Reading Comprehension of Foreign Language Readers on Screen and Paper

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Abstract

Digitalisation has led to many challenges in education. One of those challenges is the use of digital assessment. Digital assessment often involves reading from a screen. However, there are uncertainties about the impact this has on reading performance. This study examines reading comprehension performance of foreign language readers in the Netherlands in the context of digitalization. It focuses on the difference between computer-based and paper-based reading and how this affects the use of reading strategies. It is important to have insight into the consequences of testing foreign language reading comprehension digitally before digital examinations on reading comprehension can be implemented. Participants in this study were 112 fourth-grade HAVO students between the ages of 15-18 years old. Participants either took a test on paper or on a screen. Factors that were expected to influence the performance on participants were the length of the texts and the item category. The results show that there is no significant difference between the results of test items about the longer and shorter texts. Furthermore, there was also no significant difference between item categories. In general, there was no significant difference between the performance of participants taking the test on paper and participants taking the test on a screen. Altogether, the mode of assessment does not seem to affect reading performance. These findings suggest that reading from a screen may not be an obstacle for reading comprehension exams in foreign languages to shift to computer-based examination. The results of this study might give foreign language teachers some insight about reading comprehension on screen.

Keywords: reading comprehension, digital reading, reading strategies.

Contents

Introduction

Traditionally education is centred around printed media, however, the possibilities of digitalization within education, such as digital assessment, are rapidly and increasingly being explored and developed. One of the important aspects of assessment in general is reading comprehension. Therefore, reading comprehension needs to be carefully considered within computer-based assessments, especially in reading assessments. Although there is a vast amount of literature available on this subject, many focus on first language reading, and not on foreign language reading (Ackerman & Lauterman, 2012; Farinosi et al., 2016; Kerr & Symons, 2006; Mangen, Walgermo and Brønnick, 2013; Margolin et al.; Porion et al., 2016). Having a better understanding about foreign language reading on screen and the impact it has on reading comprehension is necessary before computer-based assessments can be implemented. Moreover, insight into the differences between foreign language reading from screen and paper will help foreign language teachers to better adjust in the change to digital reading. Therefore, this study investigates whether there are differences in performance of foreign language reading comprehension in computer-based and paper-based assessment in the Netherlands.

In order to understand the concept of reading comprehension it is firstly important to get insight into how the concept of literacy has developed over the years. Bormuth (1973: 9) wrote "literacy may be defined broadly as being able to respond appropriately to written language". The concept of reading literacy has changed immensely since then. One of the traditional views on literacy is the simple view of reading by Gough and Tunmer (1986). They propose that only two skills are needed in order to understand a text: the ability to identify different letters and words (decoding) and the ability to understand what those words mean in a context. According to van Gelderen (2018) decoding skills are an important component of reading, but other components that are relevant are vocabulary, grammatical knowledge, knowledge of text structure, background knowledge and motivation. While vocabulary is also essential for decoding, these components are all important for comprehending and interpreting a text.

The Programme for International Student Assessment (PISA) also mentions decoding but writes that it is not sufficient to completely understand and engage with a written text. PISA is a programme of the Organisation for Economic Co-operation and Development (OECD). They conduct an international assessment with the aim to produce comparable data on education policy and outcomes across country and is repeated every three years. The OECD (2019:27) first described reading literacy as "understanding, using and reflecting on written texts, in order to achieve one's goals, to develop one's knowledge and potential, and to participate in society". Their definition of reading has changed over the years and in their latest definition the word 'written' has been removed and the words 'engaging' and 'evaluating' have been added. According to the PISA 2018 framework by the OECD (2019:27) this definition is the following: "Reading literacy is understanding, using, evaluating, reflecting on and engaging with texts in order to achieve one's goals, to develop one's knowledge and potential and to participate in society". Overall, it can be said that decoding skills may be enough for reading, but to comprehend a text other skills are necessary.

Reading comprehension is central to teaching and learning, all through the educational system and in all areas of the curriculum. Much emphasis is placed on the acquisition of knowledge from written texts, making reading comprehension a fundamental skill for school success for children. From the moment students learn to read in primary school, they are expected to be able to find relevant information in texts. Students have to be able to research topics from books or from the internet, locate relevant information, evaluate the information found and reflect upon the information it.

Reading comprehension is also an important skill in language learning, in first language (L1), second language (L2) learning as well as foreign language (FL) learning. As Grabe (1991) mentions reading is probably the most important skill for university students studying in a foreign language. Research on FL reading has grown remarkably in the past quarter century. Early FL reading research was by many considered just to be an extension of research trends in L1 reading. Bernhardt (2005) argues that many researchers made assumptions about the FL reading process based on L1 reading research. Today it is generally accepted that L1 knowledge interacts with FL in ways more extensive than interference of L1 to FL. Most researchers agree that both general reading skills and proficiency

in the FL are important for reading in a FL and that a reader can make most use of general reading skills when the reader has a certain amount FL knowledge (Alderson, 1984; Clarke 1980). However, FL reading research in the context of digital reading is rare.

