the navigation is difficult to use (Wilson and Landoni, 2003; Anuradha and Usha, 2006; Gregory, 2008).

Many content publishers are still considering e-books as paper behind glass – simply a digital form of the printed textbook where the functionality of e-book readers is not fully harnessed. When looking at textbooks, there are limited opportunities for students to connect with peers and share discussions around textbooks (Lim and Hew, 2014). Annotations and highlights cannot be shared by students in a large number of readers which limits the collaboration students can do in a digital environment.

E-book formats are not standardised (Gu, Wu and Xu, 2015) with some textbooks only available in one format. This means that students cannot use a single reader to read all their digital content and there is not a standardised method to create annotations, highlights and summaries in their e-books. From a software development perspective, the lack of a standard means application developers spend a large amount of time creating compatible applications for the various e-book standards.

Due to the nature of computer software and hardware, e-book readers may occasionally give technical difficulties. In some cases, this may require the reader to make contact with the e-book reader's support channel which is not as accessible as the institution's librarian or local bookseller (Gu, Wu and Xu, 2015). Waiting for technical support to solve an issue a student is experiencing with the e-book reader may take valuable time away from learning. One of the causes of technical difficulties may be incompatible devices. Most applications, including e-book readers, have minimum device specifications. It is often costly to upgrade a device to one that meets the minimum specifications.

E-book formats

There are multiple formats of e-books available. A review of e-book formats by Gu, Wu and Xu (2015) identified more than 30 different formats. Some formats such as Amazon's KF8 is created to work on a specific platform while open standards such as EPUB can be read

by a variety of e-book readers. Traditional document formats such as PDF has also been repurposed as e-books due to the common availability of editing and production tools.

The format of the e-book plays a role in the functionality of the e-book reader and may in some cases be perceived as limitations of the e-book reader rather than limitations of the e-book format. One such an example is zooming in - the EPUB format allows reflowable text which allows all book elements to scale according to the zoom level whereas the text and images in a PDF are static. This should not necessarily be seen as a disadvantage of the PDF format as the fixed layout functions better when complex layouts are present in the e-book (Browne and Coe, 2012). Popular e-book formats will be discussed in more detail below.

EPUB

The EPUB specification is an open format that defines a means of representing, packaging and encoding structured and semantically enhanced web content in a single file format. This format, much like its counterparts, is XML based and pages inside the EPUB are typically HTML pages with added XML content such as metadata and reader instructions.

The current version of this specification is version 3.1. Version 3.0 superseded version 2.0.1 in October 2011. Version 2.0.1 was released as a maintenance release in May 2010, but is now obsolete and no longer under active support. The list of changes between EPUB version 2.0 and 3.0 can be found on the IDPF website (http://idpf.org/epub/31).

EPUB uses markup language for its content documents, thereby enforcing its relationship with existing specifications such as CSS (Cascading style sheets), SVG (Scalable Vector Graphics) and HTML5.

PDF

Adobe describes Portable Document Format (PDF) as an “open standard for electronic document exchange”. A PDF document contains pages that replicate the exact format of the document if it was to be printed but can contain additional elements such as hyperlinks, forms, and multimedia. Although the original purpose of PDF documents was not that it should be used for e-books, many books are currently available in PDF format due to its cost-effective conversion to printable documents.

A new trend has emerged in the form of ePDFs (electronic PDF). There are no rules in the specification of PDFs that suggest a difference between printed PDFs and ePDFs. New functionality such as digital signatures, interactive forms and the embedding of multimedia content (Adobe, n.d. b) exist in the current PDF format. PDFs which use this functionality are in general referred to as ePDFs.

KF8

KF8 (Kindle Format 8) is a proprietary format introduced by Amazon to be used on the Kindle range of devices and software. KF8 replaces MOBI (the latest version is 7) as a format read on Kindle devices and Kindle software (Browne and Coe, 2012).

KF8 supports a limited subset of HTML tags and CSS properties such as drop caps, numbered lists, fixed layouts, nested tables, callouts, sidebars and Scalable Vector Graphics.

The functionalities of e-readers

For an e-reader to be useful, it needs a basic set of functions that users can perform within their e-books. These functionalities include text and graphical annotations, bookmarking, copy and paste, highlighting, print, search, word look-up and type (text) customisation (Lemken, 1999; Wilson and Landoni, 2003; Rao, 2004; Lim, Song and Lee, 2012; MacWilliam, 2013). It is important to note that the print and copy-paste functionality may be limited by the content creator due to rights issues (Rao, 2003) and e-readers should always respect these limitations (Connaway, 2003).

E-readers have network connections which enable the ability to update or enhance the e-book content after production (Rao, 2004). A network connection should not be required to consume the content as this will limit the usage of the e-book (Beer and Wagner, 2011). This is important in an educational environment where educators want to keep learners up to date with current affairs. Text-to-speech is a function where the e-reader can read the contents of a page to the user. This functionality has added much value to e-books in terms of accessibility (MacWilliam, 2013). Dictionary and thesaurus integration, where a learner can look up a word from within the e-book, is important for both educational and recreational use (Wilson and Landoni, 2003; Beer and Wagner, 2011).

2.3 THEORETICAL FRAMEWORK

Introduction

This section will introduce the task-technology fit (TTF) theory as a means to evaluate information systems. A brief history of TTF, first introduced by Goodhue and Thompson (1995) will be presented and its role in the explanation of information system utilisation will be discussed. To accurately present the role of TTF in the utilisation of an information system, the technology-to-performance chain (TPC) will be presented and the role of TTF in the TPC will be explained.

The TTF theory will be further discussed by examining the components, limitations and application of the theory. Task requirements, technology characteristics and fit will be discussed as the three components that make up the TTF framework. As the TTF theory holds certain limitations that have an influence on the outcome of any research conducted using the theory, these limitations will be presented to the reader.

Lastly, a review of literature making use of the TTF theory in similar studies will be presented. As TTF is usually used in combination with quantitative studies its role and use in qualitative studies such as this dissertation will also be discussed. TTF and the Technology Acceptance Model (TAM) will be compared and justification for the use of TTF will be given. Similar components of other frameworks such as perceived usefulness and ease of use will be compared to the TPC components as many articles in the literature review refer to these. Finally, this section will review TTF and its role in e-book related research such as the work done by D'Ambra, Wilson and Akter (2013).

The Task-Technology Fit (TTF) Theory

The TTF theory aims to provide a model that can be used to explain the utilisation of a given computer system. To explain utilisation, TTF finds the relationship between task requirements and technology characteristics. The model was introduced by Goodhue and Thompson (1995) as a means to describe the impact the relationship between tasks and technology has on user performance.

The higher the TTF, the better performance by users (Goodhue, 1995; D'Ambra and Rice, 2001), similarly, the use of information systems will be high if the task fit for that system is high (Goodhue and Thompson, 1995). The need for TTF arises out of the lack of a theoretical basis in traditional user evaluations (Dishaw and Strong, 1999).

TTF forms part of the technology-to-performance chain (TPC) (Goodhue and Thompson, 1995) which investigates how individual performance is impacted by technology. The TPC builds upon earlier work by DeLone and McLean (1992) on the Information Systems Success theory.

The technology-to-performance chain

The technology-to-performance chain (TPC) was introduced by Goodhue and Tompson (1995) and models the role of user attitudes on utilisation and TTF on performance (Figure 1). The model dictates, that for an information system to have a positive impact on user performance, the system "must be utilized, and the technology must be a good fit with the tasks it supports" (Goodhue and Thompson, 1995:213). TPC proposes that TTF is determined by task, technology and individual characteristics. Performance is directly influenced by TTF and utilisation, where utilisation is determined by precursors of utilisation such as individual attitudes, habit and social norms (McGill and Hobbs, 2008).

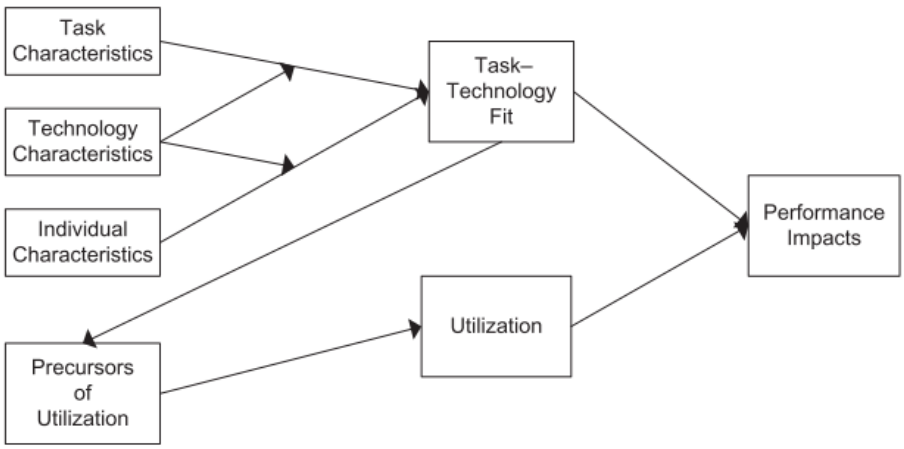

Figure 1 - The Technology-to-performance chain

Components of TTF

Tasks can be defined as "the actions carried out by individuals in turning inputs into outputs", (Goodhue and Thompson, 1995:216). The task characteristics define the tasks a user

wishes to perform with a given technology. Two types of tasks were distinguished by Goodhue and Thompson (1995) namely routine and non-routine tasks. Information systems used to perform non-routine tasks were found to have lower fit ratings by the individuals that performed them. When considering e-book readers, typical tasks may be routine tasks such as navigating the e-book or non-routine tasks such as completing an interactive activity embedded within the e-book.

Technology can be defined as the tools these individuals use to complete these actions where individual characteristics play a role in the utilisation of these tools (D'Ambra and Rice, 2001). Differences in the configuration and the tasks technology are used for may have different outcomes related to its TTF (Goodhue and Thompson, 1995; Dennis, Wixom and Vandenberg, 2001). Technology can also be influenced by TTF where fit can influence design decisions of offer guidance when developing information systems (D'Ambra, Wilson and Akter, 2013). Technology characteristics can be related to physical attributes of the information system such as the size, weight and battery life in the case of mobile devices or it can be related to software characteristics such as font size, navigation or background colour if an e-book reader application was looked at.

Fit can be defined as the ability for a technology to support a task (Dishaw and Strong, 1998) and is influenced by cognitive fit cost-benefit characteristics (Vessey and Galetta, 1991). The TTF construct is related to the Technology Acceptance Model (TAM) user-perceived usefulness (D'Ambra, Wilson and Akter, 2013). From an educational perspective, the performance impact of a Learner Management System (LMS) has been found to be influenced by the fit the LMS displayed with the task requirements and skills of the lecturers using it (McGill and Klobas, 2009).

TTF Limitations

TTF is influenced by the cognitive fit concept, TAM, the theory of reasoned action and the Volitional Behaviour Model. As the previously mentioned theories are more focused on individual behaviour towards technology, one limitation of TTF is its application to group behaviour and technology decisions (Dishaw and Strong, 1998). A second limitation to TTF is the peculiarity of measures. Although the TTF model is general and does not focus on a single application, measures developed for TTF are not general enough to be reused for a variety of applications (Dishaw and Strong, 1998). The limitation of low scale reliability is a

reality (D'Ambra and Rice, 2001) and researchers may need to develop their scales of measurement further.

The application of TTF

The use of TTF in practice will ensure that system designers not only take TAM variables such as perceived ease of use and perceived usefulness into consideration when designing a new system but also the task fit (Dishaw and Strong, 1998; Dishaw and Strong, 1999). TPC can assist practitioners in determining whether a system has a performance impact on the organisation (Goodhue and Thompson, 1995). Studies based on the TTF model can assist organisations in determining whether the systems they implemented assist users with problem resolution (D'Ambra and Wilson, 2004).

Research has been done on the impact of TTF on group performance (Zigurs and Buckland, 1998; Roberts *et al.*, 2004) where tasks differ in nature and groups need to select technologies that best address their needs (Maruping and Agarwal, 2004).

Goodhue (1995) presented the TTF model in "Understanding User Evaluations of Information Systems" and supported the TTF model by a survey conducted. Goodhue and Thompson (1995) further discussed the relationship between TTF and its impact on individual performance. Zigurs and Buckland (1998) viewed the TTF model from a group task perspective and developed the theory of TTF in group support systems. Dishaw and Strong (1999) used the TTF model to extend TAM. D'Ambra and Wilson (2004) applied TTF to Web usage by integrating uncertainty into the model.

Qualitative studies on TTF

TTF and TAM research is commonly based on quantitative studies (Vogelsang, Steinhüser and Hoppe, 2013) but these studies are lacking in explaining the construction process of these theories as they focus predominantly on the influencing factors (van Biljon and Renaud, 2008; Vogelsang, Steinhüser and Hoppe, 2013). Lending & Straub (1997) employed the ethnographic interview method to gain a deeper understanding of the decision-making process a user follows in the fit-recognition process. In their opinion, the TPC provided an informative model on technology use but lacks the explanation of the use of the various TTF factors.

Goette (2000) studied the successful adoption and use of voice recognition technology (VRT), a form of adaptive technology, by people with disabilities. Due to the physical condition of the respondents, surveys could not be distributed, and interviews were conducted. Through the qualitative data collected, Goette identified the different technology characteristics of VRT and the different task characteristics of the users and could explain that many of the failed use attempts were due to bad fit.

Gebauer & Shaw (2011) used qualitative data collection methods to gather more information on the functionality that was employed to meet certain task characteristics in the use of a mobile application. The authors noted that data from interviews provided them with additional information that reached beyond the survey questions.

TTF and TAM

TTF is related to TAM as both models' outcome is the actual use of an information system (Dishaw and Strong, 1999). TAM puts an emphasis on the intention to use an information system, while TTF, on the other hand, focuses on the performance impact when using an information system (Zigurs and Buckland, 1998). A limitation of TAM is the assumption that any system usage by an individual is done without any barriers that may prevent usage. TAM does not allow for variances such as time, funding and system knowledge and these variances have been found to play a role in IS usage (Mathieson, Peacock and Chin, 2001). Models such as the theory of planned behaviour have been shown to better explain IS usage when behavioural intention is considered (Taylor and Todd, 1995).

Both TAM and TTF use (perceived) ease of use as a variable. Perceived ease of use was found to be an important determinant in users' intention to use and their acceptance of information systems, although the effect of the variable subsided over time (Davis, Bagozzi and Warshaw, 1989; Keil, Beranek and Konsynski, 1995).

TPC, Perceived Usefulness and Ease of Use

Davis (1989) identified two characteristics of a system namely perceived usefulness and ease of use that influence its acceptance or rejection by users as part of the technology acceptance model (TAM). These characteristics of a system are not limited to TAM and play

a role in the fit of a system. Staples and Seddon (2004) distinguishes between two types of task-technology fit namely facets-of-fit and predicted outcomes. When the facets-of-fit approach is employed to assess the fit of a given technology, the focus of the evaluation will be on whether key facets of the task requirement are met. Ease of use is an example of facets-of-fit (Cane and McCarthy, 2009).

Perceived ease of use refers to the “degree to which a person believes that using a particular system would be free of effort” (Davis, 1989:320). Even though a system may be perceived as useful by a user, the amount of effort required should not be greater than the performance gained.

Letchumanan and Muniandy (2013) found that perceived ease of use influences the perceived usefulness of e-books while conducting research on the use of mathematical e-books by undergraduate students. In the same study, the authors found that perceived usefulness had a greater influence on the use of e-books than perceived ease of use and concluded that perceptions of e-books greatly influence the use of e-books.

The predicted outcomes approach to task-technology fit evaluates the fit of a given technology by predicting the outcome of use when a technology is employed to see if it is the desired outcome. Perceived usefulness is one example of the predicted outcomes approach (Cane and McCarthy, 2009).

Perceived usefulness refers to the “degree a person believes that using a particular system would enhance his or her job performance” (Davis, 1989:320) where the system will be perceived as superior to those systems currently in practice (Keil, Beranek and Konsynski, 1995). Applying this statement to the use of e-books in educational institutions, a user will perceive the usefulness of an e-book as the degree to which it improves the user’s educational performance. This may be a quantifiable value such as better test marks or simply a higher level of satisfaction experienced by the user after working with an e-book.

TTF and E-reader fit

The TTF model focuses on the ability of a system (e-reader) to match the tasks users (learners) need to perform using that system (Goodhue and Thompson, 1995). A high TTF will result in a greater performance impact and greater usage of the system.

D’Ambra, Wilson and Akter (2013) used the task-technology fit model (Goodhue and Thompson, 1995) to evaluate the adoption of e-books by academics and to determine how it is influenced by the fit and performance. They consequently provided an e-book TTF construct which could be used to evaluate academic task fit and confirm the hypothesis that task, technology and individual characteristics influence the use and performance of e-books in an academic setting.

As educational applications are tools that individuals (learners) use to complete certain tasks (studying, assessment etc.) it can be evaluated using TTF. This will require the author to present a set of scales of measures designed for this specific audience. TTF has been used by other authors to evaluate e-learning systems. In one such an example, the TTF was measured for two user types (instructors and students) in a tertiary learning environment by using a questionnaire (McGill and Hobbs, 2008). Another study investigated the relationship between perceived fit and the continued utilisation of an e-learning system in a blended learning environment (Lin and Wang, 2012). Both the abovementioned studies noted that student utilisation of e-learning systems is influenced by the instructor’s perception of the system.

2.4 UTILISATION

Utilisation can be defined as the number of times an individual chooses to make use of a technology to complete a given set of tasks. This definition has its limitations, as individuals may not always have a choice in the technology they use, therefore utilisation should be defined as the extent to which a technology is integrated into an individual’s routine (Goodhue and Thompson, 1995).

Utilisation can be measured by hours of use, which may be self-reported as measured by Ferratt and Vlahos (1998), but this is only one measurement instrument. Frequency of use and the diversity of application in which the technology is used can also be used as measures (Davis, Bagozzi and Warshaw, 1989).

Social norms may influence the utilisation of a technology, therefore, irrespective of the fit the technology has with the task requirements it may still be underutilised (D’Ambra and Wilson, 2004). The influence social norms have on utilisation leads to two types of utilisation

namely voluntary utilisation and mandatory utilisation. Mandatory utilisation can be seen as utilisation where “social norms to use a system are very strong and overpower other considerations such as beliefs about expected consequences and affect” (Goodhue and Thompson, 1995:218).

2.5 E-READER EVALUATION METHODS

The user’s experience of an e-book is influenced by three factors: the device, the e-reader and the content (MacWilliam, 2013). In some cases, the device and e-reader are combined and cannot be separated (for example an Amazon Kindle Paperwhite). In other cases, the device and the reader are interchangeable (for example a reading application on an Apple iPad). Various studies have been done on the usefulness, usability and fit of e-book readers in the educational environment. This section will discuss a few of these studies and the methods used to evaluate e-book readers.