The concept of reading has changed immensely over the last decade; digitalization has rapidly taken over many aspects of our society. Digital reading has increased enormously: what we read, the way we read and the medium we read on are constantly changing. Nowadays, 95,9% of people living in the Netherlands have access to internet (Internet World Stats, 2019). Over the last decades, an exceptional amount of digital media and digital texts have become available. We read from our laptops, smartphones and tablets. While traditional texts often have no distraction, digital texts are often highly interactive, with pictures, videos and music.

These rapid technological developments also caused a shift in education. Traditionally education is centred around printed media. Digital technology and media have become an integral part of the educational system, especially in developed countries. Classrooms with devices like computers, tablets and interactive whiteboards have become a common sight. These devices are used to access digital learning tools and software. According to a study by Smeets and Horst (2018:21) among 346 schools in the Netherlands most schools (58%) encourage their teachers to use digital technologies and some schools (22%) even give their teachers additional support in using these technologies. In 65% of the schools participating in the study, digital learning materials are used in the classroom.

In addition to the above mentioned, technological developments were also incorporated in assessment. In 2018, 79 countries participated in PISA and in most countries, including the Netherlands, the students took the test on a computer. Pisa changed the mode of assessment from paper-based assessment (PBA) to computer-based assessment (CBA) in 2015. According to Reimer et al. (2018) the performance of students in developed countries have not deteriorated after this change.

Many of the standardized national examinations in the Netherlands are also digital. However, the mode of assessment of the national school-leaving examination (in Dutch: Centraal examen, CE) is still paper. Cito (the Central Institution for Test Development in the Netherlands) is in charge of

developing the CE. The only focus of the CE in secondary school for Dutch and foreign languages is reading comprehension. This makes reading comprehension and teaching reading comprehension really important in secondary education. This is also the case for English, which is a mandatory subject for all Dutch secondary school students. A major difference between PISA and the Dutch CE for English is that PISA only tests the readings comprehension of students' first language, while English is a foreign language for Dutch students. A better understanding of the consequences of testing FL reading comprehension digitally is needed before digital national examinations on reading comprehension can be implemented.

Therefore, the main aim of this study is to explore whether there are differences in performance of foreign language reading comprehension in computer-based and paper-based assessment. This research is important because computer-based assessment has high societal impact; every secondary school student in the Netherlands has to take part in the national examination in order to graduate. Every year there are more than 200.000 students who take part in the national examination. English is a subject compulsory for everyone, so a change of medium of this exam might have a major impact on students and the education system. Moreover, the change of the medium of assessment could have many benefits. It is financially beneficial, more sustainable and less time consuming for educators. Moreover, a digital reading assessment could create new possibilities for testing, because digital texts can include videos, animations and hyperlinks.

The research questions in this thesis are as follows: "Is there a difference in the performance of reading comprehension of foreign language readers being assessed on a screen compared to the performance of foreign language readers being assessed on paper?".

In this thesis, first a theoretical framework with an overview of the literature and existing theories on foreign language reading, reading strategies and digital reading will be provided. Then the methodology and design of this study will be outlined. After that an analysis of the results will be given. Finally, the main findings will be discussed with existing literature, and a conclusion will be drawn.

Theoretical background

First, the context of the study will be described in the next section for a better understanding of the used concepts. The context of this study is the Dutch education system, especially the national written examination at the end of secondary school. To get a better insight in existing theories and models on reading the following topics will be further elaborated: second language reading, reading strategies and digital reading. This will lead to the hypotheses and research questions.

The secondary school system in the Netherlands

The Dutch secondary education system is rather complex, because it is characterized by division. The type of secondary school children attend determines what type of university they will be allowed to enter. After finishing primary school, students continue their education at one of the three tracks, VMBO, preparing for vocational education, HAVO, preparing for an education at a university of applied sciences and VWO, preparing for an education at a research university. The tracks differ in difficulty and time to obtain a degree. All students from all tracks have to take the national written examination at their educational level. In the Netherlands the school-leaving examination for secondary school consists of a school examination and a national written examination. For the school examination the schools set their own exams. The Dutch Ministry of Education prescribes the topics that should feature in the exams. The dates of these exams are not nationally fixed, and schools are free to test their students in the way they prefer.

The national written examination consists of a national written exam per subject for all students receiving the same type of education. The national exam always takes place at the end of the final year and is compiled by the Ministry of Education. The responsibility for administering the national examination belongs to the College voor Toetsen en Examens (CvTE), and the exams are developed by Cito.

There is one national written exam per subject for all students from the same track. Regardless of whether a subject is compulsory or optional, the exam questions are the same across the whole country. All foreign languages are assessed in the same way, with a reading comprehension exam. This means that 50% of the final grade will consist of reading assessment.

A syllabus has been developed for every subject by the CvTE. The aim of the syllabus is to inform teachers about future exams so they can prepare their students accordingly. The syllabus explains all domains which should be covered in secondary education. There are six domains which range from listening skills to literature. According to the 2018 syllabus by the CvTE (2018:25), the national written examination for English only assesses domain A, which consists of reading skills. The syllabus states the following aims for students: "students should be able to indicate which information is relevant, be able to indicate the main idea of a text or part of a text, be able to indicate the meaning of important elements of a text, be able to indicate connections between parts of a text and be able to draw conclusions regarding the intentions, views and feelings of the author"[1].

The syllabus also gives the results of a study of the 2011 English exam. This exam has been investigated by experts (not further specified in the syllabus) and estimated to be at C1 (according to the Common European Framework of Reference for Languages (CEFR)) level. However, this does not mean that all students have acquired this level. Students must obtain at least 64% for C1 level. To get a pass for the exam in 2011, students had to obtain at least 57% of the points, which is less than needed for C1 level. This means that not all students who pass the exam have obtained C1 level, but according to the syllabus they will have acquired at least B2 level. The CEFR descriptions of C1 and B2 for reading are as follows:

C1: "I can understand long and complex factual and literary texts, appreciating distinctions of style. I can understand specialised articles and longer technical instructions, even when they do not relate to my field." (Council of Europe, 2018)

B2: "I can read articles and reports concerned with contemporary problems in which the writers adopt particular stances or viewpoints. I can understand contemporary literary prose." (Council of Europe, 2018)

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[1] "aangeven welke informatie relevant is, gegeven een vaststaande behoefte; de hoofdgedachte van een tekst(gedeelte) aangeven; betekenis van belangrijke elementen van een tekst aangeven; relaties tussen delen van een tekst aangeven; conclusies trekken met betrekking tot intenties, opvattingen en gevoelens van de auteur." (College voor Toetsen en Examens, 2018, p. 25)

From these descriptions it becomes clear that the main difference between C1 and B2 level is the length and complexity of texts. This means that a C1 level of reading is expected from students in secondary schools, which is quite an advanced level, since one level higher, C2 is native level. By the end of this chapter we will explain why these levels are important in this study.

Defining reading

In the introduction it was already discussed that there are various definitions of reading. It is not as simple as only decoding words and letters. We read with a goal; to understand a text and comprehend what the author intends. Koda (2005:4) writes that: "comprehension occurs when the reader extracts and integrates various information from the text and combines it with what is already known". Urquhart and Weir (1998:22) define reading as "the process of receiving and interpreting information encoded in language form via the medium of print". Grabe (2009) claims that reading cannot be defined in a simple statement and identified ten processes that define reading; a rapid process, an efficient process, a comprehending process, an interactive process, a strategic process, a flexible process, a purposeful process, an evaluative process, a learning process and a linguistic process. These processes partially correspond to the components of reading mentioned by van Gelderen (2018); vocabulary, grammatical knowledge, knowledge of text structure, background knowledge and motivation. A considerable amount of literature has been published in the field of reading, however, there are many contradictory results (Grabe, 2009). Many models and theories have been presented by researchers to explain reading comprehension. As the present study focuses on reading in a foreign language, important models and theories concerning second language reading will be further discussed in the next section.

Interaction between L1 and L2 reading

First language (L1) and foreign language (FL) reading were already mentioned in the introduction. In literature about FL and L2 reading, the term FL is interchangeably used with L2. In this study second language refers to "the chronology of language learning; a second language being any language acquired after the native" (Stern et al, 1983:12). This definition includes second language readers as well as foreign language readers. For this reason, we will discuss L2 reading in general when reviewing previous research.

Research on second language reading has grown remarkably in the past quarter century. As mentioned before, research into L2 reading has come a long way. It is not just an imitation and replication of L1 reading studies anymore. Today it is generally accepted that L1 knowledge interacts with L2 in ways more extensive than interference of L1 to L2. There is however, not much known about what this interaction is and how it occurs. There are two commonly accepted mainstream hypothesis. The first one is the *linguistic interdependence hypothesis* by Cummins (1979). This hypothesis is represented as two tips of an iceberg with every language (L1 and L2) containing surface features, however this iceberg has a common basis, or the 'Common Underlying Proficiency'. This suggests that reading skills are language independent and second language readers can transfer their L1 reading skills directly to L2 reading. A study by Sarig (1987) supports the linguistic interdependence hypothesis by showing a strong correlation to exist between L1 and L2 reading processes. The participants in this study were 10 female native speakers of Hebrew who were studying English as a foreign language. The participants were asked to self-report their reading behaviours. The results revealed that the participants transferred strategies from L1 reading into L2 reading. These strategies include skimming, marking parts of the text, summarizing paragraphs in the margin and flexibility of reading rate. The other hypothesis is proposed by Clarke (1980) and is called the *short circuit hypothesis*. In contrast to Cummins, he suggests that there is some transfer of skills to the second language, however sufficient L2 proficiency is needed to transfer L1 reading skills to the target language. Clarke (1980:206) claims that limited L2 proficiency of a good L1 reader will "short-circuit the good reader's system". The *linguistic threshold hypothesis* by Alderson (1984) complements this theory. He claims that second language knowledge determines whether a second language learner will

become a proficient reader. Before second language readers can make use of their L1 reading abilities they must first pass a threshold of L2 knowledge. Various studies show support of the linguistic threshold hypothesis or linguistic interdependence hypothesis to varying extents (Zwaan & Brown, 1996; Taillefer & Pugh 1998; Schoonen, Hulstijn, & Bossers, 1998).