Wilson and Landoni (2001) present a methodology to evaluate electronic textbooks. Three types of tasks were outlined namely ‘scavenger hunt’, memory tasks and high cognitive skill tasks. ‘Scavenger hunts’ require participants to find a statement in the given material without using the ‘search’ or ‘find’ commands of the application. The results of such a scavenger hunt can feed into the effectiveness and efficiency measures. Memory tasks require participants to complete a set of multiple-choice questions and recall a list of items after reading a piece of text. High cognitive skill tasks require more time and resources to execute and requires a lecturer or subject expert to study the material and test the learners’ understanding of concepts.

Siegenthaler, Wurtz and Groner (2010) created a legibility test and a task-based usability test to evaluate the use of e-books for non-educational users. In the legibility test participants were asked to read a piece of text on five different devices and rate the devices by preference. The results can be fed into the satisfaction measurement, determining how satisfied users were with the functions of the e-reader. In the usability study, the users were given a set of basic tasks to complete, after which they were asked to evaluate the devices on design, navigation, orientation, functionality and handiness. Although this study was done on devices, the usability and legibility evaluations can be done on the e-reader too.

Lai and Ulhas (2012) conducted a qualitative study on the intention of use for e-books by university students. This study made use of the technology acceptance model, as well as the innovation diffusion theory. The authors distributed a questionnaire to collect survey-based responses from university students. They found that perceived usefulness, convenience, compatibility, and perceived enjoyment all contributed to e-reader acceptance.

Jou, Tennyson, Wang and Huang (2016) made use of TAM (Davis, 1986) to evaluate the usability of e-books and the role of learning styles in a mechanical drawing course. E-books were analysed on usability in the perception, intent and usage phases of TAM. The researchers created 11 aspects used to measure e-book usability. Results showed that aesthetics had the highest influence on usability evaluations by users, followed by convenience and intention of use. The lowest scoring measure in this study was emotional preference.

2.6 EDUCATIONAL TASKS

Introduction

Although this research is not focused on the educational outcomes (performance impacts) of e-books but on the utilisation thereof, it is worth mentioning two categories of educational tasks namely cognitive and metacognitive activities. The tasks learners execute while using the e-book reader, fit into one of these two categories and, as discussed below, can have a direct or indirect impact on learning. The categorisation of tasks in the educational environment is important when identifying the task characteristics to ensure non-educational tasks do not form part of the evaluation. For the sake of consistency with the TTF theoretical framework, activities will be referred to as tasks.

Cognitive tasks

Cognitive processing tasks are the tasks learners execute that lead directly to learning and understanding (Vermunt, 1996). These tasks assist learners in becoming more skilful or knowledgeable in a subject or topic. Examples of cognitive learning tasks include thinking of examples that match a piece of theory; or establishing relationships between entities in the subject.

Metacognitive tasks

Metacognitive regulation tasks regulate the cognitive learning tasks which in turn indirectly lead to learning results (Vermunt, 1996). Metacognitive tasks can include identifying difficulties while studying for a subject by doing self-assessments; or by having greater control over the learning environment. Learners who have a greater control over their learning environment have been found more able to easily execute their cognitive tasks (Ford *et al.*, 1998). Metacognitive tasks were found to be an influencer of the perceived usability (utility) and satisfaction of e-learning platforms (Johnson, Gueutal and Falbe, 2009).

Task Characteristics

Making Annotations

Creating annotations inside a textbook can aid learners in both cognitive and metacognitive aspects of learning (Dennis *et al.*, 2016), where metacognitive aspects of learning can be defined as activities that regulate learning and can therefore lead to better results (Vermunt, 1996). Annotations include notes, comments, explanations or other types of remarks that were not part of the original content of the textbook (Yang *et al.*, 2011). Annotations can assist the learner with discussions, indexing, organisation and attention.

Creating Highlights

Highlighting text as well as images in e-books is important for referencing the content in the future and recalling the content in a timeous manner (D'Ambra, Wilson and Akter, 2013). Although highlights were one of the most used features discussed by interviewees, a contradiction in its use exists, similar to other studies on e-books in education. Users regularly mention the ease of making highlights and the quality of the highlights in e-books (Richardson and Mahmood, 2012), but at the same time users would like to print out the e-book to make highlights (Jamali, Nicholas and Rowlands, 2009) - with highlights being one of the 'well understood' advantages of printed content (Richardson and Mahmood, 2012).

Reading Aloud

Reading aloud in electronic books can aid learners in language fluency, assist them with making notes and summarising content faster, and add accessibility functionality to e-books, which is not offered by printed textbooks (Siegenthaler, Wurtz and Groner, 2010). There are two ways in which an electronic book can be read aloud: media overlays and a built-in reader.

The EPUB 3.0 format has an accessibility feature called media overlays that enables an e-book reader to read the book content aloud to the user. MP3 audio files are stored within the EPUB container, with an XML file linking a selection of test in the book to a timespan in the MP3 audio file. When the user plays the audio, the corresponding selection of text is highlighted as the e-book reader reads the text aloud. This synchronised highlighting allows learners to improve fluency and pronunciation of words as the reader provides accurate pronunciation models (Weber and Cavanaugh, 2006). An example from the popular free e-book reader, Readium can be seen in **Figure 2**. Media overlays hold the advantage that the reader does not have to be a computerised voice and audio can be tested for quality beforehand by the e-book publisher.

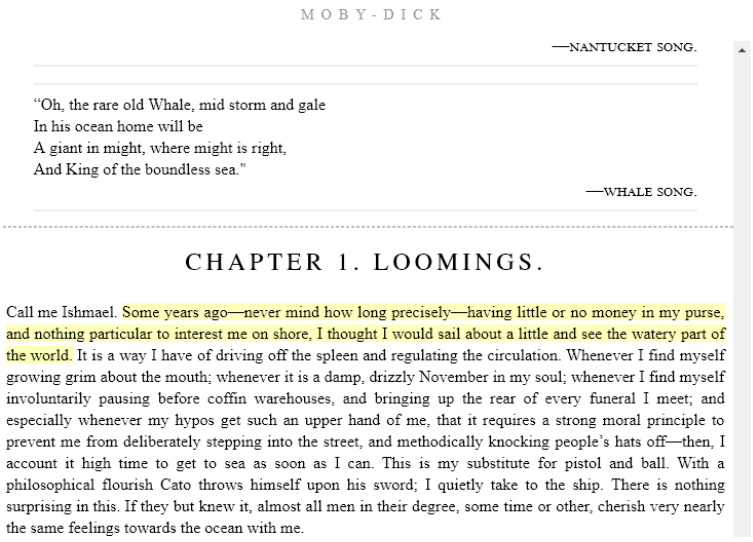

Figure 2 - Media Overlays in Readium

E-book readers can also read textbooks by using the built-in screen reader that is available on a large number of operating systems. The screen reader attempts to read the text in the correct order but does usually not enable any highlighting of the corresponding text. Another disadvantage is the audio quality of the built-in screen reader, which in many cases does not pronounce sentences grammatically correct. Built-in readers can read the text from EPUB and PDF, where media overlays are limited to EPUB only.

Additional Resources

In a study at the Indiana University, 54% of the respondents reported that annotations created by the instructor in the textbook are useful and 70% of respondents stated the

instructor annotation was an important factor in choosing electronic textbooks (Abaci, Morrone and Dennis, 2015).

Additional resources create new opportunities for interaction between the educator and the learner and allows the learner to have valuable insight into the educator's interpretation and perspectives of the textbook's content (Dennis *et al.*, 2016). Gaps in the learner's knowledge can be filled by the additional resources which educators include in the textbooks. This functionality also allows educators to add quizzes to the text which allows educators to identify these potential gaps and complement them with the educator's own understanding of the content (McFall, 2005).

Dictionary

Most e-book reading applications or the platforms that they are installed on provide an electronic dictionary functionality. This usually involves the user tapping or clicking on a word and choosing the define or look-up option. No additional physical books are needed to look up word definitions, and the lookup action is much faster than paging through a printed dictionary. This provides learners with a just-in-time learning experience when learning new vocabulary identified within the textbook (Weber and Cavanaugh, 2006). As there are no physical restrictions such as space constraints in the electronic definition, it can contain more examples and background on the word.

Previous e-book usability studies found that dictionary integration was one of the most desirable aspects of e-book readers (Browne and Coe, 2012; Richardson and Mahmood, 2012). Learners are also able to receive definitions from a variety of sources. This includes specialised dictionaries such as medical, engineering and law dictionaries. Educators can also create their own dictionaries if they feel the need to explain terms in simpler or even the learner's native language (Cavanaugh, 2002).

Searching

In order for electronic textbooks to be practical in education, there has to be functionality that allows the user the find the information they are looking for within the content (Jou *et al.*, 2016). Full text search takes a given search term and searches the full textbook for occurrences of that search term. Full text search assumes the user knows what s/he is searching for and cannot make any inferences on its own.

Referencing

One can differentiate between two types of referencing within the e-book: internal and external referencing. Internal referencing can be considered cross-referencing between pages, footnotes, indexes and the illustrations of a textbook (Wilson, Landoni and Gibb, 2003). External referencing can be considered cross-referencing with other textbooks, web pages, encyclopaedia articles and more.

Recording Voice Notes

Voice notes are used as an after-class annotation tool as creating voice notes in class can cause a disturbance. Dennis *et al.* (2016) found that learners who created more voice notes after class and annotations in class were in general found among the high achieving segments of learners.

2.7 CONCLUSION

This literature review discussed the definitions of the various components involved in the e-book reading process namely the e-book, the hardware and the e-reader application. The review further discussed utilisation and tied the utilisation of usability to e-readers as an underlying system.

The task-technology fit (TTF) framework was introduced as the theoretical framework for this research. As TTF is very generalised, it can be of use in various IS evaluations. Outcomes from studies that use TTF as a model can be of interest to researchers who wish to do user evaluations on systems where the focus is on the individual's performance and not necessarily on the perceived ease of use and usability.

This chapter also presented a high level overview of TAM, its role in user adoption studies, its limitations and practical use. Further, e-reader fit was explored, and work done by other authors was discussed. Finally, similar studies and their tools of measure were discussed where these studies followed a range of different methodologies and models.

CHAPTER 3: METHODOLOGY

3.1 INTRODUCTION

This chapter will discuss and justify the paradigm, design and methods used as part of this research. The interpretive research paradigm will be followed as the researcher's prior experiences, values and beliefs will ultimately play a role in the outcome of the research. Certain limitations apply when conducting this research and will be presented in this chapter.

A case study will be presented to describe the use of e-book readers in the educational environment. The case will describe a popular e-book reader in the South African secondary education market in order identify its technology characteristics for use in the TTF theory presented in chapter 2 and the rationale behind the choice of a case study will be discussed in this chapter.

Qualitative data will be collected by means of interviews and the use of qualitative data in a traditional quantitative model will be justified. To collect data the researcher will follow an ethical process as set out by the University of Pretoria. The details of this process and the application thereof is also discussed in this chapter.

3.2 LIMITATIONS

Number of Participants

Due to the administrative process to arrange for learners at schools and the burden such interviews places on learners, the number of interviews had to be limited. Schools were chosen geographically closer to the researcher to save time and costs typically involved in travelling. This should though not have a major influence on the outcomes of the research as experience with the implementation of the EduReader has shown that it is adopted similarly across different regions.

Recording

A disadvantage of the recording of interviews can in some cases prevent the interviewee of providing complete and accurate answers, especially when interviewed about sensitive or confidential information (Walsham, 1995). As the type of information gathered in the interviews for this research was neither sensitive nor confidential, it is not probable that

interviewees felt inhibited. During the interviews, there were no signs that any of the interviewees felt uncomfortable or over-conscious of the recording device.

Researcher Bias

All researchers are biased by their own backgrounds, knowledge and prejudices (Walsham, 2006) which means each researcher sees things differently from the other. According to Walsham (2006) being a neutral observer is being unbiased, where a neutral observer is not perceived to have any personal or professional stake in the outcome of the research.

Although every effort was made by the researcher not to be perceived as being aligned with the EduReader, some interviewees still interpreted it in that way. This may be due to their age and lack of previous experience with researchers. To address this the researcher gave interviewees the assurance that there is no personal stake in the outcome of the research and the objective is purely academic.

Referral to Gender

To guarantee anonymity and avoid excessive use of gender-neutral statements, all respondents will be referred to as female in the data analysis. This is in no way an actual representation of the interviewees and is used only for the sake of simplicity.

Pseudonyms

The software and company name have been pseudonymised to address concerns the company had with the sharing of sensitive data and the retention of that data. As the software solution is used by the entire school and not only certain classes, the school names of the schools that were interviewed we're also pseudonymised to not enable identification of the company.

3.3 RESEARCH PARADIGM

Ontology is a theory related to the nature of reality (Walsham, 1995) and the researcher's view of reality. Epistemology can be seen as the theory of knowledge (Hirschheim, 1985) which includes how knowledge is acquired and defined.

Information Systems research can be divided into three epistemological and ontological categories namely positivist, interpretivist and critical (Wai Fong, 1986; Myers and Avison, 2002). This research will be conducted from the interpretivist perspective, but for the sake of thoroughness, a short overview of positivist and critical research will also be provided.

Positivist Research

Ontological View

Researchers in this paradigm believe that reality exists independent of the researcher and can be described by measurable properties (Myers and Avison, 2002). Positivist researchers believe that an objective reality exists, and they need to only discover this reality.

Epistemological View

Positivist research is set out to develop and test theories (Orlikowski and Baroudi, 1991). When working through a text, researchers believe they can extract the meaning of the text based on semantics alone and do not need any interaction with the original author of the text (Lacity and Janson, 1994). Theories presented by positivist researchers are assumed to be true as long as that theory is repeatedly proven by empirical data (Chua, 1986).

Critical Research

Ontological View

Critical researchers believe that everything has unfulfilled potential and that humans' ability to change this is constrained by political, economic and cultural systems. Critical researchers' primary objective is to discover and create awareness of these limitations (Orlikowski and Baroudi, 1991) thereby improving the human condition (Myers and Avison, 2002). Similar to interpretivist researchers, critical researchers place importance on the actor's interpretation and role in the creation of reality (Myers and Avison, 2002).

Epistemological View

Critical theory is concerned with the improvement and emancipation of humans. In order the do this, critical researchers attempt to find alternatives to existing social conditions to better address human desires (Myers and Avison, 2002).

Interpretivist Research

Ontological View

If the researcher's knowledge of reality is gained by means of social constructs the research can be classified as interpretive research (Klein and Myers, 1999). Interpretivist researchers will try to make sense of reality from their own perspective and their own goals (Weber, 2004). Due to the important role these social contexts play in the sense making of reality, reality cannot be explained without taking social constructs into consideration. As a result of these social constructs, researcher bias will always be present in interpretive research (Lacity and Janson, 1994).

Epistemological View

Interpretive researchers gain access to others' interpretation of events and attempts to provide a version of events that has been filtered through their own "conceptual apparatus" (Walsham, 1995). Testable predictions from theories presented in interpretive research are not always the main concern of the researcher, providing readers with the researcher's view of the world is of more importance (Gregor, 2006).

The truth provided by interpretive researchers will not always be the final truth as this knowledge is based upon comparing alternative truths through the researcher's own perspectives (Sandberg, 2005).

Choice of Research Paradigm

To truly understand the use of e-books in South African Secondary Schools, a detailed study, with rich, thorough data should be conducted. The interpretive paradigm aligns best with the level of data richness required to conduct such a study. The researcher accepts the fact that the research for this dissertation will be carried out with the assumption that the researcher's conceptual apparatus acts as a filter through which interpretations of events pass.

The data gathering techniques chosen to conduct this research aligns with that of the interpretive paradigm in which it delivers detailed data sets of a qualitative nature rather than statistical, quantitative data. To achieve the level of data richness required, a case study will be presented by the researcher. The researcher is aware that his own bias, created through past experiences and knowledge influences the results of the study and that results cannot

independently exist without the researcher. These assumptions justifies the choice of the interpretive paradigm, rather than that of positivist or critical research.

3.4 RESEARCH DESIGN

A methodology for electronic textbook evaluation was presented by Wilson and Landoni (2001) and was later used by Wilson, Landoni and Gibb (2003) and Wilson and Landoni (2003). The abovementioned methodology is concerned with several components namely the selection of material, selection of actors, selection of tasks and the selection of evaluation techniques.

A case study will be presented to explain the use of e-books in an educational environment. A case study is ideally suited for this purpose as it provides an understanding of the day to day use of e-books by students without gaining access to the entire population (Cohen, Manion and Morrison, 2011:289). Data will be collected by means of semi-structured interviews. Semi-structured interviews allow the interviewer to still have an open conversation with the interviewee but will ensure the topic is discussed (Rabionet, 2011). Participants will be presented primarily with open ended questions as this will assist in identifying their attitudes and preferences when using e-books (Gregory, 2008).

Task-technology fit constructs will be identified in the data provided by the case study. These constructs will be validated by means of a semi-structured interview and observation of task execution employing the think-aloud method.

Case Study

Case studies provide “the study of an instance in action” (Adelman *et al.*, 1976:141) which is the main purpose of the initial data collection. The strength of case studies is the ability to observe effects in real context with context being a determinant of causes and effects (Cohen, Manion and Morrison, 2011:289). It is necessary to place bounds on the case study to avoid attempting to answer, “a question too broad or a topic that has too many objectives” (Baxter and Jack, 2008:546) therefore, the events will be limited by subject and academic level of participants.

Yin (2003) identified three types of case studies namely exploratory, descriptive and explanatory. An exploratory case study will be presented for this research. Although exploratory case studies are useful for motivating research or arguments, this type of case study can also effectively be used to obtain new data for theories (Pan and Tan, 2011). In a similar study, an exploratory case study was successfully used to identify 20 task-technology fit attributes for e-books (D'Ambra, Wilson and Akter, 2013). Exploratory case studies can be used as a precursor to larger studies but researchers should be wary not to perceive the premature outcomes as conclusive findings (Davey, 1991).

Due to the specificity of case studies, it is often criticised for a lack of generalisability (Cohen, Manion and Morrison, 2011:294; Flyvbjerg, 2016). This lack of generalisability refers to statistical generalisability and is based on the variation of the population and sample. Generalisability of a single case is possible if the researcher is able to include a larger range of variability (Cohen, Manion and Morrison, 2011:295).

Context dependent knowledge (Flyvbjerg, 2016) is required from the case study as context plays a large role in the perceived fit of an e-book reader. A popular South African e-book reader, EduReader, will be the subject of a single case study.

3.5 SAMPLING

An appropriate sample that adequately represents the target population is crucial to the data collection process. There are five factors to be taken into consideration when deciding on an appropriate sampling strategy: the sample size, representativeness that the sample has of the target population, researcher access to the sample, the sampling methods to be used by the researcher, and the type of research being executed (Cohen, Manion and Morrison, 2011). Keeping the above factors in mind, the sampling strategy that will be used in this study is set out below. The target population is defined where after the sampling size and method is justified.

Target Population

Kitchenham and Pfleeger (2002) define the target population as individuals that are capable of answering the questions presented and to whom the outcomes of the research are applicable. The target population for this research will be South African secondary school

learners, aged between 15 and 17 that have used the EduReader application in an educational environment for at least two school terms.