Koda (1994) also recognizes that L2 reading research was mainly based on principles found in L1 research. She writes that there are differences between L1 and L2 reading and identifies three conditions that distinguish L2 reading from L1 reading; the influence of prior literacy, limited linguistic knowledge, and the cross-linguistic effects. With cross-linguistic effect she refers to skills and knowledge that is transferred from L1 to L2. In contrast to the *linguistic interdependence hypothesis* by Cummins (1979), she writes that there is evidence that learners with different L1 backgrounds use different reading strategies and thus that reading strategies are language dependent. Singhal (1998) also challenges the *linguistic interdependence hypothesis*. She argues that although reading in the first language is similar to reading in a second language, the processes necessary may also differ greatly. She claims that factors of cultural differences impact the reading process of a L2 reader. Singhal (1998:8) argues that L2 readers will encounter difficulties because they have not the same culturally based knowledge as an L1 reader and that "such difficulties may be greater when there is a greater difference between the L1 and the L2".

L2 knowledge or L2 proficiency are often used in L2 reading research. Language proficiency "relates to language competence, metalinguistic awareness, and the ability to speak, listen, read, and write the language in contextually appropriate ways" (Lee & Schallert, 1997:716). There is, however, no clear agreement among linguists what components identify language proficiency (Yamashita, 2002a). According to Yamashita (2002a:83) "it relates to knowledge of language and ability to use the language in different modes (speaking, listening, reading, writing) in contextually appropriate ways". Yamashita (2002a:716) writes that in order to determine the language proficiency level of participants in a study, often an established test with known validity and reliability is used such as the TOEFL, or participants' language proficiency level is determined according to the different levels of a language class they participate in. Since many studies have found that reading in an L2 is most influenced by

knowledge of vocabulary and grammatical structures (Barnett, 1986; Grabe, 1991; Stanovich, 2000; Alderson 2005; Tannenbaum, Torgesen, & Wagner, 2006) often L2 proficiency in L2 reading research refers to knowledge of vocabulary and grammatical structures.

The relationship between L1 reading ability, L2 proficiency and L2 reading ability has been discussed for a long time. Bernhardt (2005) proposed a compensatory model of second language reading. This model consists of three components: L1 literacy, L2 language knowledge and an unexplained variance. According to this model, L1 literacy and L2 language knowledge predict 50% of second language reading comprehension (30% from L2 language knowledge and 20% from L1 literacy). Bernhardt claims that deficiencies in any knowledge source can be overcome by relying on other knowledge sources. For example, a reader can compensate deficiencies in vocabulary with background knowledge. Bernhardt does not predict the contributions of variables outside of L2 language knowledge and L1 reading ability. McNeil (2012) proposed an extended compensatory model of second language reading, including the components of strategic knowledge and background knowledge. Strategic knowledge is the reader's knowledge of reading comprehension strategies. McNeil (2011) identifies two types of reading comprehension strategies: cognitive strategies and metacognitive strategies. Background knowledge is defined by McNeil (2011:884) "as the content area knowledge or topic familiarity learners possess regarding texts". McNeil has examined the contributions of L2 language knowledge and L1 reading ability to L2 reading further. Participant were at the same L2 language proficiency level. This was measured with course grades in reading, speaking and grammar. He concludes that the correlation between L1 and L2 reading will increase over time with L2 language development. He also claims that L1 reading ability is a stronger predictor of L2 reading than L2 language knowledge.

Van Gelderen et al. (2003:11) claim that there are three different components of knowledge and skills which are relevant for reading:

(1) linguistic knowledge, specified in this study as knowledge of vocabulary and grammar, (2) the speed of accessing this knowledge, specified in this study as speed of lexical access and

sentence comprehension and (3) metacognitive knowledge, specified in this study as knowledge of text characteristics and reading and writing strategies

The authors also make a distinction between lower order skills and higher order skills. Lower order skills are word and letter recognition skills and higher order skills refer to comprehension of the content of a text. When first starting reading in a L1, a reader has already developed a certain level of L1 proficiency in speaking, whereas L2 learners learn various skills, like speaking, writing and reading, in the L2 simultaneously. This may impact the efficiency of lower order processing in L2 reading. Metacognitive knowledge is assumed to be relatively independent of the language in which a text is written or their native language. This knowledge is acquired with L1 reading but can be transferred to L2 reading. As mentioned in the studies before, it is believed that a reader has to have a certain level of L2 proficiency in order to make use of this metacognitive knowledge.