A single case study with the EduReader application as the subject is presented to the reader. The choice of a single case rather than that of multiple cases is justified by the need for high-quality data about the subject. The gathering of high-quality data required by this research will not be possible for multi-case designs due to logistical and time constraints. A disadvantage of presenting a single case design rather than a multi-case design is that the case loses some credibility as a result of the lack of replication.

Sampling Method

Due to the time and resources required to gather responses from the entire population, a sample that represents the population will be determined. The sample should provide units consistent with the research's unit of analysis, individual learners. Due to the length of the interview and the possibility of disruption in the individual's school day, purposeful sampling was chosen as the sampling method. In field based research, statistical generalisability does not play such a large role and non-probabilistic sampling methods are often used (Guest, Bunce and Johnson, 2006). Purposeful or purposive sampling means the participants in the sample possess certain characteristics that will assist in reaching the research goals (Koerber and McMichael, 2008). A small element of convenience sampling is introduced as learners are only selected from schools in Gauteng, the researcher's geographic location. Geographic location should not influence the findings as learners who make use of the EduReader live in relatively similar socio-economic conditions.

Sampling Size

To match the population characteristics, learners were chosen from schools that match the following criteria:

- using the EduReader reader for more than six months
- in grade nine, ten or eleven (aged 15 – 17)
- use the EduReader in class

Three schools were identified and contacted regarding the research. For each of these, the principal agreed to interview five learners, thus a sample size of 15 was determined. If saturation were to be reached before the number of interviews were completed, the

interviews were to be stopped. Saturation is reached when no new information is gathered from the interviews anymore (Krueger and Casey, 2009:21). The theory that results from saturated data is complete and offers a rich explanation to the reader (Morse, 1995). There are no published guidelines on determining the exact size of the sample to reach the saturation point and the onus lies with the researcher to evaluate the data and determine whether the saturation point has been reached.

3.6 DATA COLLECTION

Interviews

Interviews form an important part of interpretive studies as they allow a way of gathering interpretations related to their actions from participants (Walsham, 1995, 2006). Participants are given the opportunity to discuss their point of view with the researcher and although the order of the interview can be controlled there is still space for spontaneity (Cohen, Manion and Morrison, 2011:409). Unlike survey based methods where the researcher is not always present, interviews allow the interviewer to rephrase or clarify questions to enable better understanding by the interviewee (Tong, Sainsbury and Craig, 2007). As interviews generally have a smaller amount of participants, it provides better response rates than survey methods (Connaway and Powell, 2010:172). In similar studies, interviews were used to clarify events in e-book usage and the data collected was used in addition to the survey data collected (Shin, 2014).

Rephrasing questions or probing interviews can introduce interview bias (Irani and Love, 2000). Bias can also be introduced by the reactions an interviewer has to the interviewee's responses (Connaway and Powell, 2010:171). It is therefore critical that the researcher commits to a neutral stance and avoid any overarching emotions in reacting to respondents (Irani and Love, 2000).

In order to prevent the introduction of bias, the interviewer will ask respondents to describe the tasks they perform within the e-reader app each day. Quantitative studies collect statistical data on a predefined set of tasks they’ve identified (Dishaw and Strong, 1998, 1999; Ferratt and Vlahos, 1998), due to the exploratory nature of this study, no predefined tasks will be mentioned to the participants during the interviews.

The interviews conducted for this research will be semi-structured as this provides the opportunity to explore the subject rather than providing the interviewee with a predefined view (Pathak and Intratat, 2012). Semi-structured interviews must follow some form of predefined structure, but the researcher may digress if an opportunity to enrich the data is presented (Carruthers, 2007). An interview guide is presented in **Appendix E** which outlines the structure the interviews conducted in this research followed.

Interview Questions

The following interview questions were asked to interviewees during the interview. As the interviewees are semi-structured, the respondent is allowed to deviate from the question, and if the information is useful to this study, the researcher may probe for more information. Interview questions were developed from existing studies identified in chapter 2 and references were included where questions have been used in previous studies. The list and description of the interview questions as they appear in the interview guide (**Appendix E**) follows.

What is your home language?

As South Africa has 11 official languages and the e-book reader's interface is only offered in English, the researcher wanted to compare the experience interviewees, with a home language other than English, have with the e-book reader, to the experience of those whose home language is English. Chisholm (2012) mentioned that delivering electronic textbooks in the correct language for learners should be one of the South African government's priorities to address learning difficulties. The assumption is that interviewees who do not have English as their home language will, in general, have a worse experience of the e-book reader and would expect an interface in their home language. The responses to this interview question will contribute to answering the technology characteristics research question posed in chapter 1 of this study.

Do you use e-book readers for non-educational tasks?

The recreational use of e-book readers should play an important role in the use of the e-book reader within the educational environment. The assumption that formed the basis of this question was that interviewees who use e-book readers outside of the educational environment will perceive e-book readers within the educational environment differently and will, in general, be more acceptant towards the limitations that e-book readers have.

Previous studies have found that former use of e-books will increase the interest in e-books for educational purposes (Anuradha and Usha, 2006; Shin, 2014). This interest is not always positive though. In their study on the use of e-books in an academic institution, Cassidy et al. (2012) found that only 11% of users who have used e-books previously would prefer e-books above printed textbooks.

What are your daily tasks while using the e-reader for educational purposes?

This question was structured in such a way to elicit a personal response from the interviewee and not on e-book reader tasks in general. Responses to this interview question provide the researcher with a more personalised view of e-reader usage in general. The researcher assumed that most of the tasks identified in chapter 2 would be listed by the interviewees.

Instead of predetermining the tasks to be used in the TTF model as previous studies (Wilson, D'Ambra and Drummond, 2014) have done, this open ended question allowed the interviewee to potentially identify tasks that were not mentioned in the literature review due to different environments or time spans.

What are your expectations when using the e-reader?

This open-ended question aimed to draw information from the interviewees regarding their general expectations from e-readers. The researcher specifically did not mention technological, functional educational expectations in an attempt to gather a wider array of responses.

"The better the fit between the capabilities of e-books, the task, and the individual, the more positive the expected consequences and the higher the user's affect toward using e-books", (Wilson, D'Ambra and Drummond, 2014:56). Users' expectations of e-books play a role in the utilisation of e-books. Developers of e-reader software should aim to achieve high positive expected consequences which will motivate users to use e-book readers rather than printed textbooks. This is achieved through a good fit, and responses to this question would provide an indication of the current fit the EduReader has between the user's task requirements and the e-book reader's technological characteristics.

How many hours per day do you use the e-reader at home?

Two questions were asked regarding the number of hours interviewees use the e-book reader. At home, learners have the choice of not using the e-book reader and can easily fall back to printed textbooks. If the difference in usage between home and school is too great, it could point to a flaw in the e-book reader which needs to be addressed to increase voluntary home adoption under learners.

Previous studies on the number of hours spent using e-books in the academic environment show that users would rather use the e-book for quick skimming of the content that thorough reading (Mulholland and Bates, 2014). Students reported that in e-books they would typically just flip through the pages rather than reading from the front to the back of the book (Wu and Chen, 2011). Similar results were found by McLure and Hoseth (2012) where respondents noted that e-books are well suited for quick access, referencing and reading over brief sections, but not well suited for reading longer sections of text.

How many hours per day to you use the e-reader at school?

As discussed in chapter 3, the schools that the interviewees attend use e-books as a replacement for printed textbooks. In the majority, of classes, the e-book is the only allowed textbook that learners may use. The majority of the interviewees uses the e-book reader throughout the school day with printed textbooks the exception rather than the rule. This means that the number of hours spent using the e-reader at school should not deviate too far from school hours, and if it does, the e-reader is under-utilised.

How would you describe better learning performance?

This question aimed to explore the desired outcome e-books should have within the educational environment. As with all educational tools, the outcome should be improved performance, but performance may have a different meaning for different learners.

This question refers to the performance impact e-book readers has on the learner. As the TPC (Goodhue and Thompson, 1995) suggests, an e-book reader with a greater task-technology fit would have a greater performance impact. In order to determine where that performance impact takes place, the researcher first needs to determine what the interviewee considers better learning performance to be.

What functionalities of the e-reader do you think positively impacts your performance most?

Both positive and negative impacts of e-readers have been listed in the literature. The difference between this research and many previous papers is that the interviewees in previous studies could use e-readers voluntarily. This aspect could have led to bias in the studies as users more comfortable with technology would have skewed the results. From this question and the following question, the researcher attempted to get a better view of the perceived performance impacts e-readers have.

Certain functionalities of e-book readers positively impact the user's performance, and as they fit the task requirements of the user, lead to greater utilisation of the reader. One such example is full-text or keyword searching where users can search for a specific keyword throughout the e-book. Most of the respondents noted that keyword searching was easier in e-books compared to printed books in a study done by Wu and Chen (2011) on the use of e-books by undergraduate students in Taiwan. This question aims to identify other such functionalities of e-book readers that positively impacts on the performance of users.

What functionalities of the e-reader do you think negatively impacts your performance most?

As e-books replace printed textbooks, learning should not be negatively influenced. Any aspects raised in the answer to this question should be addressed by application and content developers to ensure that e-books still achieve the main purpose of textbooks, which is to enable learning. This interview question addresses the technology characteristics research question where technology characteristics of e-book readers fail to match the task characteristics as set out by users.

An example of e-reader functionality that negatively impacts performance is slow loading time of pages which would not happen in printed textbooks. Mulholland and Bates (2014) noted that 32% of respondents found page load time as a disadvantage to e-books. Waiting for pages to load takes time which could otherwise have been used more productively and in turn, influences the user's performance. This question aims to identify other such functionalities of e-book readers that negatively impacts the performance of users.

What aspects of e-readers do you think offers performance improvements when compared to traditional studying methods?

This question aimed to gather more information about the interviewee's perceptions of e-books, especially compared to traditional printed media. All the interviewees have used e-books for a number of years and some classes still offer only printed textbooks. This provides the researcher with an ideal opportunity to compare the two mediums.

Many studies compare the two mediums of textbooks with a variety of conclusions. McLure and Hoseth (2012) found that users prefer printed textbooks for their reading comfort and ease of paging with many respondents noting that the strain electronic reading caused on their eyes put them off from electronic books. Richardson and Mahmood (2012) noted that users preferred the accessibility of e-books and how multiple titles can be loaded onto a single device without increasing the weight the student needs to carry. This interview question aims to gather more data on this topic from the environment the study is targeted at, as there is a lack of research in the South African Secondary school context.

What type of device do you use the e-book reader application on? Laptop, tablet or phone?

As discussed in chapter 2, the term e-book is ambiguous in literature. In some cases, the physical hardware that e-books are read on is referred to as the e-reader. A wide range of devices is used for the EduReader application. This question aims to list those.

The device has an impact on the user's perception of e-books although the two components are not necessarily related. The use of e-books is influenced by the device, with some devices featuring more built-in functionality than other devices, irrespective of the reading application used (Richardson and Mahmood, 2012). Fortunately, the devices that can be used with the EduReader application is limited by device specification as set out by EduCorp. This does not rule out the influence the device has on the EduReader application. One such an example is the built-in screen reader of the Apple iPad which seems far more superior than the offerings on Android devices.

What else do you use the device that the e-reader is loaded on for?

When using an e-reader for recreational purposes, the ability to use other apps and swap between apps can be considered an advantage. This is not the case in an educational

context though, where these distractions can become a problem (D'Ambra, Wilson and Akter, 2013).

"Tablet computers, the fourth generation of e-book device, also offer a reading platform but are layered with other applications and do not offer a dedicated reading environment but a multimedia experience", (MacWilliam, 2013:3). These applications offer the useful ability to enable push notifications where the device notifies the user of new events in one of the installed applications. Features such as push notifications can distract the user from the e-book which will not happen while using a printed textbook. This question aims to get a picture of the applications, both educational and non-educational that the interviewees use their devices for.

Do you frequently swap between the e-reader and other applications?

Much like annotations, bold text and other focus points in e-books can help focus the user's attention on certain sections of a page (Yang *et al.*, 2011). In the same way, certain elements outside the e-book can cause the user to lose attention in an e-book. This interview question directly follows on the previous question, where swapping between apps constantly while using the e-book reader can negatively impact the learner's performance. There are cases, however, that justifies swapping between applications, if one takes into consideration calculators, dictionary applications, etc. As discussed in chapter 2, much of the research on e-book usage relies on a dedicated device and not a multipurpose device such as the Apple iPad. This question aims to identify the role these multipurpose devices play in the usage of e-books, especially when considering the multitude of applications, both education and non-educational, available on these devices.

Have you received any training on using the e-reader?

When implementing electronic textbooks, the staff is usually targeted for training, and when these implementations fail, the focus is placed on inadequate training of staff members (Dlodlo and Foko, 2012). Learners should also receive training on e-book readers though, as they are in many cases the intended recipients of the e-books.

Prior experience and training have a positive impact on the perceived fit of a system with the user's requirements (D'Ambra, Wilson and Akter, 2013). Without training on the EduReader application, users will not have the required knowledge of the complete

functionality and may, due to their ignorance perceive the technology fit to educational tasks to be lower. Based on the response given to the first part of this question, interviewees were asked follow-up questions. If they answered yes, some feedback on the training was requested. If they answered no, they were asked if they think training would improve their experience with the e-book reader.

What functionality would you add to the e-reader?

This question provided interviewees with the opportunity to voice the functionality that they would want to be added, to match their task characteristics while studying, with that offered by the e-book reader. Respondents are encouraged to list as much as possible and give detail on each functionality listed.

One e-book limitation which is pointed out by previous studies is the lack of a 'printing from the textbook' functionality. Respondents to a survey done by Cassidy et al. (2012) mentioned printing pages from the e-book to be one of the most important functionalities that an e-reader should have, yet many e-readers do not offer this ability.

Lack of functionality points to task requirements that the user has which is not currently addressed by the EduReader's technology characteristics. These requirements should be added to the resulting model to ensure application developers consider them when developing the e-reader application.

Are there any errors in the e-reader that you regularly experience?

The final question in the interview asked interviewees to list regular errors they experience when using the e-reader application. Errors in the EduReader application could lower task fit as the technology cannot be used at its full potential.

Errors or problems users experience while using the e-book interrupt the primary purpose of using the e-book, which is reading (Browne and Coe, 2012), or in the case of electronic textbooks, studying. This could have a negative impact on the utilisation of the e-reader. Difficulties when trying to access textbooks, or any books, while using an e-reader may result in users gaining a negative perception of e-readers which in turn lowers the utilisation of the e-reader. These problems impact the fit of the reader and will be incorporated into the

TTF model presented by this study to ensure developers identify these problems during the development of the e-reader and address them before releasing the software.

Respondents

Interviews for this research will be conducted after school hours at three schools that were identified from the sample. The schools identified for interviews were Stonebridge College, South High School and The Oaks Secondary. City High School was contacted initially for learners to be interviewed but was replaced by The Oaks Secondary due to the exam schedule. [Note that, as stated in paragraph 3.2, the school names of the schools that were interviewed are pseudonymised for ethical reasons of non-identification.]

The interview time slots for each school were scheduled as follow (all interviews were conducted in 2018):

	Interview 1	**Interview 2**	**Interview 3**	**Interview 4**	**Interview 5**
Stonebridge College	19 April 14:30	19 April 14:50	19 April 15:10	26 April 14:30	26 April 14:50
South High School	25 April 14:00	25 April 14:20	9 May 08:30	9 May 09:00	9 May 09:20
The Oaks Secondary	4 May 08:30	4 May 08:50	4 May 09:10	4 May 09:30	4 May 09:50

Table 1 - Interview Schedule

Earlier in this chapter, the sampling criteria for each respondent were presented. Respondents had to be in grade nine, ten or eleven (aged 15 – 17) and had to be using the EduReader for more than six months in class. A summary of the respondents' grade and EduReader usage is presented in the table below.

	Interviewee 1	**Interviewee 2**	**Interviewee 3**	**Interviewee 4**	**Interviewee 5**
Stonebridge College	Grade 9 >1 year	Grade 10 >1 year	Grade 9 >1 year	Grade 10 >2 years	Grade 11 >2 years

South High School	Grade 9 >1 year	Grade 9 >1 year	Grade 9 >1 year	Grade 10 >2 years	Grade 10 >2 years
The Oaks Secondary	Grade 9 >1 year	Grade 10 >2 years	Grade 10 >1 year	Grade 11 >2 years	Grade 11 >2 years

Table 2 - Interviewee Grade and EduReader Usage

3.7 ETHICAL PROCESS

The researcher has applied for ethical clearance at the University of Pretoria's Faculty for Economic and Management Sciences ethical committee. As part of this application, the researcher submitted his personal information, degree details, the title of research, supervisor details, research period and the purpose of the research. In accordance with the ethical committee's requirements, the problem statement, objectives and research design also need to be submitted. Ethical clearance received by the ethics committee of the University of Pretoria can be found in **Appendix A**.

All data is presented anonymously, and participants' personal information will only be kept for follow up interviews. The nature of the study will have no ethical implications and participants will be allowed to respond voluntarily to all questions. The interview recordings and transcripts will be stored for ten years as per university regulations.

As the participants will be school learners, the consent form makes provision for the guardian's signature as well. The introduction letter and consent form used are presented in **Appendix B**. Principals of the schools identified for interviews will be provided with the information form in **Appendix D** and consent from principals will be collected by the consent form in **Appendix C**.

3.8 DATA ANALYSIS

Introduction

Interviews can be considered as the primary data source for interpretative case studies where the researcher is an outside observer that needs to gather the interviewee's interpretations, filter it through his/her own conceptual apparatus and present a new interpretation thereof to others (Walsham, 1995). For this reason, the researcher needs to

take into consideration that all interpretations, including his own, are a subjective reality created by the researcher.

During interviews, the researcher maintained a neutral stance to all responses provided by the interviewees. The script was followed as closely as possible but, in some cases, where the researcher felt more details could be provided the script was adapted real-time to explore certain topics deeper. Interviewees were given sufficient time to provide responses, and when they misunderstood a question the researcher provided further explanations in a non-guiding way, in most cases avoiding the need to provide examples.

The data collected by the interviews appear to be of sufficient quality to draw conclusions from. Tests for construct validity (Yin, 2003:34) by comparing interview data to previous studies discussed in chapter 2, provided positive results. Tasks identified by interviewees matched those identified by previous research done on the subject (Lemken, 1999; Wilson and Landoni, 2003; Rao, 2004; Lim, Song and Lee, 2012; MacWilliam, 2013). The data saturation point can be described as the point in the interview process where no new themes, concepts or problems are identified in the data (Francis *et al.*, 2010). The number of interviews proved sufficient as the saturation point appeared to be reached in the second last interview.

Data Analysis in Previous Studies

Shelburne (2009) collected data by distributing a survey which included open ended questions to about 47 000 university staff and students. 1 547 Responses were received, and the responses were divided into the following themes: e-book usage, usage type, advantages of e-books and disadvantages of e-books. Shelburne presented the responses in the form of comments subdivided into the above categories.