In sum, the review of the literature clearly shows that, besides L2 language proficiency, L2 reading is influenced by other skills. It is generally agreed that these skills are acquired in L1 reading. However, not everyone supports the claim that these skills are language independent. Furthermore, it is argued that readers can only make use of reading skills if the reader has a certain level of L2 proficiency. This shows that L2 reading is fundamentally different from L1 reading and that reading strategies matter. In the next section we will discuss reading strategies further.

Reading strategies

One of the components of reading skills is knowledge of reading strategies. Strategic competence is defined by Britt, Rouet, & Durik (2017:200) as "the ability to decide what to read and how to read it". When research on reading strategies was just in its infancy, Hosenfeld (1977) had already observed that skilled readers read the text in large blocks chunks of phrases and ignored irrelevant words while less-skilled failed to identify the main idea of a passage and focused mainly on short phrases and single words, without ignoring any words. There are a variety of approaches to reading strategies. One of these approaches are the 'bottom-up' and 'top-down' theories. Bottom-up reading is "a process of decoding written symbols into their aural equivalents in a linear fashion" (Nunan, 1999:252). Readers start at the bottom, with decoding letters, words, and syntactic features of a text, then they build textual meaning. Prior or background knowledge of the reader is mostly ignored in this theory. Eunjeo (2009) identifies three characteristics of bottom up reading: the focus on individual words, having to pause when encountering grammatical difficulties and repeated reading. With top-down reading the reader uses background knowledge to predict the meaning of what they are reading (Carrell & Eisterhold, 1988). Moreover, readers use top-down reading when they need to find out the overall purpose of the text or to comprehend the main ideas of the text (Nuttall, 1996). The result of a study by Block (1992) suggests that there is more difference in reading between less proficient and proficient readers than L1 and L2 readers. Proficient L2 readers were as able as the proficient native speakers to recognize and solve the problems that the text presented. Less proficient L1 an L2 readers both lacked awareness of problems and the ability to take action when they recognized a problem. Their seems to be a difference in the use of strategies between skilled and less-skilled readers. Skilled readers concentrated more on the overall meaning of a text and used prior knowledge (top-down reading) while less-skilled readers focused almost exclusively on the identification of lexical problems (bottom-up reading). Even if they managed to identify a lexical problem, they lacked the resources to solve it. A study by Davis and Bistodeau (1993) that compared the effect of general L2 proficiency on L2 reading strategies had similar results. They also found that low-level readers tend to use more bottom-up strategies in L2 and more top-down strategies in their L1, while there was no difference between L1 and L2 reading between advanced readers. In the study by Block (1992) there were two

separate groups of L1 and L2 readers while in the study by Davis and Bistodeau (1993) there was one group of participants reading in their L1 and L2. Both studies generally support the linguistic threshold hypothesis; readers need a certain level of L2 proficiency in order to use L1 reading skills or top-down strategies.

Following the compensatory model of second language reading by Bernhardt (2005) Stanovich (1980) proposed the interactive-compensatory model. This model supports mutual influence of various components of reading and suggests a deficit in any knowledge source can be compensated with other knowledge sources. They investigated the interactive effect of orthographic structure and contextual information on word recognition. This model suggests that less-skilled readers have to compensate for their deficit in vocabulary knowledge by using contextual information, whereas skilled readers who do not have a deficit do not need contextual information. Other aspects of compensation such as the relation between vocabulary and background knowledge (Stahl et al, 1989, 1991) and between reading ability and background knowledge (Adams et al, 1995) have also been investigated.

Yamashita (2002a) compared reading strategies in L1 and L2 among Japanese university students learning English as a foreign language. They were divided into three levels (high, middle, low) according to the levels of their L1 reading ability and L2 language proficiency. Nine groups were formed, for example a group of students whose L1 reading ability was middle and whose L2 language proficiency was low or a group of students whose L1 reading ability was at the middle level and whose L2 language proficiency was high. L1 and L2 reading ability were determined with gap-filling tests and multiple-choice tests (in Japanese and English). L2 language proficiency was determined based on grammar and vocabulary with section 2 and 3 from TOEFL. The results suggest that both L1 reading ability and L2 language proficiency contribute to L2 reading comprehension, but that the effect of L2 language proficiency is much stronger than that of L1 reading ability. Remarkably, the results of the group that consisted of high L1 reading ability and low L2 language proficiency students suggest that high L1 reading ability compensates for low L2 language proficiency. This means that even readers with a low L2 proficiency may experience some facilitative effects if their L1 reading

ability is high enough. However, the influence of L1 reading ability is weaker than that of L2 language proficiency. These findings support the linguistic interdependence hypothesis. Yamashita (2002a:91) concludes that the level of linguistic threshold cannot be determined as the level of the linguistic threshold changes according the level of readers' L1 reading ability. In another study, Yamashita (2002b) also concludes that compensation exists between L1 reading ability and L2 proficiency. The two studies by Yamashita (2002a, 2002b) actually support a combination of the linguistic threshold hypothesis and the linguistic interdependence hypothesis.

Kong (2006) investigated reading strategies used by four Chinese adult readers. All were proficient Chinees native readers and English L2 readers. Think-aloud and interview methods were used to collect information on the readers' strategy use. Kong (2006:26) classified reading strategies into two major categories: text-initiated strategies (e.g., focusing on vocabulary, using text structure, summarizing, and utilizing pictures) and reader-initiated strategies (e.g., invoking prior knowledge, predicting, evaluating, monitoring, and translating). Kong's results reveal that the participants used more strategies in reading the English texts than in reading the Chinese text. The participants focused more on word meanings when reading in English and more on comprehension when reading in Chinese. The findings were in line with the threshold hypothesis that participants with a low L2 proficiency seemed to be hindered from using the more top down strategies even though they were used in L1 reading.

Previous studies show that research into strategy use in L2 reading is very complicated since there are many factors involved. Some studies conclude that low-level readers use more bottom-up strategies and that L2 readers need a certain level in the L2 to be able to use reading strategies used when reading in the L1, whereas Yamashita (2002a) claims that L2 readers with high L1 reading skills can transfer those skills, even if they have a low L2 language proficiency. According to Coiro and Dobler (2007:217), "expert readers use a range of strategic cognitive processes to select, organize, connect, and evaluate what they read". However, there is no agreement on the conditions that are necessary to transfer those reading strategies to L2 reading. Little is known, about reading strategies

and their transfer to L2 reading in the context of digital reading. In the following section we will discuss the concept of digital reading.

Digital reading

Digitalisation has changed our lives in every aspect. Reading has also undergone a transition. There is a shift from reading on traditional sources, such as books and journals, to reading on electronic sources such as cell phones, tablets and computers (Cartelli, 2012). As new technologies demand new literacy skills (Leu, Kinzer, Coiro, & Cammack, 2004), there is a concern that theoretical models on reading comprehension have not progressed as rapidly as developments in new technologies (Leu, Kinzer, Coiro, & Cammack, 2004). Rasmusson & Eklund (2013) argue that there is a difference in the way we access and understand the information when reading from a screen compared to traditional reading. It is evident that a digital text differs from a text on paper. Most importantly, digital texts are presented on an electronic device such as a computer, tablet or mobile phone. A digital text may contain images, videos and hyperlinks, which makes reading a digital text very different from traditional reading. Thus, it can be expected that digital reading requires different skills from traditional reading. Murphy, Holleran, and Esterly (2003:528) stated that ''the strategies requisite for comprehending traditional printed text are not the same strategies required to comprehend computerized texts''. Rasmusson and Eklund (2013) investigated the skills and abilities involved in reading on the internet among Swedish students. Besides multimodal literacy, path-finding, IT abilities and information abilities, traditional literacy was also a part of digital reading. Navigation is also an important skill in digital reading. Rasmusson and Eklund (2013:411) use the term path-finding and define this as "the ability to be a path-finder and navigate the Internet 'jungle'". Examples are navigating between multiple tabs and windows on a screen and using search engines.

According to Leu et al. (2007:5) the traditional models of reading comprehension are not sufficient. The authors divide the new literacies of digital reading into five "major functions": identifying important questions; locating information; analyzing information; synthesizing information; and communicating information. It may seem that these functions already exist in traditional reading, but there are skills needed that are distinctive to online reading. For example, since information on the internet can be written by everyone, evaluating this information requires new skills.

PISA also mentions the importance of navigation skills in digital reading (Reimer et al., 2018:125), however, they define this as "the way in which students move around in a digital text in order to orient themselves and to find the information they need". This points to navigating within a text not on the internet. Texts on the internet are often non-linear. PISA describes linear reading as "reading that is normally performed when reading printed texts in books, newspapers, journals, etc." (Reimer et al., 2018:124). Non-linear texts do not have a clear layout, and often contain videos, images and hyperlinks. However, it is also possible to read a linear text on screen. Mostly, these are texts that are written for traditional reading, but also have a version to read on screen. Linear texts presented on a screen may have the same content as a printed text, however, the experience of reading a text from screen is also very different than from paper. For example, it is not always possible to make notes, or mark passages. Moreover, a text on screen does not always have pages like a traditional book, instead you have to scroll down when reading. Thus, despite that texts presented on screen can be linear or non-linear, reading a text from a screen will always be different than reading it on paper.