D'Ambra, Wilson and Akter (2013) analysed the data from two sources (Shelburne, 2009; Gray and Byrne, 2011) and retrospective categories to identify different TTF attributes. The process revealed 20 items, which in turn were assessed for domain coverage by judges. Researchers should be aware of the fact that judges bring their own cultural aspects into the assessment and this social context should be considered when presenting the results. The researchers finally presented 12 usable items after confusing and redundant items were removed.

Data analysis process

The interviews were recorded with the permission of the interviewee and the interviewee's parents. The interview data were transcribed in MS Word documents, a single interview per MS Word document.

The documents were then coded to identify themes across documents. Coding is the process of assigning labels symbolising some meaning to parts of the text (Miles, Huberman and Saldaña, 2014:72). First cycle coding is the first method of discovery which the researcher uses to start assigning a deeper meaning to the data collected. Due to this discovery process, there was no pre-defined list of codes. As new themes had emerged from the data, new codes were added, previous interviews were then revisited and recoded using the new coding list.

Two coding processes were used as a form of hybrid coding. Process coding was used to identify actions in the interview data. These actions can be seen as the tasks which learners perform on their e-book readers. Process coding uses gerunds, or words ending in -ing as it's labels, for example highlighting or note taking (Saldana, 2011:77). The next coding process used in the data analysis was descriptive coding. Descriptive coding (also known as topic coding) labels sections of data as a short phrase or a single word (Saldana, 2011:70). The descriptive codes were assigned primarily for indexing of themes and categories arising in the data.

Coding can be done manually by printing the interviews and assigning the different labels related to parts of the text in the margin of the page. For this research, the researcher chose to do the coding using a popular free application. QDA Miner lite is a free textual data analysis tool which will be used to code the qualitative data gathered by the interviews. QDA Miner lite accepts popular text files such as PDF, Word and TXT as well as popular image formats. Codes can be organised into different categories and frequency analysis of codes are presented via bar charts, pie charts and tag clouds.

3.9 CONCLUSION

This chapter discussed the interpretative research paradigm which the researcher followed to conduct this research. In order to justify the interpretivist approach, two other research

paradigms, critical and positivist, were also elaborated on. The case study research strategy followed for this study was also presented and interviews were discussed as the qualitative data collection instrument. Furthermore, the sampling strategy, data collection and data analysis methods used, were discussed from an interpretative perspective. The strategy will enable the researcher to gather data and to analyse it in such a way that a contribution could be made to the existing e-book usability body of knowledge.

CHAPTER 4: THE CASE STUDY AND RESEARCH FINDINGS

4.1 INTRODUCTION

This chapter describes the research findings of this study. Firstly, the case description is presented within which the technology characteristics of the EduReader e-reader is listed and discussed in detail. As discussed in chapter 3, process and descriptive coding were used to identify codes in the data collected by the interviews. These codes are presented in this chapter.

The data collected while conducting the student interviews are presented in detail with the responses to each question summarised individually. From the data collected in the interviews, a set of task requirements characteristics are formulated to accurately reflect the respondents daily use of the EduReader e-reader. Subsequently, the individual characteristics are discussed to provide a clear description of the individuals using the EduReader e-reader.

Finally, a TTF model is presented which incorporates the technology characteristics from the case study, the task characteristics from the interview responses and the fit between the task and technology characteristics as a precursor to utilisation.

4.2 CASE DESCRIPTION

EduReader E-Reader

This section will describe EduReader, the e-reader that will be the subject of the case study presented by this research. The interviewer downloaded the EduReader reader for iOS and purchased a couple of textbooks in both EPUB and PDF format to accurately describe the functionality offered by the e-book reader.

EduReader is an interactive e-reader that was developed specifically for educational use. **Figure 3** shows the library view of the EduReader application, where users are able to open an e-book for reading. The e-reader is developed by EduCorp, a company based in Pretoria, South Africa. EduReader can be used to read the two most popular e-book formats, EPUB and PDF. The app is downloadable for free on the Windows Store, Google Play Store and the Apple App store. As of August 2017, the EduReader application is used by more than 80 000 users from a variety of primary, secondary, tertiary and corporate education

environments. The functionality available in the EduReader application will be discussed in detail below. Unless specified, each function is available in both supported e-book formats (EPUB and PDF).

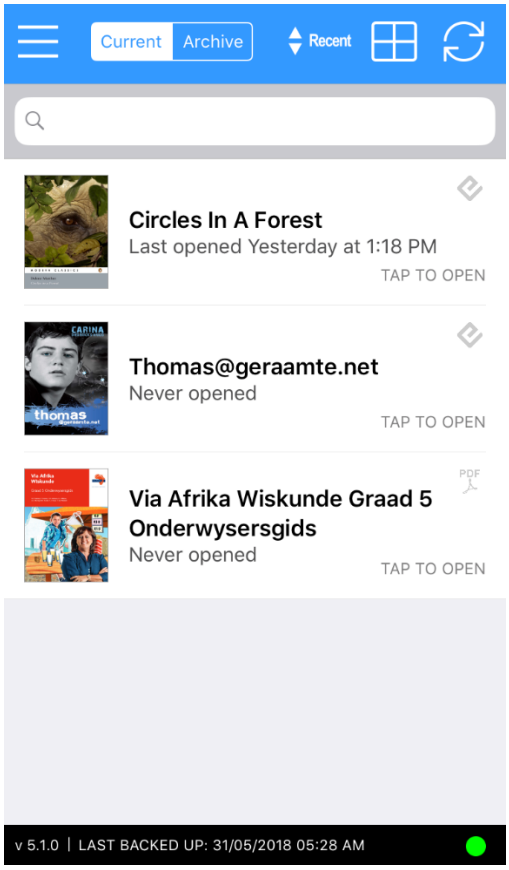

Figure 3 - The EduReader library

Annotations and Highlights

Users can create notes, sketches and highlights in the EduReader reader. Different e-book formats have different ways to create these annotations though. Due to the reflowable nature of an EPUB, annotations cannot be created on the page, and are rather added to the right-hand margin of the book, attaching itself to an element within the EPUB to keep its location. **Figure 4** shows the view a user will see when creating a note on an EPUB and viewing the note in the margin afterwards. A note is created by long-tapping a piece of text in the e-book and selecting ‘Add note’ from the pop-up menu. The notes created can only contain plain text, with no formatting such as colours, font-size or font-styles available. Once the note is created, the user can access it by swiping from right to left or clicking on the menu icon in the top right corner.

Highlights are created by selecting the highlighting too from the toolbar on top of the book views. There are six predefined colour choices available for highlights as well as an eraser option to erase existing highlights. When making a highlight as shown in **Figure 5**, the user has the ability to undo the last couple of highlights.

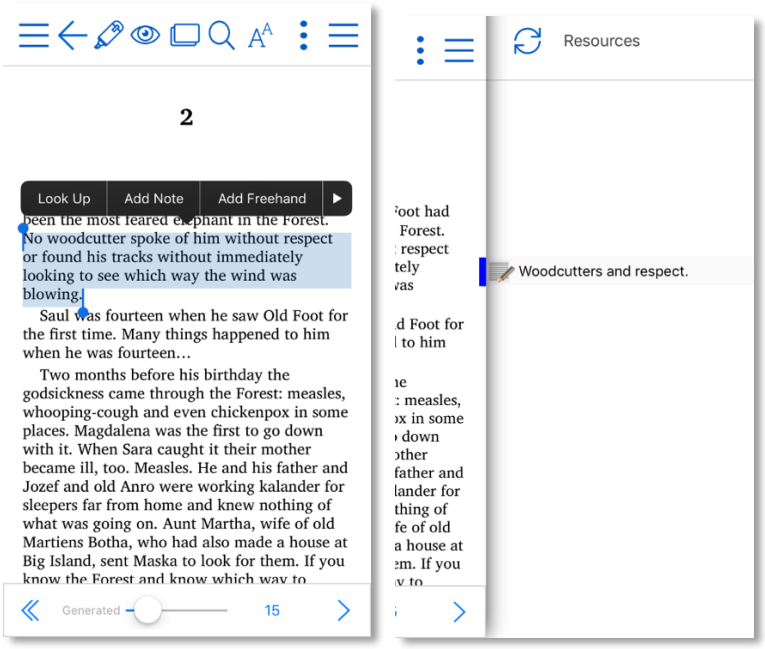

Figure 4 - Notes in an EPUB using the EduReader application.

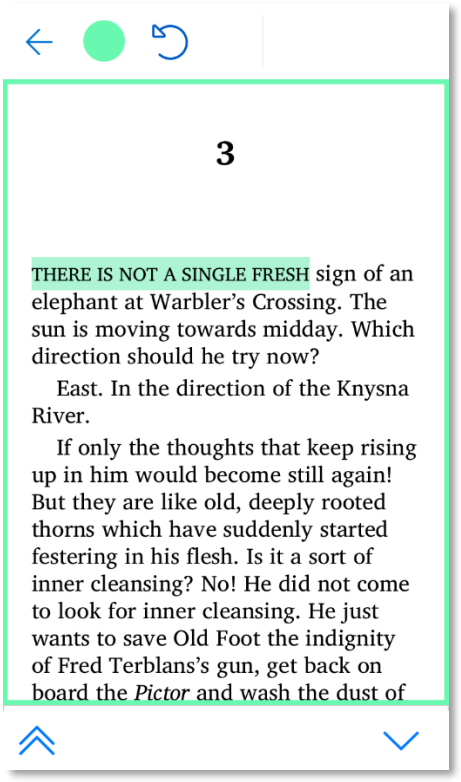

Figure 5 - Highlighting in an EPUB.

EduReader offers drawing functionality to users for both PDF and EPUB formats, albeit a different between the two formats. For PDFs with static, non-reflowable content, users can draw directly on the PDF page as seen in **Figure 6.** As with highlights discussed earlier in the chapter, the drawing tools offers the user six predefined colours, an eraser and undo functionality. Due to the reflowable nature of the EPUB format, users are not able to draw directly on the e-book. Users will follow a similar process to creating a note, by long tapping on a piece of text and choosing ‘Add freehand’ from the popup menu. The sketch is then saved in the right-hand margin and keeps its vertical position even after the page is resized. The drawback to this method is that the user cannot see the sketch and the page content at the same time.

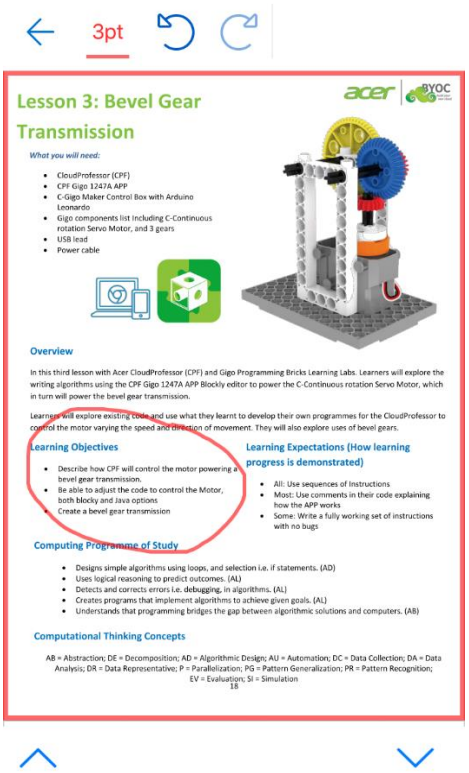

Figure 6 - Drawing on a PDF

Additional Resources

Content such as videos, images, URLs and assessments can be delivered to the EduReader application by educators through a push service. The educator uses a separate application to add content to parts of the e-book, similar to the way a learner will add a note. This content is then delivered to all learners in that educator’s class and is also shown in the right-hand margin, alongside the learner’s own content and annotations. These additional resources

allow the educator to augment the e-book which is useful if the e-book has missing or outdated content.

Summaries

EduReader combines all annotations and additional resources into a digital summary. The summary view (**Figure 7**) allows users to show or hide notes, headings, and highlights based on colour. This summary can then be downloaded as a PDF to print and use for studying.

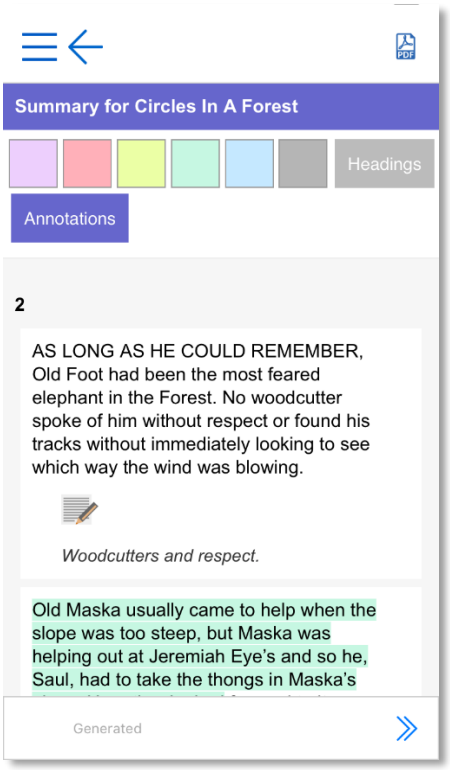

Figure 7 - Creating a summary

Navigation

The EduReader application offers several methods of navigating an e-book. **Figure 8** shows three ways of reaching specific content. All e-books offer a table of contents which contains a collection of hyperlinks, linking to the start of a section or page (Browne and Coe, 2012). The table of contents is accessible from anywhere in the book by opening the left-hand drawer. This is done by clicking on the menu icon in the top right corner or swiping right with your finger or pointing device. The EduReader offers a table of contents search, which hides all options in the table of contents that does not match the search term entered.

Users can also search for a term throughout the book. While reading the book, a search icon in the top toolbar opens a search box. Terms entered in this search box are matching with content throughout the e-book. A list of each occurrence of the search term, including some context text and the page number is returned and displayed to the user.

If a user prefers to navigate directly to a page instead of a chapter or piece of text, the application has a page number selector within the book view. Users can navigate page numbers by clicking on the next or previous buttons in the bottom toolbar or by clicking on the page number itself. When clicking on the page number, a toolbox opens which allows the user to enter a page number manually. Unfortunately, page numbers do not always match the printed book, especially in the EPUB format, where reflowable content makes traditional navigation difficult. PDFs generally use the same page numbers as the printed book.

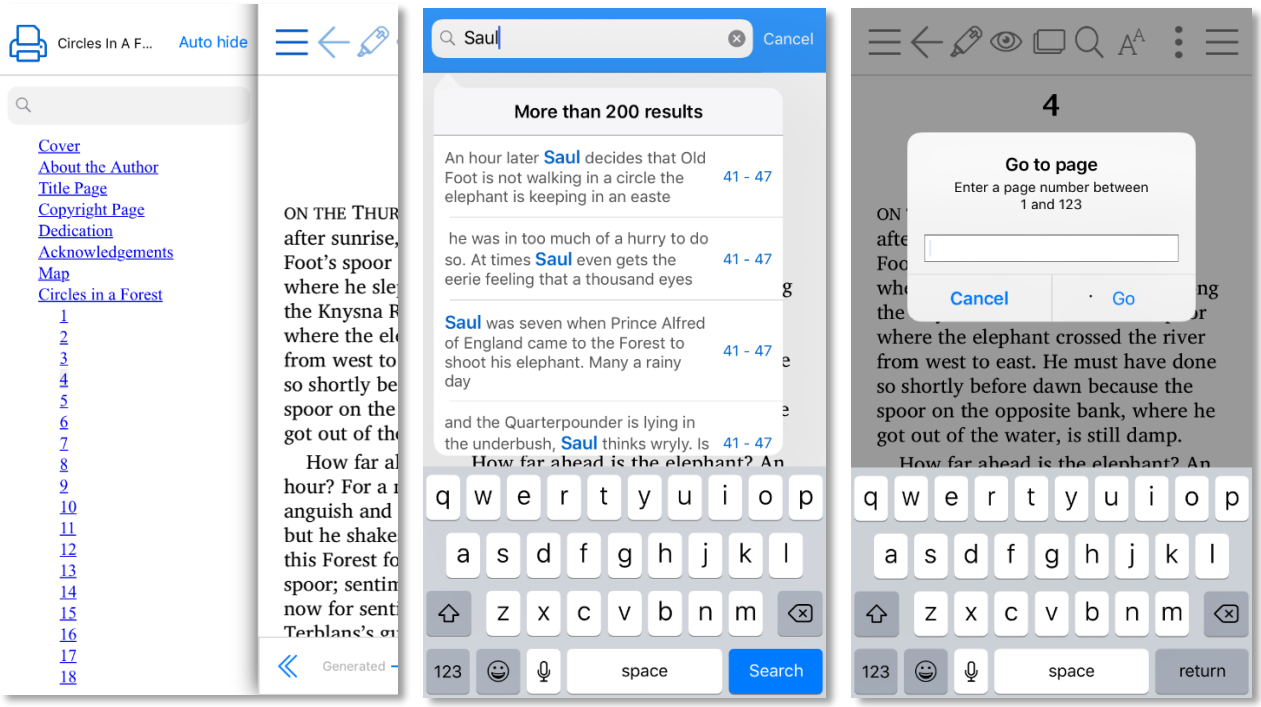

Figure 8 - Navigation methods

4.3 CODE CATEGORIES

As discussed in chapter 3, two coding processes were used as a form of hybrid coding namely process coding and descriptive coding. There was no pre-defined list of codes and as new themes emerged from the data, new codes were added revisiting previous interviews

to update labels. The coding was done using the QDA Miner lite application by reading through the interview transcripts and assigning labels to text as they were identified.

As tasks are actions executed by the user, process coding was used to label tasks identified in the interview transcripts. Process coding uses gerunds, or words ending in -ing as it's labels (Saldana, 2011:77). A gerund was constructed from each task identified in order to use process coding to label future occurrences of the code. Process coding was used to identify the tasks interviewees perform while using the EduReader application in order to explore task characteristics as a component of the TTF theory.

Descriptive coding (also known as topic coding), which are descriptive labels assigned to sections of text, was used to code usage trends, technology characteristics and individual characteristics. Process coding was not suitable for this type of data as gerunds could not necessarily be formed from the categories identified. The codes identified using descriptive coding was used to label sections in the interview transcripts that assisted in formulating the technology characteristics component of the TTF theory.

The following codes were identified while analysing the data. The researcher assigned these codes as labels to clusters of text:

- **Demographics**
    - language
- **Task**
    - taking notes
    - highlighting
    - making sketches
    - reading aloud
    - referencing
    - receiving resources
    - navigating
    - dictionary
    - zooming
    - completing activities
    - accessing calendar

    - summarising
    - recording voice notes
    - searching
    - communicating
- **Characteristic**
    - access
    - aesthetics
    - stability
    - non-permanent annotations
    - battery-life
    - updates
- **Usage**
    - home
    - school
    - training
    - non-educational
    - device
    - other apps

As an example of the coding, the frequency of the gerunds used for tasks across interviews can be seen in **Figure 9** below.

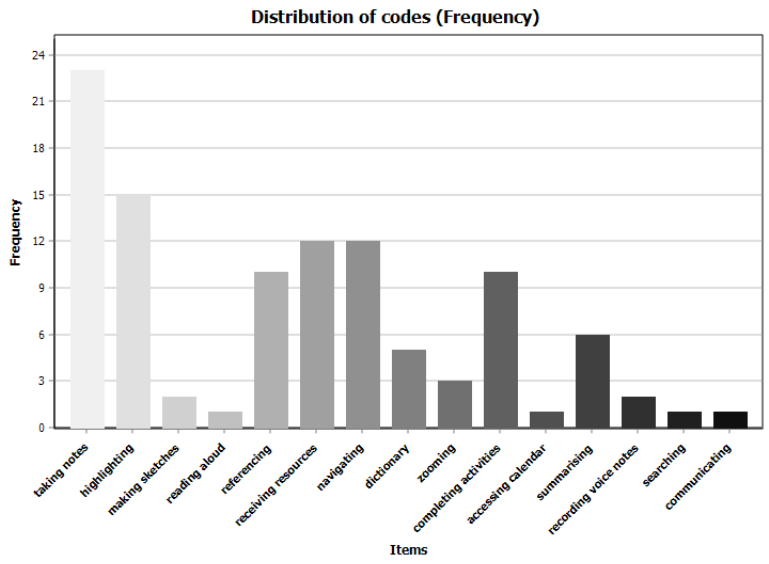

Figure 9 - Code frequency for tasks

4.4 INTERVIEW QUESTIONS

The researcher conducted one round of interviews with learners at various high schools. The background for each question is discussed in chapter 3. 15 Interviewees participated in the interviews and their responses were analysed and are presented below.

What is your home language?

All interviewees answered this question. As expected, a variety of home languages were recorded. Nine of the interviewees stated that English is their home language, making up the majority of the interviewees. Three interviewees stated that Afrikaans is their home language followed by Setswana, Tsonga and Portuguese, each with one respondent.

No clear correlation could be formed between the various home languages and the experience the interviewee had with the e-book reader even though the e-book reader only offered an English interface.

Do you use e-book readers for non-educational tasks?

All interviewees answered this question. Six interviewees indicated that they use e-book reader applications for non-educational purposes. Although the EduReader has an online bookstore where learners can purchase fictional e-books, none of the interviewees stated that they use EduReader for recreational reading. Three interviewees that use e-book readers for non-educational purposes used another app, Kindle by Amazon, to read recreational e-books. Adobe Reader and Apple iBooks were mentioned by one interviewee each. The reason for preferring the Amazon Kindle app above the EduReader may be financial rather than functional with two of the interviewees mentioning that they use their parent's Amazon account:

"I read on my Kindle, my dad's Kindle"

"I use normally read, nowadays, I buy all my reading books on my iPad or my Kindle. […] My dad has the Kindle which I sometimes use, but I use my iPad most of the time."

One interviewee mentioned that although she has read recreational books on e-book readers, she still prefers physical printed books.

"I do. I use it for enjoyment reading, but not often. But I do prefer the physical books."

No specific reason was provided by interviewees for not reading e-books recreationally with most non-users not having a strong opinion:

> *"I don't really know. I don't really use it a lot at home, but I use it a lot at school."*

> *"Non-educational, meaning not relating to any school work. Not really. I only use it regarding my school work whenever there is school related stuff. […]"*

> *"E-readers only help me for educational purposes. It defeats the purpose of using it for non-educational stuff if I don't get anything for educational purposes."*

There was no clear correlation between non-educational use of e-readers and educational use of e-readers. Interviewees who use e-book readers outside the educational environment had mixed responses to questions regarding the educational environment, similar to those who do don't read e-books recreationally at all.

What are your daily tasks while using the e-reader for educational purposes?

All interviewees answered this question. The tasks identified in the responses will be discussed in more detail later on in this chapter. Learners use their devices for more than the e-book reader and will tailor their usage to a unique style that fits them. The same goes for the way they use e-books (MacWilliam, 2013). Throughout the responses, there was no pattern in daily tasks, with some interviewees making highlights, others making notes and other not making any annotations.

> *"[..] I don't really highlight or make notes. What I do is when the teacher gives us an exercise I do go to the book and read it and then do the work […]"*

> *"Some subjects require us to use our tablets instead of textbooks. So we'll usually read with the teacher, we can highlight stuff in our e-books. We get extra PDF files as well, so for like comprehension pieces […]"*

> *"What I really like, is that if there's an important part, I can actually put pressure onto the screen and it lets me add a note there and it will save there. So, I really use that a lot, especially in History."*

As discussed earlier in this chapter, the EduReader allow educators to add additional resources to the learners' e-books. This functionality enables an enhanced version of the e-book, where relevant content such as videos and other documents are readily available

within the app. Interviewees mentioned that educators add homework assignments to their e-books in this way as well, instead of printing or delivering via some other application.

"Reading from the textbook, answering the questions using the textbook, viewing or download resources via the EduReader app [..]"

"[…] What's also nice is that they can send us presentations and extra notes when we don't understand it. So that's also kind of nice"

What are your expectations when using the e-reader?

All interviewees answered this question. A number of interviewees expected the e-books to behave like a normal textbook, with a specific reference to navigation. The e-book should also contain all the content that the printed textbook does.

"I expect it to be like a book. You can pick and find a page easily. Go to that page. Find the topic or unit, whatever it is. […] it should have all the activities and that, like a normal textbook."

"Just to be the exact same thing as a normal physical textbook. […]"

"Not really that much, just the same as the book. Obviously, it must make it easier to make notes and stuff."

Interviewees also had the expectation of stability from the e-book reader. This expectation is closely linked to the responses received for question 9 of the interview. Printed books do not "crash", "glitch" or "freeze" and respondents expect the same stability from e-books.

"It must not glitch. It must be quick to open, so that you can make notes as the teacher is saying it. You must be able to use basic functions such as highlighting and making quick notes."

"I expect the e-book not to crash and I expect the e-book to be available at all times when I want to use it and the resources […]"

"I expect all my textbooks to be there. I expect all the information to be there, not to glitch. It is technology based."

How many hours per day to you use the e-reader at home?

All interviewees answered this question. All 15 interviewees indicated that they use the e-book reader at home with the shortest period of time being less than an hour and the longest period being eight hours. The mean average of the responses being two and a half hours. The number of hours the interviewees use the app at home is based on the amount of homework they received for a specific day.

"It depends. If I have a lot of homework, two hours. If I don't have homework, none. Sometimes I study on the books. Like an hour a day."

"It differs from day to day, depending on homework and studies if you know what I mean. But I would use it about every day, about two hours tops. I don't know, that's an average."

Although interviewees used the e-book completely voluntary at home and had the possibility to fall back onto the printed textbook at any time, they did not. This should not be assumed as a positive attitude towards e-book readers though. Learners may merely study with e-book reader for practicality.

"I'd say like about an hour more or less, depending on what subject I have homework for. I don't really go on the e-book reader because I like to, it's mostly just for school."

How many hours per day do you use the e-reader at school?

All interviewees answered this question. All 15 interviewees indicated that they use the e-book reader at school with the shortest period of time being two and a half hours and the longest period being seven hours. The mean average of the responses being four and a half hours. The variance in school usage can be attributed to the subjects in which e-book usage is encouraged by the educators. In some subjects, e-books are not practical, and educators use the printed workbook:

"At school, depending on which subject, cause Afrikaans for example we don't use it […] for Afrikaans we have our own personal workbook […]"

The interviewee responses confirmed the initials assumptions made for this question, with all respondents using e-books throughout the school day.

"A whole school day, I would say six hours."

"The whole day basically, I would say about 4 hours as well."

How would you describe better learning performance?

All interviewees answered this question. This question received a wide array of answers, with a couple of interviewees linking it to the e-book rather than answering it in the general sense. Interviewees described learning performance as the way in which one learns and the time it takes to understand the work presented.

"I would describe it as, you can learn easier and quicker and better and understand it easier."

"[…] I would describe it as the way in which you learn and the more you understand things, the more you will prosper, or you will improve in certain things."

The result of better learning performance was listed as higher grades and a progression in the knowledge of a given topic or unit.

"[…] It's basically how you understand and how you learn and your performance on how you obtain knowledge. Your marks and your results relate to your performance and how you learn."

"I would say, it's the progression in which you learn. How you've progressed, from where you were to where you're going forward."

"Basically, how I perform at school."

"[…] Like for example the results you see in tests or academic or just what you can see that they've taken what you've taught them, they've taken it in and are able to apply it successfully"

What functionalities of the e-reader do you think positively impacts your performance most?

14 out of 15 interviewees answered this question. Highlighting is the functionality that the interviewees mentioned most and appears to have the largest positive impact on learning performance. This can be attributed to the aid highlighting provides in comprehending text (Felvégi and Matthew, 2012).

"I would say the use of being able to highlight. I love having colour in my books. It helps me learn. I enjoy the highlighter function."

An unexpected theme that emerged from this question was the temporary state of highlights and annotations in e-books, where learners can erase highlights from e-books unlike from printed books where once the highlight it made, it is permanent. This was not a common discussion in the literature studied on the subject.

"[…] I mean if you are normally highlighting on a page you can't take it back. But if you highlight something accidentally in the e-book, you can erase it. […]"

"You can make notes where the book you damage the book if you write on it."

Navigation in e-books can consist of browsing (paging), looking at the table of contents, searching and using the index (Browne and Coe, 2012). It is important that e-books offer a

variety of different navigation methods as learners will have different preferences and navigation should never intervene with the e-book's primary goal which is studying.

> *"[…] there's a lovely little search function so if I'm looking for one specific thing in the book I don't have to flip through pages and pages looking for it, I can just click on it and it shows me where that word appears […]"*

Traditionally, e-books, especially those in the EPUB format offered no page numbers and this raised serious issues in studies done on e-books in the American K-12 education system (Felvégi and Matthew, 2012). A possible explanation for this was the technical difficulties attaching page numbers to reflowable content (Browne and Coe, 2012) as found in the EPUB format. The EduReader features page numbers in all of its e-books, even when the publisher did not create the e-book with page numbers. This feature drew positive responses from the interviewees, even though the page numbers do not always match the printed textbook.

> *"How quick you can use it. You can type a number of the page. You don't have to swipe through, or page through and find. […]"*

Physical attributes of e-books were also mentioned, with the reduction of carrying weight an important factor for a number of interviewees. In all the schools the interviewees attend e-books replaced the majority of subjects, which means a single tablet replaced six or seven textbooks.

> *"[..] The fact that I don't have to carry all my books […]"*

> *"[…] I don't have to carry seven different textbooks in my bag; it's physical strain on my body […]"*

What functionalities of the e-reader do you think negatively impacts your performance most?

All interviewees answered this question. Stability was at the centre point of the majority of responses to this question. A concern raised by interviewees was that the e-books and resources sometimes disappear, thereby hindering the learning process, which is the e-book's primary goal.

> *"[…] If I planned on studying for two hours, and I open my book when I get home, my book is not there which have to make me rearrange my whole schedule, that negatively impacts the way I work […]"*

A more temporary but equally important issue raised by the respondents was the occasional application crashes they experienced. No content was lost, but valuable studying time had to give way to an application restart.

> *"Sometimes it gives you the error message "EduReader isn't responding, do you want to wait." Sometimes the app just completely freezes, so you cannot really work. […]"*

As mentioned in the previous interview question, page numbers do not always exactly match the printed textbook's page numbers and this was a concern for two interviewees.

> *"The pages are inaccurate compared to the physical book, so that creates a conflict because the teachers often use physical books […]"*

> *"I would say that the digital page number, the slider at the bottom where you pick a page, it doesn't always correspond to the actual page number that's on the bottom of the physical textbook there."*

Although not a direct functionally of e-books or e-book readers, but rather a function of the device on which the e-book reader is installed on, distractions were listed as a negative aspect by two interviewees.

> *"If I'm using a tablet and I have a sim card, I get Whatsapp messages which distracts. I click on the Whatsapp message and lose track of where I was."*

> *"Distractions, procrastinating, as well as looking at, for example somebody sending an SMS and then you move onto something else."*

What aspects of e-readers do you think offers performance improvements when compared to traditional studying methods?

All interviewees answered this question. As with question 8 regarding the advantages of e-books for learning performance, the physical attributes of e-books drew many comments in this question.

> *"[…] Over here, it would have one tablet for, I have 13 subjects. So, for me it's an advantage because my bag is lighter so that also helps […]"*

As all e-books, content and resources are backup up throughout the day by the EduReader application, an account is easily recoverable when a learner loses her device. Interviewees mentioned that this accessibility offered by the e-reader presents an advantage over printed textbooks, where if it was lost or damaged, you will need to recreate all your annotations.

"It's better because now if you let's say you lose your tablet or so, you can put it on your phone, the app. You just type in your crp and you'll have all your books back. But let's say you lose all your books, then you have to buy all those books separately again."

Digital summaries, where the e-reader takes the collection of annotations created by the learner and summarises it into a single view automatically saves the learners time when doing preparation for tests and exams. The annotations, resources and e-books are all shared across the learner's devices, which means at school they can use a tablet or notebook to save space, and at home they can make use of a desktop PC with a larger screen and more ergonomic keyboard and mouse.

"[…] it's nice because there's a feature on EduReader, where you can highlight the text and then it makes a summary for you. So that saves you a lot of time when you're learning as opposed to re-write things that are already in the textbook."

"[…] It also allows cloud services, that's very good. It allows you to keep your notes everywhere […]"

What type of device do you use the e-book reader application on? Laptop, tablet or phone?

14 out of 15 interviewees answered this question. Nine interviewees use the e-book reader on their Android Tablet, three use it on their iPad and two use it on a Windows laptop. EduReader offers the ability to share an account across three devices, one interviewee mentioned this as a positive aspect of the e-reader in question 8.

"Yes, as I said, the fact that it can be available on multiple devices using the same account and when you're able to share it and the portability. But also, the fact that you can make notes on the textbook, that's a nice feature. Because you have it again available on other devices."

What else do you use the device that the e-reader is loaded on for?

All interviewees answered this question. Interviewees use their devices for a wide range of applications as expected from a multipurpose device. Only one interviewee stated that she does not use other applications on her device due to storage limitations.

The applications interviewees use on their devices can be categorised into the following categories:

- Browsing – Any mention of internet browsing or Google

- Media – Listening to music, watching videos
- Social – Social media applications such as Instagram, YouTube, Facebook and Twitter
- Productivity – Taking notes, using an office suite such as Microsoft office
- Games – Any form of mobile gaming
- Education – Other educational apps such as Turnitin.

Social media was mentioned nine times by the interviewees for this question making it the most popular secondary use of the devices. Most interviewees stated that they use Instagram or YouTube as their social media platforms of choice.

> *"A lot of things. Instagram mostly to be honest, YouTube a lot. For sure my books, I have like a separate thing called "e-books" I think, where you can like download magazines and things. And probably my editing where I do my photos on."*

Applications in the browsing, games and productivity categories were mentioned seven times each respectively. Microsoft Office being the productivity suite of choice for interviewees. The media category of applications was mentioned five times.

> *"I'm not going to lie, I use it for games in my spare time. I download movies, I listen to music which I've mentioned. I send messages."*

Two interviewees stated that they do not play games on their devices at all, one of them mentioned that this was due to storage issues on the device.

> *"Well before I started using the iPad for school, I used it to play games. But afterwards, I haven't touched it. Especially using it for school purposes."*

Other educational apps were only mentioned three times, with Turnitin the most used educational application. Photomath was the only other educational app mentioned.

> *"[…] this one app, I downloaded Photomath, it helps you with solving your maths equation. So, if there is something you don't understand, you can take a photo of it and it will show you how to solve it step for step. […]"*

Do you frequently swap between the e-reader and other applications?

All interviewees answered this question. Only one interviewee stated that she does not swap between the e-book reader and other applications. An unexpected outcome of this question is the number of interviewees who swap between the e-book reader and the gallery.

> "[…] Say now, there's a rubric and the instructions. I open the rubric and take a screen shot. I then go to the Gallery to take the rubric and while I'm doing the questions, I look and go back to the Gallery to check what I'm supposed to do properly."

> *"[…] I swop between Gallery because I take pictures of the work. I refer back to Gallery work and look back to the textbook."*

Interviews regularly swap with an external PDF reader in order to open multiple PDFs at the same time. The reason very similar to the gallery swap mentioned above, where the interviewee needs to see a rubric or assignment while working in the e-book.

> *"[…] It depends if we are using multiple PDF textbooks, then I will. Then I'll open the PDF in a different reader."*

This phenomenon is best explained by the e-reader's lack of ability to display everything that a learner is busy with. With printed books, notes and additional resources a learner can lay out all the content on her table and have a big picture view.

> *"[..] That's why it's better to not use an e-reader, because when you don't use the e-reader you have everything in front of you and it's easier to flip through it. Whereas on the tablet you have multi-view where you can open only two to be able to see them properly at the same time."*

Only two interviewees mentioned that they swap to a non-educational application. Both stated that they only swap when they are bored in class.

> *"[…] When I'm bored at times during class. But not most of the time. Only when we are not doing anything important […]"*

Have you received any training on using the e-reader?

All interviewees answered this question. Only three interviewees have received training on the use of the e-book reader, the remaining 12 interviewees have not received training yet. Assistance is offered by the school if a learner experiences any problems with the e-book reader or struggles with some functionality. This is purely retroactive with no training provided beforehand.

"[…] there is somebody that comes weekly. If we have issues or if we don't know how to use it, they will come and help us."

Seven interviewees responded that receiving training on the e-book reader will indeed improve their experience. Although they have basic knowledge of the e-book reader's usage, they miss some knowledge on using more advanced features.

"I think so, because there are features on the certain apps like EduReader and Adobe Reader we don't utilise fully, […] instead we use the traditional ways. So, I think that if we had better training of every single feature on the app it would be better.

"[…] So, I would say that training would really be very helpful, because you would get that every time you update the app or every time there's a new function in the app, we can access it more easier and have the knowledge on how to use that specific app, I mean, the functions of the specific e-book."

Interviewees who stated they do not require any training mentioned experience and their generation as the reasons. Many apps offer help and training videos online which users can work through at their own pace without requiring physical intervention by a trainer. At the time of these interviews, no EduReader training videos could be found online, but apps such as Adobe Reader had multiple official and community created tutorials.

"No because our generation has grown up with technology. And you have access to YouTube videos and so forth, so you can learn about the devices that we have. Its self-teaching basically."

One interviewee complimented to intuitive UI and ease of use and provided this as the reason that she does not require training.

"Not really. But we don't need to because the interface that they provide us with is very good. It's not anything overly complicated […]"

What functionality would you add to the e-reader?

14 out of 15 interviewees answered this question. Although the EduReader application enabled note taking within e-books, several interviewees stated that a better note taking functionality is needed. The app allows learners to create a note on a selection of text and then appends that note to the right-hand margin of the book. The margin is hidden by default and learners need to slide it open to be able to see their notes. Interviewees stated that they would like to have the notes visible, in the correct place on the page they made the note.