The differences between reading from a screen and from paper have been extensively researched. Most studies show that readers perform worse when they read from a screen (Kerr & Symons, 2006; Jeong, 2012; Rasmusson, 2015). Mangen, Walgermo and Brønnick (2013) investigated differences in reading comprehension among two groups of Norwegian students. The first group read two texts in print, and the other group read the same texts as PDF on a computer screen. The texts on screen were linear texts exactly the same as on print, the only difference is that they were presented on a screen. Font size and font type was controlled, participants had internet access, but were not allowed to switch to a different window during the test. Participants had one hour to complete the test and they all submitted their test within this time limit. The results show that the students who read the texts from a screen scored significantly worse on the reading comprehension test than students who read the texts in print. The authors conclude that reading comprehension is negatively impacted by reading from a screen compared to reading the same texts on paper.

There are also studies that found no difference in reading comprehension in print and on screen (Farinosi et al., 2016; Porion et al., 2016). Margolin et al. (2013) compared reading from paper,

computer and e-reader. They recruited 90 participants from a college class in New York and divided them randomly into three groups. There is no mention of their reading proficiency. Each group was presented with texts on paper, on a computer or on a e-reader. The participants were given multiple-choice questions after each text. The results of the three groups were compared and no significant differences were found. This indicates that different presentation types of texts do not influence reading comprehension.

A study by Kerr and Symons (2006) even found that participants recalled more of the information they had read from the computer than from paper. However, it took participants more time to read the same material from a computer. They concluded that children are more efficient at comprehending text they read on paper. They authors claim that the difference in comprehending reading on a computer and on paper will disappear when readers are given enough time.

Similarly, Ackerman and Lauterman (2012) found that participants reading from paper only performed better under time pressure. There were no significant differences between reading from paper and reading from on a computer when time pressure was not present. Liu (2005:701) also reported that reading from a screen had certain advantages such as "interactivity, non-linearity, immediacy of accessing information, and the convergence of text and images, audio and video". However, these advantages of reading from a screen could at the same time hinder reading comprehension.

When reviewing literature about digital reading we should keep in mind that technological developments are so rapid that these studies might be outdated. Nowadays children grow up in digital age and are used to read from a screen. Cartelli (2012) claims that students today read much less on traditional sources such as paper, and much more on electronic sources such as computers, tablets, and cell phones. Moreover, the Education Council (2006) has reported that the use of Internet and digital media have increased, and the reading of electronic texts has become necessary in society during the last decades. This generation that is born into a highly digitalized world are also called the 'net-

generation', (Støle, 2018) or 'digital natives' (Prensky, 2001). This generation includes children born after the mid-1990s (Kim & Kim, 2013).

Research questions

The previous sections have shown that there are many studies in L2 reading and digital reading. The connection between L1 reading, L2 language proficiency and reading skills and strategies is complex. Research into reading on screen often involves participants reading in their L1. Since reading is such an important part of second language education in the Netherlands and since there is a shift towards computer-based testing it is important to know if such a shift could affect reading comprehension. The research question in this thesis is as follows: "Is there a difference in the performance of reading comprehension of foreign language readers being assessed on a screen compared to the performance of foreign language readers being assessed on paper?".

Based on literature study it is expected that the results of the digital test will be lower than the test on paper, and that the mode of assessment does have an influence on the performance of students, leading to the following hypotheses:

H_{A1}: The results of the digital version of the test (P_D) are lower than the results of the paper version of the test (P_P).

H_{A1}: $P_D < P_P$

H_{01}: There is no difference in the results between the digital and paper version of the test.

H_{01}: $P_D = P_P$ of $P_D > P_P$

It can be expected that the length of texts has influence on the performance of participants. The test includes texts and items (questions about the text) presented on a screen or on paper. Participants reading the text on paper have immediate access to the text in its entirety. While participants reading the text on a screen only had access to a part of the text and had to scroll to read further and to access the test items. It is possible that there are differences between the reading comprehension of students on longer and shorter texts on both paper and screen. However, the question is if this difference is larger for texts presented on screen compared to texts on paper. The first sub-question is as follows: "Is there a difference in students' reading comprehension on long and relatively shorter texts presented on a screen and on paper?"

While the participants are used to this type of texts on paper, they might not be used to reading the same texts on screen. Since participants do not have access to the whole text with the longer texts, navigation within the text will be different than reading the same text on paper. The digital and paper version of the short text are more similar in that way. Thus, it can be expected that the difference between the scores of the digital version of the test and the paper version of the test will be greater with questions about longer texts, leading to the following hypotheses.

H_{A2}: There is more difference between the results of the paper version of the test and the digital version of the text with questions about longer texts (LT) compared to the results of questions about relatively shorter texts (ST). The performance of students on questions about longer texts will be worse compared to questions about relatively shorter texts.

H_{A2}: $\Delta LT > \Delta ST$

H_{02}: There is no difference between the results longer texts of the digital test and the longer texts of the paper test compared with the results of the questions about the shorter texts.

H_{02}: $\Delta LT = \Delta ST$

Previous research suggests that there is a difference between bottom-up and top-down reading. The test item determines how the reader is supposed to read. It is possible that there are differences between students' performance on different item categories on both paper and screen. However, the question is if this difference is larger for texts presented on screen compared to texts on paper. The second sub-question is as follows: "Is there a difference in students' performance on different item categories concerning texts presented on a screen and on paper?"