"[…] The notes are in a subsection, you will get your note, but I personally think the notes should be a physical note where you can look at it where you wrote it down and make it, hide it if you don't want it or you know […]"

"[…] You can make notes while typing but then making notes with maybe a pen function where you can draw around and on the textbook. Like if you had a physical textbook, in your book you would write down whatever you are figuring out or the calculation or whatever […]"

Interviewees further required an assessment functionality in the e-reader. These activities should automatically mark themselves and give real-time feedback to the learners. These activities should be in line with the content and answers to the activities should be visible on the page, similar to the notes discussed earlier in this question.

"[...] So you can, if you want to answer the activity in the book, and you put the correction of the activity, you can write it down there and you can see the answer versus the question. If you want to go over the activity yourself, you can hide it, so you don't see it."

"To do activities on the tablet and then it marks it for us it would be very useful. And then it can give us tips and tricks and stuff like that. It would teach us more effectively, so it gives a description of what to do and then it gives an example. I would say if it could explain more and more examples and stuff like that would more effective I would say. If it can help us with activities as well."

Are there any errors in the e-reader that you regularly experience?

All interviewees answered this question. Navigation functionality is one of the features that interviewees listed as an advantage e-books hold over printed books. Scrolling or changing pages too fast, however, causes issues in the e-reader with many interviewees mentioning that the app crashes during these actions.

"It's just sometimes when you go to fast to other pages, it gets stuck, but then you go out and swipe it and go back in […]"

For some respondents, this also resulted in the loss of annotations which they have made in their current study session, which in turn means they have to redo the section.

"[…] I would be scrolling up and then it would just freeze and say "EduReader has unfortunately stopped." When I go back in, all the stuff that I highlighted has been erased. So now I have to do my studies again, which wastes time."

Additional resources pushed by the educator does not always reach the recipient. One interviewee noted that this problem may possibly not lie with the e-reader but with the network infrastructure at the school. Although there is no clarity over where the issues

originate from, learners have the expectation that resources pushed to their e-book by the educator should appear in a timely manner. When this does not happen, it creates the perception of a “glitch” in the e-book reader.

> *“[…] When the teacher sends us resources, so when they send us our tasks, our newspaper or answers for an activity and you cannot receive it, that happens a lot. I don't know why, they say it's a wi-fi problem, but it’s been happening since grade 4 […]”*

In an effort to enable offline learning, all resources and e-books are stored on the device by the EduReader application. While this assists learners, who do not have connectivity at home and therefore cannot access resources from home, it creates a problem with device storage. Older devices, especially, has limited storage, and without the ability to remove old resources, learners cannot download any new resources.

> *“[…] I would say that the resources, because you'd find that sometimes there are too many resources and then your tablet or your phone runs out of space. So, it makes it hard to access other new resources, because the old ones are still there. At the moment they can't take them out of the e-book. So, you find that sometimes you have a problem with space and you have to delete your personal stuff and other things in order to get your new resources.”*

Updates to the application, which is intended to rectify issues learners experience was also mentioned by the interviewees as a potential issue. Three interviewees mentioned the issues related to updates, with one respondent mentioning that only the latest version of the app can correctly receive resources and content from educators.

> *“[…] It will receive your resources if your software is the latest version that the device can get and the latest version of the app. There should be some sort of 2 to 3-week leeway for the app and software to be upgraded before you cannot receive anything before that.”*

4.5 TASK CHARACTERISTICS OF AN E-BOOK READER IN AN EDUCATIONAL ENVIRONMENT

Based on the interview questions discussed above, a number of task characteristics were identified. These task characteristics were not listed in a single interview question and many of the characteristics came forward as part of discussions on other topics regarding the e-book reader. As discussed in chapter 2, this is an advantage of determining task characteristics from qualitative data, rather than quantitative, where the number of tasks identified would have been limited.

Making Annotations

Interviewees listed “looking over the notes” and making notes as some of the typical daily tasks they execute with the e-book reader. The notes are then backed up and “allows you to keep your notes everywhere, so if your book is lost for whatever reason, you still have your notes”. Interviewees expected the e-book reader to “make it easier to make notes” and the functionality to be available at all times.

There is still room for improvement, however, as discussed earlier in this chapter, the notes are saved as typed text in the margin of the e-book, which is a problem for some interviewees. Interviewees would have liked “making notes with maybe a pen function where you can draw around and on the text itself” and “to be able to make a sticky note and then choose whether to have it displayed or not”.

Creating Highlights

Interviewees mentioned highlighting as one of the major functionalities that e-books offer which improves their learning experience. One interviewee commented on the e-book highlighting functionality which allows for multiple colours that “I love having colour in my books. It helps me learn.”. Highlighting in e-books has its advantages over its printed counterparts, especially when a user “highlights something accidentally in the e-book”, as “you can erase it”.

Interviewees who didn’t make use of the highlighting functionality mentioned stability as a concern where “sometimes you find that if you highlight something or you underline something it just disappears”. When highlights disappear, it defeats the purpose of the easier recall discussed above.

It is worth mentioning that the use of highlights is dependent on the user. Some interviewees enjoy the ability to “highlight certain keywords” as I “don't have to waste my time studying with pen and page and writing everything”. Other interviewees would when they “get back home … write everything down, where instead of highlighting” they would “just write it down”.

Reading Aloud

The EduReader application does not have any form of read aloud support and this was not mentioned by interviewees as a task they expect e-readers to be able to execute. One interviewee requested read aloud functionality as the feature she would add to the e-reader as it will allow her to “make physical notes while listening to (my) textbooks”. The lack of interest in the read aloud functionality may be related to the lack of exposure to this functionality due to the feature not being implemented in the EduReader, and it being the only e-reader used by the majority of interviewees. The interviewee who requesting this feature is one of only a few interviewees that has experience with other e-readers, in this case, the Amazon Kindle application.

Additional Resources

In the interviews, interviewees identified the purpose of additional resources and mentioned that “teachers are also able to send you things that you need that is not in the book”. The additional resources assisted in filling the gaps in the learner’s knowledge where educators “send us presentations and extra notes when we don't understand it”.

The delivery of these additional resources can add strain to the institution’s network infrastructure where a sudden increase in traffic can cause sluggishness and slow delivery times. Interviewees found it problematic when an educator “send us our tasks, our newspaper or answers for an activity and you cannot receive it” and when the e-book reader “doesn't receive your resources the first time”. It was not possible to determine the exact cause of the resource delivery problems from the interviews as further investigation will require technical expertise. It is problematic, however, that functionality intended to ease a burden on learners is causing issues for the learners.

Navigation

Navigating an e-book can be cumbersome to a user if the e-book does not offer the ability to browse content, where browsing means to quickly skim through the book to find the content the user needs (Browne and Coe, 2012). To make up for this lack of functionality, e-book readers offer the user additional functionality to aid in navigation. A well-structured table of contents with working hyperlinks to the correct section in the book “allows you to go through all of the things in the textbook” and enables the user to “just click on the option and it takes you directly to what you want to do”. An e-book usability study targeting medical

academics in Australia stated that academics consider index and contents page browsing some of the most important functionalities of an e-book (Wilson, D'Ambra and Drummond, 2014). Interviewees did not mention any negative aspects towards the table of contents navigation of the EduReader and complimented "the chapters listed on the slide to the left of the tablet".

Page numbers have traditionally been a problem in e-books, especially reflowable EPUB e-books (Browne and Coe, 2012), as discussed earlier in this chapter, the EduReader attempts to solve this by linking page numbers to anchors within the e-book content. The functionality included by the EduReader makes navigating through the e-book using page numbers easy and interviewees commended the ability to just "type a number of the page". "You don't have to swipe through, or page through to find a page".

Although the actual navigation functionality elicited positive responses from interviewees, the inaccuracies of the page numbers swayed the general perception of page numbers to be negative. One interviewee commented that: "The pages are inaccurate compared to the physical book, so that creates a conflict because the teachers often use physical books". Although inaccurate page numbers are in many cases introduced by the publisher, and the e-book reader only uses the structure given to it, the learners are not aware of this. In their eyes this is a flaw of the e-book reader, and inaccuracies are directly linked to the page number selector as another interviewee explained: "I would say that the digital page number, the slider at the bottom where you pick a page, it doesn't always correspond to the actual page number that's on the bottom of the physical textbook."

Dictionary

The EduReader offers two types of dictionary integration within the e-books. Firstly, it provides learners with the native platform dictionary discussed above. This was favourable to the interviewees as "you can also directly click on a definition of the word. It gives you direct access and it's quick." This functionality is similar to the web browser functionality shown in **Figure 10**.

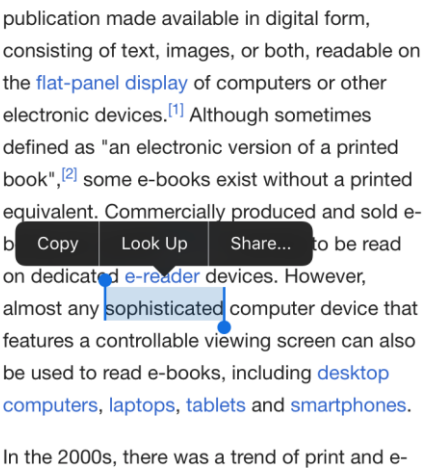

Figure 10 - Dictionary option in a mobile web browser

Secondly, the EduReader offers the Pharos Online dictionary. This is a subscription service, to which all schools that were included in the interview sample, subscribed to. The Pharos dictionary can be considered a specialised dictionary as it offers translations and context aware definitions in all South Africa's official languages, not only in English. This enables non-English learners to learn new vocabulary while using the e-book reader. Unfortunately, the Pharos dictionary is not embedded within the e-book reading applications and learners need the Pharos dictionary to "give us a link basically, then we can go to a website", where they need to search for the word they need a definition or description of.

Searching

At the time of the interviews full text search was a newly released feature of the EduReader, and only one interviewee had experience using it. The feature seemed to be well received with the interviewee stating that "there's a lovely little search function so if I'm looking for one specific thing in the book I don't have to flip through pages and pages looking for it".

Full text search can be cumbersome in many ways, especially when a user only wants to preview the search result. E-book readers should allow the user to jump from one search result to the next, without having to re-enter the search term and start the search over again (Browne and Coe, 2012).

Full text searching is though not the only search functionality necessary in e-book readers, especially when used in an educational environment. Index and content searching are also used to quickly find a topic or chapter within the contents page which allows the user faster

navigation to the correct content. The EduReader offers this functionality, but it was not mentioned by any of the interviewees. One possible reason for this could be the time of year in which the interviews were held. Learners did not yet have the need to cross-search within the textbook while studying for the exams and were only following the chapters chronologically as they worked through the term's content.

Assessments and Activities

In the printed textbook environment activities or assessments are normally completed in an additional workbook or notebook as printed textbooks are owned by the school and given back at the end of the year. E-books offer students the ability to complete activities such as these in their books with no fear of damaging the textbook. "Answering the questions using the textbook" was one of the common daily tasks mentioned by interviewees.

Another advantage of e-books is the shorter feedback loop which reduces the time within which a learner gets feedback on her assessment. Except for essay type questions, most question types can be marked by the e-reader and feedback can be provided. Although the EduReader platform offers this functionality, interviewees still requested that if they could "do activities on the tablet and then it marks it for us, it would be very useful". The reason for the lack of self-marking assessments might be due to the way in which it was implemented. Currently, educators need to use the educator companion tool to create assessments and deliver it to the EduReader application. This can add an extra workload and onto the educator who is already constrained by time. When an educator does though create assessments, it is well received: "If teachers push homework, then I complete the homework on it".

Textbook publishers already have an intimate knowledge of the curriculum and textbooks should come equipped with relevant activities and assessments, built for the digital environment. Interviewees were clear in their needs for such a feature, to use it both for revision and assessment: "if you want to answer the activity in the book, you can write it down there and you can see the answer versus the question… if you want to go over the activity yourself, you can hide it, so you don't see it".

Making Summaries

Creating electronic summaries from annotations in the e-book has not been discussed in previous literature. Making summaries is a well-used studying tool used extensively while studying using both e-books and printed textbooks. While making highlights and notes are tools offered by e-book readers for educational use, these features are just as commonly used for non-educational purposes such as highlighting an inspirational quote in a biography or making a to-do list in a self-help book.

The electronic summary functionality of the EduReader summarises these highlights and annotations for educational use. Although summaries are not a common feature in e-book readers, interviewees saw the value of it with one interviewee commenting that “the way that you can sum up all your work on one small thing… that makes everything easier.” Although summaries are generated from highlighted content and annotations, interviewees expected the behaviour of this functionality to be a bit different: “So I would add it in such a way that it's available for all textbooks and not highlight it but copy the text” and “The only thing that would be nice is if we were to be able to copy like specific parts of the books, just so we can create summaries for ourselves”. It was not clear from the responses whether the interviewees would prefer to rather use another application such as a word processor to create the summaries, but being able to copy large parts of the textbook may have certain legal implications with one interviewee realising “we are not allowed to because it's got copyright”.

Referencing

Internal referencing has not been given much attention by the EduReader application, with simple functionality such as bookmarks not present. This functionality is an important factor for the academic use of e-books (Wilson, D’Ambra and Drummond, 2014) but the functionality was less mentioned by interviewees, suggesting that it is not such an important feature for the school level use of e-books. One interviewee mentioned that the e-book “has a glossary so if I don't know a word, I can quickly go to the glossary and figure out stuff”.

External referencing was widely used by the interviewees and learners would “sometimes use the Internet because my e-book reader would not have the complete information that I’m looking for. So, I'd usually just go onto the Internet and when I get the relevant information I'd go back to my e-book to access the questions”. The clear advantage e-books hold over

printed textbooks is the time it takes to do external referencing. There is no need to visit the library to find the texts a learner is looking for, and learners can access the external information from the same device the e-book is read on.

“I prefer to use physical textbooks, but at school it's much easier to use the e-book and the various technologies because you can use Google and use the resources”. Google was the only service specifically mentioned by interviewees for referencing use and interviewees frequently swapped between the e-book reader and Google while working in their e-book. This adds the opportunity for e-book readers to have better integration with Google search services, much like the dictionary integration shown in **Figure 9** earlier in this chapter. It is worthwhile to note, that most of the schools where learners were interviewed do not have full Internet access and learners accessing services such as Google “have to use 3G, as the wi-fi outside doesn't give access to that”.

Recording Voice Notes

To make up for the inability of electronic textbooks to be laid out across a table and seen as a big picture, interviewees use other features of the devices. Voice recordings offer learners an additional layer of note taking which can be played back while studying or revising for a test. “I memorise it and repeat what I learn. I record it, so when I'm at school, I listen to it on my earphones and then it just goes through my head”. Recording the notes, a learner repeats to herself is much quicker than typing the notes using a tablet and is not limiting in terms of physical space as another interviewee mentioned that “you can make voice notes and you can listen to them anywhere”.

4.6 INDIVIDUAL CHARACTERISTICS OF EDUCATIONAL E-BOOK USERS

Individuals are the learners who use e-books in an educational environment to improve their performance. The fit of a technology to a given task will be influenced by certain individual characteristics such as prior training, time spent using the system, experience in other systems and motivation (Goodhue and Thompson, 1995). Technology can in some cases have the perfect fit to the task but if the user does not know or understand how to use it, then the perceived fit will be very low.

As discussed in chapter 3, the sampling method used to select interviewees excluded learners that did not have prior experience with the EduReader application. The results of

the interviews showed that even though learners that took part in the interview process had prior experience with the e-book reader, their individual characteristics still had an influence on their perceived fit of the e-reader.

Four of the interview questions were structured to elicit personal characteristics from interviewees. The first personal question was on the interviewees' home language. As indicated earlier in this chapter, it was assumed that non-English home language interviewees would perceive a lower TTF than English home language interviewees. This was however not the case.

In the second personal question the interviewees were prompted to give more details about their use of e-books outside the educational environment, i.e. for recreational purposes. The results show that interviewees who used e-book readers for recreational use had a better understanding of the more complex technology characteristics of the e-reader. One interviewee stated that "I use electronic books, like you get a physical book and I got a digital copy which I use" and later showed a better understanding of the highlighting functionality on the e-book reader, stating "I mean if you are normally highlighting on a page you can't take it back. But if you highlight something accidentally in the e-book, you can erase it".

The third personal question was on the number of times interviewees used the e-book reader per day. Interviewees were asked a ballpark figure on the daily time they spend using the e-book reader, split up between home and school usage per hour. Most of the interviewees spent many hours per day, which could be expected due to the EduReader reader containing their compulsory textbooks at schools. Interviewees with lower e-reader usage time also seemed to make less use of the technology in general. One of the interviewees stated that the hours spent using the app was "not even one, because homework probably takes me only 45 minutes". This same interviewee stated "I don't highlight, because I write down all the stuff from the textbook then highlight. I don't highlight on the app".

The fourth and last personal question explored individual training, with the assumption that interviewees who received previous training on the use of e-book readers would, in general, have a better perceived fit of the e-reader. In one such case an interviewee responded with "yes because a lot of the things that are on the tablet, we don't really know what it's for", when asked if training will improve her experience on the e-book reader. This interviewee

also stated that “I don't really highlight or make notes”, when asked about the highlighting and note making functions of the e-reader, which are considered to be the two highest task requirements of educational e-book usage.

4.7 A QUALITATIVE MODEL FOR DETERMINING TASK-TECHNOLOGY FIT

According to the TTF model, for a technology to be effective, it should be accepted willingly and should fit the tasks that users need to complete (Goodhue and Thompson, 1995).

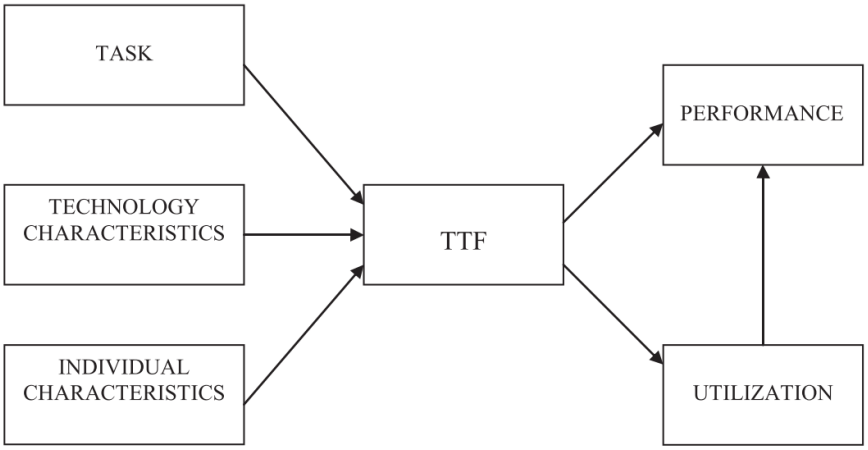

Figure 11 - TPC for e-book usage (Wilson, D’Ambra and Drummond, 2014)

Figure 11 shows a technology-to-performance chain (TPC) used in a study on e-book usage by Australian medical academics (Wilson, D’Ambra and Drummond, 2014). The TPC shown in **Figure 11** was used to determine the utilisation and performance from quantitative data as the TPC suggests. **Figure 12** shows a TPC that does not include the performance construct and which was used by Ip and Fun (2005) to determine the TTF of weblog technologies.

The purpose of this dissertation is not to prove that TTF leads to improved performance, as factors outside the scope of this study could also have a great influence on learner performance and the data gathered in this study will not allow an accurate reflection of performance improvements. For this reason, TTF will be discussed only as a precursor to utilisation and the effects of fit on utilisation will be presented.

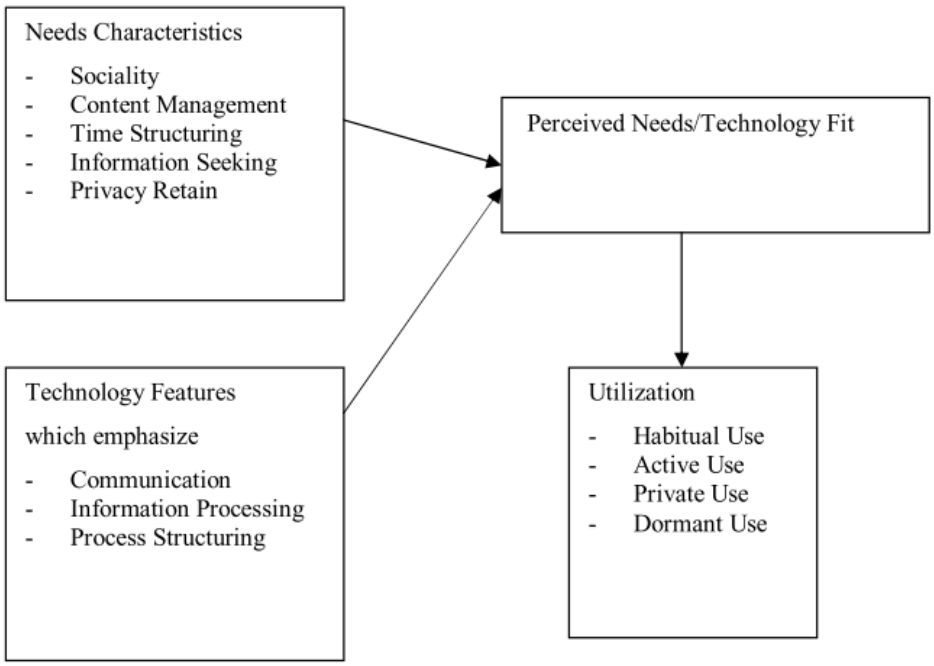

Figure 12 - TPC without performance (Ip and Fun, 2005)

The task requirements for e-book readers in an educational environment were identified earlier in this chapter. Eleven tasks were identified. These include:

1. Making annotations
2. Creating highlights
3. Reading aloud
4. Additional resources
5. Navigation
6. Dictionary
7. Searching
8. Assessments and activities
9. Making summaries
10. Referencing
11. Recording voice notes

The technology characteristics of e-readers were also discussed earlier in this chapter. The table below matches the required tasks of e-readers with the required technological characteristics as were identified in the interviews described earlier in this chapter.

EduReader required tasks	*EduReader current technological characteristics*	*The **gap** in EduReader technological characteristics*
1. Making annotations	• Notes and sketches in the margin	• Inline notes and sketches • Able to see notes on text while working through the book
2. Creating highlights	• Multi-colour highlight creation • Backing up of highlights	
3. Reading aloud	• Basic read aloud when enabled by the device	• Should work for all e-book formats • Media overlay support • "Follow" as you read by highlighting read words.
4. Additional resources	• Learners can receive additional resources uploaded by the educator • Learners can upload their own resources to EduReader	
5. Navigation	• Page number picker • Table of Contents navigation • Internal hyperlinks • Next and previous page buttons	• Accurate printed book page numbers
6. Dictionary	• Device default dictionary • Pharos dictionary as an external application	• Built in contextual dictionary support
7. Searching	• Full text searching • Navigation searching	
8. Assessments and activities	• Assessments as additional resources	• Inline assessments • Activities where the learner can enter answers to assessments and save it in the e-book
9. Making summaries	• Automatic summaries generated from highlights	• Manual summary creation by copying text
10. Referencing		• Referencing tools such as Web Search • Reference generation
11. Recording voice notes		• Voice note recording functionality

Table 3 - EduReader TTF

The task characteristics and technology requirements identified by the data collection instrument developed in chapter 3 are summarised in **Table 3** above. These characteristics and requirements can be used in the TPC framework to determine the task-technology fit of a given e-book reader in the South African secondary education environment. The technology characteristics are based on that of the EduReader e-book reader alone and is not intended to be generalised for all e-book readers currently used in the South African educational space. Researchers who have identified other requirements or characteristics can add to this list to create their own set of variables for the TPC framework. **Figure 13**

shows the TTF section with TTF as a precursor to utilisation with the variables in the corresponding components.

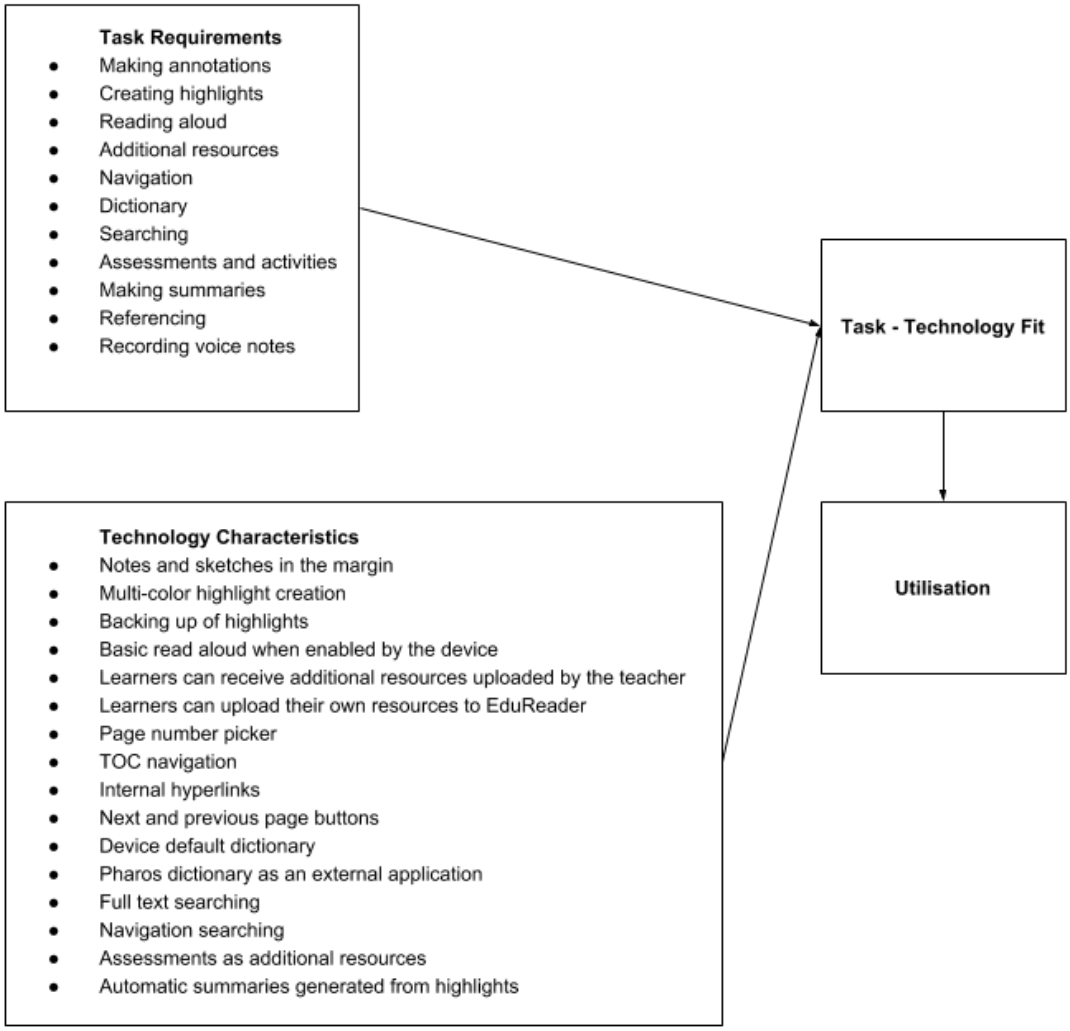

Figure 13 - TTF for e-books in South African Secondary Schools

4.8 E-BOOK READER DESIGN GUIDELINES FOR FIT

Taking the components listed in **Figure 13** into consideration, it is possible to provide a set of guidelines for e-book reader developers to ensure the app they are developing delivers a good fit to the task requirements of users. **Table 4** presents a set of e-book reader developers' guidelines. The guidelines are formulated as a set of statements representing the characteristics of the educational tasks which need to be supported by the technology (the e-book reader application) to a achieve a good fit between the tasks and the technology. The task category describes the type of task as discussed in section 2.6 of chapter 2.

E-Book Reader Tasks	Task Category	True	False
Making Annotations			
1. Users can make textual annotations in their e-books.	Metacognitive		
2. Users can make freehand (drawing) annotations in their e-books.	Metacognitive		
3. Annotations are synced across all devices the user is signed in to.	Metacognitive		
4. User annotations are visible while browsing the e-book.	Metacognitive		
Creating Highlights			
5. Users can create highlights in their e-books.	Metacognitive		
6. Users can create highlights in multiple colours in their e-books.	Metacognitive		
7. Users can erase highlights made in their e-books.	Metacognitive		
Reading Aloud			
8. The e-reader can read sections of the book aloud.	Metacognitive		
Additional Resources			
9. Educators can share additional content with users in a specific location of the e-book.	Metacognitive		
10. Users are notified when new content has been shared with them by the educator.	Metacognitive		
11. Users can copy text and images from the textbook to use in other applications such as word processors.	Metacognitive		
Navigation			
12. The e-reader offers TOC navigation.	Metacognitive		
13. The e-reader supports page numbers and users can navigate using page numbers.	Metacognitive		
Dictionary			
14. Users can look up the definition of a word without the need to use another application.	Metacognitive		
15. Users can define a word quickly by selecting the word in text and tapping define.	Metacognitive		
16. Definitions provided by the dictionary are context and region dependent.	Metacognitive		
Searching			
17. The e-reader has an in-book search functionality that performs a full text search across all the pages of the book.	Metacognitive		
18. Users can search within the TOC to filter sections within the e-book that does not match the search phrase.	Metacognitive		
19. Users can search application wide within the e-reader to find books and content that matches the search phrase.	Metacognitive		
Assessments and Activities			
20. The e-reader offers the ability for users to complete assessments within the application.	Cognitive		
21. The assessments in the e-book have a self-marking functionality to provide real-time feedback on student answers.	Cognitive		
22. The e-reader supports common learning object formats which allow e-book publishers to add their own in-line assessments to e-books.	Cognitive		

23. Educators can provide assessment feedback to users and the feedback is delivered by the e-reader.	Cognitive		
Making Summaries			
24. The e-book reader can create summaries based on the user's annotations and highlights.	Cognitive		
25. Users can edit these summaries after summary generation to add additional notes and content.	Cognitive		
26. The summaries are correctly formatted and readable within the e-reader.	Cognitive		
27. The summaries are printable by the user.	Cognitive		
Referencing			
28. Users can use external search tools such as Google Scholar within the e-book reader.	Metacognitive		
29. Users can generate references from the e-book they are working with to use in assignments.	Metacognitive		
Recording Voice Notes			
30. Voice notes can be created by the user and added to sections of the e-book.	Cognitive		

Table 4 – A set of development guidelines for e-book reader developers

4.9 CONCLUSION

This chapter presented the task and technology characteristics as identified by the data collection instruments. Task and individual characteristics were analysed from coded interview data which was then further discussed by referring to existing literature. The technology characteristics of the EduReader were discussed as a case study.

The interview questions and responses from interviewees were analysed and a set of code categories were identified to label the various task requirements in the response data set. For each interview question, a summary of the responses was provided. Individual characteristics identified in the interview process were also discussed in this chapter.

A sample TTF model was presented for e-book readers in the South African secondary school context. Along with this model, a set of guidelines for e-book reader developers/designers was presented in the form of a true/false statement list. This list could be used by e-reader developers to ensure that the functionalities of the applications they develop will fit the task requirements of the learners for whom they develop it.

CHAPTER 5: CONCLUSION

5.1 INTRODUCTION

In chapter 1 the need for a model to determine the utilisation of e-book readers in the South African secondary education environment was identified. The majority of research on the subject had been done on the academic or librarian use of e-books which, although similar in nature, has different tasks and individuals who execute these tasks.

In order to gain a better understanding of e-book utilisation in this specific environment and to determine whether or not current technology applications address the task requirements, the task-technology fit framework was chosen as the theoretical framework. The TTF framework was introduced by Goodhue (1995) and sets out to determine the correspondence between task requirements, technology characteristics and individual characteristics.

The task and technology characteristics used in the TTF Framework for this research differs from previous studies done on this topic. This is due to the variances in environments and the implementation of e-books at the various institutions. Previous studies focused on the statistical analysis of the TTF framework to determine fit as a quantifiable entity. These studies did not provide many details on how they determined the characteristics used within the TTF framework. This research focused on the data collection and analysis that needs to happen before the statistical analysis of the framework is done, namely determining the correct task and technology characteristics to be used in the model.

The research questions for this study was set out in chapter one. These questions will accordingly be answered in this chapter, after which the findings and conclusions of this dissertation will be presented. Finally, the contributions of this study will be discussed and possible avenues for future research will be elaborated on.

5.2 SUMMARY OF FINDINGS

There is a need for a set of required technology characteristics for e-reader developers/ designers which focusses on the educational tasks which learners have to use them for. This will ensure the product they develop has high utilisation. This level of utilisation can be

achieved by ensuring the technology applications they develop fit the task requirements of the ebook-readers.

The task-technology fit (TTF) theory offers a well-established framework for determining the fit between technology characteristics and task requirements and forms part of the technology-to-performance toolchain (TPC) presented by Goodhue and Thompson (1995). The TPC suggests that fit can be considered a precursor to utilisation and plays a signification role in whether an information system will be used.

As the task requirements of e-reader users in South African secondary schools has not been established in literature, a qualitative approach was followed to determine the requirements. Interviews were chosen as the primary data collection instrument. Purposeful and convenience sampling was used to identify a subset of the population that were able to assist the researcher in achieving the research objective, but who were also geographically located close enough to the research so appointments could be scheduled without disrupting school days.

A case study of the EduReader, a popular South African e-reader used in secondary schools, was presented to highlight the current technology characteristics of this e-reader. The e-reader presented several functions such as summary generation and additional resources which recreational e-readers do not have.

The interview data and the case study identified task requirements of secondary school learners and technology characteristics of the EduReader e-reader. Individual characteristics were identified from the interview data by using descriptive coding. Although not needed for the model proposed in chapter 4, individual characteristics will be needed should performance impact be measured by using TTF. Typical individual characteristics included the interviewee's previous experience or training with e-book readers or their daily use of the device for other educational tasks as these may influence their performance while using e-books.

Task requirements were identified from interview transcripts by process and descriptive coding across the data set. The resulting model showed a set of technology characteristics

of the EduReader e-reader and the task requirements of its users as well as the gaps in the e-book reader's technology characteristics.

A sample TPC incorporating the above technology characteristics and task requirements was presented to illustrate the role of these components as a precursor of the e-readers utilisation in a secondary educational environment. For e-book reader developers and designers, a set of guidelines in the form of statements to be answered true or false was presented.

5.3 CONCLUSIONS

In this section, the research questions listed in chapter 1 will be answered by discussing the findings of the research sub questions first and secondly proposing an answer to the main research question. The research questions in chapter 1 were listed as follow:

- Sub question 1: What are the task characteristics of an e-book reader in the South African secondary school environment?
- Sub question 2: What are the technology characteristics of an e-book reader in the South African secondary school environment?
- Sub question 3: What guidelines should developers follow to create e-book readers that are fit for the South African secondary school environment?
- Main research question: How can a fit between the task and technological characteristics of e-book readers be assured in the South African secondary school environment?

What are the task characteristics of an e-book reader in the South African secondary school environment?

In chapter 2 the task characteristics of e-books in the educational environment were discussed. It was clear from the existing body of research that very little research was done on utilisation and fit in the secondary school educational environment and no research on this was found representing the South African perspective. Task characteristics in the existing body of research were identified and were very similar to that of recreational reading. Highlighting, annotations, search and read-aloud functionality we're common tasks identified in existing literature. Due to the limited number of studies done on e-book fit in the

educational environment, literature from usability studies was also discussed as task characteristics were mentioned indirectly in these articles.

A data collection instrument in the form of semi-structured interviews was developed to ask students about their daily use of the EduReader application and the expectations they have when using the EduReader application in secondary schools in South Africa. To accurately determine the tasks executed in the secondary educational environment, a set of open ended questions was developed and presented in chapter 3. From the data collected, a set of task characteristics was identified. The data collection instrument also probed interviewees on the amount of time they spend using the EduReader application. By doing this, the fit between task requirements and the technology could be explained as a precursor of utilisation (hours spent using the application) as discussed in the initial TPC model (Goodhue and Thompson, 1995).

Once the data collection was complete the researcher analysed the data using coding. A hybrid coding process comprising of both process and descriptive coding was used to identify task requirements in the data collected and they were labeled using gerunds. The list of codes identified by the coding process can be found in chapter 4.

These tasks included tasks that were identified in chapter 2 but also included new tasks such as completing assessments, generating automatic summaries and receiving additional resources within an e-book. The tasks learners execute daily while using the e-book reader were:

- Making Annotations – taking notes in the e-book in a visible manner so learners can read the notes while studying or working through the book
- Creating Highlights – making highlights while working through the book
- Reading Aloud – read aloud functionality will allow learners to listen to the content of the book while creating summaries or completing activities
- Additional Resources – educators should have the ability to augment the e-book by adding additional resources to the body of the text
- Navigation – a multi-modal approach to navigation should be followed to allow learners to reach their desired location

- Dictionary – a context-based dictionary to define words in an e-book. The dictionary should provide definitions based on the content and grade/subject the book is targeted at
- Searching – searching for words, sections and annotations while working in the e-book
- Assessments and Activities – activities and assessments in the body of the e-book will allow learners to regularly revise content and test their knowledge of a given topic. These activities should provide real-time feedback to the learners
- Making Summaries – highlights and annotations made in the e-book should be summarised automatically by the reader and be printable for learners to use when studying for a test or exam
- Referencing – learners reference websites and external sources when using an e-book. The reader should add the ability to quickly look up words and terms in external sources
- Recording Voice Notes – apart from textual annotations, learners would also like to make audio notes and listen back to the notes while studying or completing activities

Making annotations (Vermunt, 1996; Yang *et al.*, 2011; Dennis *et al.*, 2016), creating highlights (Jamali, Nicholas and Rowlands, 2009; Richardson and Mahmood, 2012; D'Ambra, Wilson and Akter, 2013), reading aloud (Siegenthaler, Wurtz and Groner, 2010), receiving additional resources (McFall, 2005; Abaci, Morrone and Dennis, 2015; Dennis *et al.*, 2016), using the dictionary (Cavanaugh, 2002; Weber and Cavanaugh, 2006; Browne and Coe, 2012), searching (Jou *et al.*, 2016), referencing (Wilson, Landoni and Gibb, 2003) and recording voice notes (Dennis *et al.*, 2016) were all task requirements mentioned by authors in existing literature. Creating automatic summaries from your annotations, highlights and additional content was a new task requirement identified in this dissertation. This functionality is not widely available as it is not a recreational reading tool, but respondents found it very useful in an educational environment.

The tasks identified in chapter 4 should provide e-book reader developers that target the South African secondary education market with clear focus areas to develop to. When new features or functionality is developed, the developers should keep these tasks in mind and address them within the features they develop.

What are the technology characteristics of an e-book reader in the South African secondary school environment?

To determine fit between technology and task characteristics, the research needs to determine the technology characteristics of the e-book reader. For the purpose of this dissertation, the researcher acted as an expert evaluator due to the researcher's background and experience in developing e-book reader technology. Researchers not able to act as expert evaluators can make use of other data collection methods such as interviews or focus groups to determine the technology characteristics of a given e-book reader. In chapter 2 the different e-book formats were discussed as well as the role they play in the user's perception of the e-book reader, after which the target reader for this study, the EduReader application, was reviewed.

Notes, sketches and highlights can be created in both EPUB and PDF-based e-books although the method to create annotations differs between the two formats. Interviewees mentioned that the current method of creating sketches as annotations in the margin of the e-book, as opposed to on the page itself, was a bit cumbersome, especially when retrieving the information from the e-book. Highlighting, as one of the most used functionalities of the e-book reader, was well received by interviewees and the multiple colours and cross-platform syncing of highlights were mentioned as advantages of e-books.

The EduReader application has the functionality to receive additional resources pushed by an educator to the learner within an e-book. As mentioned above and in chapter 4, interviewees mentioned additional resources as a big advantage when using the e-book reader, as these additional resources augment the e-book and fill gaps which would otherwise have been difficult to fill. Other learning platforms offer similar functionality, where educators can upload files and learners can download those files to view later, but the EduReader application eliminates these steps by receiving the additional resources automatically with location-based context.

The highlights and annotations created by the learner in the EduReader application can be included in a summary automatically generated by the e-book reader. This summary combines all notes, sketches and highlights per book which the learner can print or study from. The digital summary is an attempt by the e-book reader in solving the issue of creating summary files when your highlights and annotations are not created on a physical medium

such as the printed textbook. As mentioned in chapter 4, interviewees would have liked to be able to control the content of the summaries even more by copying and pasting text from various sources into the summary file.

The EduReader application offers multiple methods of navigation within an e-book. In chapter 2 a clear distinction was made between searching, browsing and making use of indexes. The EduReader has full text searching built in for both PDF and EPUB format e-books and users can navigate these books through a table of contents, page numbers or by scrolling. Indexes are dependent on the publisher of a given e-book and these are not always present.

Not many studies make the clear distinction between EPUB and PDF and simply refer to e-books. Due to differences in these formats, it is important to mention the functionality available for each format and to not generalise functionality as this may exclude some e-books. The technology characteristics identified by the data collection instrument correspond closely with that of existing literature with functionality such as highlighting and annotations (Lim and Hew, 2014; Abaci, Morrone and Dennis, 2015), improved navigation (Wilson and Landoni, 2003; Browne and Coe, 2012)and accessibility options (Rao, 2003) being common functionality.

The technology characteristics described above are specific to the EduReader application and should not be generalised to all e-book readers. As discussed in chapter 2, multiple studies have been done on e-books in other environments and various other technology characteristics have been identified. To accurately determine how fit is ascertained between the technology and task characteristics, the set of technology characteristics of the EduReader was used to populate the model presented in chapter 4.

What guidelines should developers follow to create e-book readers that are fit for the South African secondary school environment?

When technology meets the task requirements which an individual has, the technology will be utilised and performance impacts will occur (Cane and McCarthy, 2009). Chapter 2 discussed the role the TTF framework plays in determining fit and how the use of an

information system will be high if the task fit for that system is high (Goodhue and Thompson, 1995).

Information system developers should keep the above in mind when developing a system such as an e-book reader. A better fit between the technology and the task requirements will increase the utilisation of the information system and lead to greater performance impacts. One way of achieving a higher fit is to identify the task requirements by making use of the methodology set out in chapter 3. Once the task requirements are identified, the TTF framework can be used to determine the fit of the information system. This will lead to informed decisions when developing new functionality.

A gap analysis of the EduReader's fit was presented alongside a technology-to-performance model in chapter 4 to show how fit between the task requirements and technology characteristics can be considered a precursor of utilisation. This TPC model and gap analysis can be used as guidelines when developing an e-book reader application to ensure all task requirements are considered.

To add a practical approach to the TPC model discussed above, a set of guidelines in the form of true/false statements for e-book reader application developers targeting the secondary educational environment in South Africa was developed. The list of 30 statements is presented in chapter 4 and covers the task requirements discussed in chapter 4 and the first sub research question. Each of the statements provided in the developer guidelines was categorised as a cognitive or metacognitive task, the two task categories presented in chapter 2.

How can a fit between the task requirements and technological characteristics of e-book readers be assured in the South African secondary school environment?

In chapter 2 tasks were defined as "the actions carried out by individuals in turning inputs into outputs" (Goodhue and Thompson, 1995:216), while technology was defined as the tools these individuals use to complete these actions (D'Ambra and Rice, 2001) and fit was defined as the ability for a technology to support a task (Dishaw and Strong, 1998). As a precursor to utilisation, the fit between the task requirements and the technology characteristics is an important factor to take into consideration when designing and developing an e-book reader.

Developers of e-book readers need to take certain steps to assure that the e-book reader application they develop fits the task requirements of the individuals that will use the e-book reader.

Firstly, an accurate set of task requirements should be gathered from users. This dissertation presented a set of task requirements in chapter 4 that was identified by means of a qualitative data collection instrument in the form of semi-structured interviews. These focussed on the use of e-book readers in secondary schools within South Africa and may not necessarily match the task needs of other regions and age groups.

Secondly, the technology characteristics of the e-book reader need to be identified. For the purpose of this dissertation, the researcher played the role of an expert evaluator and identified a set of technology characteristics by evaluating the EduReader e-book application and by exploring technology characteristics of e-book readers found in existing literature.

Finally, the task requirements and technology characteristics were evaluated and presented in the form of a fit construct taken from the TTF framework. As a result of this, a set of guidelines in the form of true/false statements and a technology-to-performance toolchain model was presented to show the relationship between the task requirements and technology characteristics.

A previous study exploring the fit between e-book readers and the task requirements of academics in Australia identified three dimensions of task requirements (D'Ambra, Wilson and Akter, 2013). Users interact with the text (e-book) within the annotation dimension and these tasks typically include highlights, annotations and bookmarking. In the navigation dimension tasks are identified that assist users in navigating through a book in a non-linear fashion. These include using the table of contents or searching for text. The output dimension refers to tasks that allows the user to get the content from the text in another modality such as reading aloud. Although this dissertation only focusses on the South African secondary education environment, the dimensions identified by D'Ambra, Wilson and Akter (2013) are also catered for in the development guidelines presented in chapter 4.

Developers have the opportunity to develop an e-book reader application with the guidelines presented in chapter 4 in mind. Doing this will ensure the task requirements of users in South

African secondary schools are taken into consideration and the resulting application (technology characteristics) will have a higher fit with these requirements.

5.4 SUMMARY OF CONTRIBUTIONS

Theoretical Contribution

This dissertation applied the TTF framework to determine the influence of fit on the utilisation of e-book readers in secondary schools in South Africa. In order to determine the task requirements and technology characteristics that make up the components of the TTF theory, qualitative data collection instruments were employed. Qualitative data collection instruments are not commonly used with the TTF theory and the process followed in this dissertation can be of use for researchers aiming at doing the same thing in another context. This is especially useful in cases where the task and technology requirements are not well established beforehand, and the researcher needs to determine these by interacting with the users rather than finding it in existing literature.

A model was presented that shows the fit between task requirements and technology characteristics as a precursor of e-book utilisation in South African secondary schools. This model can be reused by researchers in a generic fashion to determine the task-technology fit of other e-book readers in South African secondary schools.

Practical Contribution

As a practical contribution, this dissertation presented a set of task-technology fit guidelines in the form of true/false statements including the educational task category that the e-book developer/designer can apply when developing an e-book reader for the South African secondary educational sector. The guidelines are categorised per task requirement identified in this dissertation and developers can exclude sections that are not applicable to the application they develop.

The data collection instruments employed for the purposes of this dissertation can also be used in an environment where developers need to gather information regarding the utilisation of their e-reader application. The measure developed can be used in focus groups or user interviews to ensure new features match the task requirements. There is a large number of e-readers available and users are spoilt for choice. E-reader applications that

achieve a higher fit between technology and tasks will be able to gain a larger market share in the educational sector.

5.5 SUGGESTIONS FOR FURTHER RESEARCH

The limitations put in place for the purpose of this dissertation means that the task requirements and technology characteristics identified in the secondary educational environment has not been generalised for other age groups and regions. Future research can be done to validate these claims in other age groups to determine how the task requirements differ and if technology requirements need to be different for different age groups.

Similarly, task requirements may differ between regions. The focus of this dissertation was the South African market. Future research can be done to validate the claims made in this dissertation in other regions as technology and the implementation thereof may differ.

The set of guidelines for developing e-book reader applications presented in chapter 4 could assist developers/designers when developing a new platform to ensure that the reader fits the task requirements of its users. Future research can be done to determine if e-book reader applications that apply these guidelines experience an uptake in utilisation compared to previous releases. This will require analytics on the use of the e-book reader which was not readily available for this dissertation.

Further research can be done on the correct data collection instrument to be used when collecting data for determining task requirements. Although interviews addressed the needs of this dissertation, it could be a cumbersome and sometimes expensive exercise to develop such an instrument and research targeting a larger population may have difficulties using interviews as the primary data collection instrument.

Lastly, more research is needed to compare the TTF theory and other frameworks such as the Technology Acceptance Model in e-book usage. E-books are gaining traction in the market and these well-known theories have proved their worth in other disciplines. The lack of research on the application of the TTF theory to the development of e-book readers points to a clear gap in the literature.

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APPENDICES

APPENDIX A: ETHICAL CLEARANCE

UNIVERSITEIT VAN PRETORIA
UNIVERSITY OF PRETORIA
YUNIBESITHI YA PRETORIA

RESEARCH ETHICS COMMITTEE

Tel: +27 12 420 3395
E-mail: ronel.rensburg@up.ac.za

Faculty of Economic and Management Sciences

13 February 2018

Prof H Gelderblom
Department of Informatics

Dear Professor Gelderblom

The application for ethical clearance for the research project described below served before this committee on 9 February 2018.

Protocol No:	EMS063/17
Principal researcher:	**M Botha**
Research title:	Evaluating the performance impact of e-readers in an educational space: a qualitative study
Student/Staff No:	10144928
Degree:	MCom (Informatics)
Supervisor/Promoter:	Prof H Gelderblom
Department:	Informatics

The decision by the committee is reflected below:

Decision:	Conditionally approved
Conditions (if applicable):	• Permission letter to be obtained from the school principal, as well as signed informed consent from the parent/guardian of learners before any learner may participate in the proposed study.
Period of approval:	February 2018 – January 2019

Please submit proof of compliance with the above-mentioned conditions as soon as possible, to enable final approval for the proposed research. The next meeting of this committee is scheduled for 9 March 2018, but final approval may be considered on an *ad hoc* basis to prevent delays.

Sincerely

pp PROF RS RENSBURG
CHAIR: COMMITTEE FOR RESEARCH ETHICS

cc: Prof C de Villiers
Student Administration

APPENDIX B: PARENTAL CONSENT FORM

UNIVERSITEIT VAN PRETORIA
UNIVERSITY OF PRETORIA
YUNIBESITHI YA PRETORIA

Faculty of Economic and Management Sciences

Department of Informatics

EVALUATING THE PERFORMANCE IMPACT OF E-READERS IN AN EDUCATIONAL SPACE, A QUALITATIVE STUDY

Research conducted by:
Mr. M. Botha (REG0252712 / 9101205023085)
Cell: 071 1714 165

Dear Participant

You are invited to participate in an academic research study conducted by Morne Botha, a Masters student from the Department of Informatics at the University of Pretoria.

The purpose of the study is to determine the performance impact e-readers has in an educational environment.

Please note the following:

- This is an anonymous study and your name will not appear in the interview transcripts. The answers you give will be treated as strictly confidential as you cannot be identified in person based on the answers you give.
- Your participation in this study is very important to us. You may, however, choose not to participate and you may also stop participating at any time without any negative consequences.
- Please answer the questions in the interview as completely and honestly as possible. This should not take more than 40 minutes of your time.
- The results of the study will be used for academic purposes only and may be published in an academic journal. We will provide you with a summary of our findings on request.

- To ensure accurate data, the interview will be recorded and transcribing will take place on the recorded data. The recording will be made available upon request.
- Please contact my study leader, Prof H. Gelderblom at helene.gelderblom@up.ac.za if you have any questions or comments regarding the study.

In research of this nature the study leader may wish to contact respondents to verify the authenticity of data gathered by the researcher. It is understood that any personal contact details that you may provide will be used only for this purpose, and will not compromise your anonymity or the confidentiality of your participation.

Please sign the form to indicate that:

- You have read and understand the information provided above.
- You give your consent to participate in the study on a voluntary basis.

_____ _____

Participant's signature **Date**

_____ _____

Guardian's signature **Date**

APPENDIX C: PRINCIPAL CONSENT FORM

UNIVERSITEIT VAN PRETORIA
UNIVERSITY OF PRETORIA
YUNIBESITHI YA PRETORIA

Faculty of Economic and Management Sciences

Department of Informatics

EVALUATING THE PERFORMANCE IMPACT OF E-READERS IN AN EDUCATIONAL SPACE, A QUALITATIVE STUDY

School Principal Consent Form

I give consent for you to approach learners in Grade 9 & 10 at _____ to participate in the study.

I have read the Project Information Statement explaining the purpose of the research project and understand that:

- The role of the school is voluntary
- I may decide to withdraw the school's participation at any time without penalty
- Grade 10 learners will be invited to participate and that permission will be sought from them and from their parents.
- Only learners who consent and whose parents consent will participate in the project
- All information obtained will be treated in strictest confidence.
- The learners' names will not be used and individual learners will not be identifiable in any written reports about the study.
- The school will not be identifiable in any written reports about the study.
- Participants may withdraw from the study at any time without penalty.
- A report of the findings will be made available to the school.
- I may seek further information on the project from the researcher, Morne Botha on 071 1714 165

_____ _____

Principal **Date**

APPENDIX D: PRINCIPAL INFORMATION FORM

UNIVERSITEIT VAN PRETORIA
UNIVERSITY OF PRETORIA
YUNIBESITHI YA PRETORIA
Faculty of Economic and Management Sciences

Department of Informatics

EVALUATING THE PERFORMANCE IMPACT OF E-READERS IN AN EDUCATIONAL SPACE, A QUALITATIVE STUDY

Research conducted by:
Mr. M. Botha (REG0252712 / 9101205023085)
Cell: 071 1714 165

Dear [Principal]

My name is Morne Botha, and I am a Master's student at the University of Pretoria. I am conducting research on the usability of e-book readers in an educational environment under the supervision of Prof. Helene Gelderblom, also of the University of Pretoria. I invite you to consider taking part in this research. This study will meet the requirements of the Research Ethics Committee of the University of Pretoria.

Aims of the Research

The research aims to:

- Determine the task characteristics related to e-book reader use in an educational environment.
- Determine the technology characteristics of an e-book reader in an educational environment.
- Determine if current e-book readers can complete the tasks as required in an educational environment.

Research Plan and Method

Data will be collected by means of semi-structured interviews with a maximum of 5 learners per school. The interviews will take about 40 minutes and will be transcribed by an external contractor. More details on the interview questions can be found in the attached interview guide. Permission will be sought from the learners and their parents prior to their

participation in the research. Only those who consent and whose parents consent will participate. The interviews will be conducted by myself, at the school. All information collected will be treated in strictest confidence and neither the school nor individual learners will be identifiable in any reports that are written. Participants may withdraw from the study at any time without penalty. The role of the school is voluntary and the School Principal may decide to withdraw the school's participation at any time without penalty.

School Involvement

Once I have received your consent to approach learners to participate in the study, I will:

- arrange for informed consent to be obtained from participants' parents
- arrange a time with your school for data collection to take place
- obtain informed consent from participants

Attached for your information are copies of the Parental Consent Form and the Interview Guide. Please contact my study leader, Prof H. Gelderblom at helene.gelderblom@up.ac.za if you have any questions or comments regarding the study.

Invitation to Participate

If you would like your school to participate in this research, please complete and return the attached School Principal Consent Form.

Thank you for taking the time to read this information.

APPENDIX E: INTERVIEW GUIDE

EVALUATING THE PERFORMANCE IMPACT OF E-READERS IN AN EDUCATIONAL SPACE, A QUALITATIVE STUDY

Script

Welcome and thank you for your participation in this study. My name is Morne Botha and I am a master's student at the University of Pretoria's faculty of Economic and Management Sciences. This interview forms part of my study on the performance impacts e-readers has in an educational environment.

This interview will take about 15 minutes and will include 16 questions regarding your experiences and opinions of e-book readers within an educational environment. As noted in the informed consent form that you received, this interview will be recorded, so I may accurately document the information you convey. If at any time during the interview you wish to stop the recording or the interview itself, please feel free to let me know. All your responses are anonymous.

I would like to remind you of your written consent to participate in this study. We have both received a signed and dated copy, stating that we agree to continue this interview. Your consent form will be kept securely, separate from the responses.

Your participation in this interview is completely voluntary. If you feel I am moving too fast, you need a break or you wish not to continue, please let me know. If you choose not to continue this interview, there will be no consequences. Do you have any questions or concerns before we begin? Then with your permission we will begin the interview.

Questions

1. What is your home language?
2. Do you use e-book readers for non-educational tasks?
    a. If yes to 2. Discuss the tasks.
3. What are your daily tasks while using the e-reader for educational purposes?

4. What are your expectations when using the e-reader?
5. How many hours per day to you use the e-reader at home?
6. How many hours per day to you use the e-reader at school?
7. How would you describe better learning performance?
8. What functionalities of the e-reader do you think positively impacts your performance most?
9. What functionalities of the e-reader do you think negatively impacts your performance most?
10. What aspects of e-readers do you think offers performance improvements when compared to traditional studying methods?
11. What type of device do you use the e-book reader application on? Laptop, tablet or phone?
12. What else do you use the device that the e-reader is loaded on for?
13. Do you frequently swap between the e-reader and other applications?
    a. If yes to 10. What other applications do you use at the same time as the e-reader?
14. Have you received any training on using the e-reader?
    a. If yes to 11. What do you think about the training?
    b. If no to 11. Do you think training will improve your experience on the e-reader?
15. What functionality would you add to the e-reader? (Probe for why on each aspect.)
16. Are there any errors in the e-reader that you regularly experience?
    a. If yes to 13. Name them.