The reading test consists of two categories (general, detail) of test items. Readers need different skills for different types of reading. For some test items it is necessary to read a text (or a part of it) in detail, while for other test items a scan of the text is sufficient. It can be expected that the type of test item has influence on the impact that the mode of assessment has, leading to the following hypotheses.

H_{A3}: The difference between the results of the paper version of the test and the results of the digital version of the test are not the same for each item category.

H_{03}: The difference between the results of the paper version of the test and the results of the digital version of the test are the same for each item category.

The next chapter describes the procedures and methods used in this study.

Method

Study design

This is a quantitative experimental study which made use of the correlational research approach to gather relevant data to answer the research question. This approach is appropriate for this study because the data collected and used focuses on the relationship between medium of testing, participant's test score, and the characteristics of the questions and texts.

Materials

The test was composed of test items from previous HAVO English national exams. The first and second version of these exams are normally published online. To ensure none of the participants were familiar with the test items a third version of the exam was used. This exam is aimed at fifth year students, so above the level of the participants. However, fourth year HAVO students practice extensively with these texts and test items to prepare for the exam in the next year, which makes these texts highly appropriate for this experiment.

Participants had 35 minutes for the test. The digital test was conducted via internet at the website enqueteviainternet.nl, therefore, a good working internet connection was required. The participating schools all had either laptops or computers with a good working internet connection. The contents of the digital test and paper test were exactly the same. The digital version was just the paper test on a screen. The design of the digital version was simple; each text was presented on one webpage with the corresponding test items. Ideally, the whole text and the test items concerning that text would all fit on the screen at the same time. However, this was not possible as the font size had to be small to achieve this. Instead the test items were presented under the texts, which meant that participants had to scroll. The short text did fit on one page, but participants still had to scroll for the test items. It was not possible for the participants to view the test items with the text at the same time on the screen. The test items on the paper version of the text were also presented under the texts, however, students were able to put the text next to the test items to get a better overview.

The test consisted of four texts, one of them was short (250 words) and the other three texts were relatively long (690, 620 and 622 words). There were 25 items; nine multiple choice questions, six short answer questions and ten gap-filling questions. Participants had three or four options with multiple choice questions. With gap filling questions, participants had to place the right words at an empty place in the text. These questions had three, four or five answer options. The test consisted of short answer questions, multiple-choice questions and gap-filling questions. The participants have four options to each multiple-choice question, except for questions eleven and thirteen, which only have three options. Gap filling questions are questions where the participants have to fill in the right word in the gap in the text. The order of the questions in the test was random (multiple choice – open - multiple choice – gap filling – open - multiple choice – open – open - multiple choice – gap filling - multiple choice – open - multiple choice - multiple choice - multiple choice - multiple choice – open, and the last 8 questions consisted of only gap filling questions). The digital test was made on computers or laptops provided by the school.

Participants

This study was conducted at three secondary schools in the Netherlands. All participants were HAVO students in their fourth year. A total of 112 students between the ages of 15-18 participated in this study. Six of the students who participated had dyslexia and one of them failed to complete the test due to technical issues, so the results of those seven participants are left out. The remaining 105 participants (63 girls and 42 boys) did not have any learning disabilities. All of the participants were native speakers of Dutch and none of them were native speakers of English. Teachers at secondary schools were approached to inform about this study. Three teachers from three different schools were willing to contribute. The participants were students at schools in Amersfoort (26 participants), Amsterdam (25 participants) and Drachten (54 participants). Participation was compulsory for the students, because it was during their regular English class.

Digitalisation in education has been going on for a while. However, the use of digital media in class can vary immensely between schools. A short interview with the teachers of the participants were conducted to get a picture of the use of digital media at the school of the participants. None of

the schools used a digital method, and students did not have a device (like a laptop or tablet) that was used in class. All teachers indicated that there were laptops and computers available at school, but they did not use this often. None of the schools used digital assessment tools.

Procedure

The study was conducted during the regular English classes of the participants. Participants were randomly divided into two groups. One group made the test on paper and the other group made it on a computer or laptop. The test was conducted in presence of their own teacher and of the two researchers. First, the teacher introduced the researchers, then, the researchers explained the procedure to the participants. Both groups had 35 minutes to complete the test. Participants were asked consent to use their data for this study before the start of the test. When the participants were finished, they had to close the test window on their computer or laptop, or hand in their test. Participants were allowed to use an English to Dutch dictionary during the assessment, since this is also allowed in the English national exam.

Data analysis

Since participation was compulsory, a lack of motivation was expected. As a result, the test could give a biased picture of the performance of the participants. For this reason, the last 8 items were left out of the analysis which did not change the representativeness of the test. Participants could score a total of 19 points. Each item was assigned one point, except for item 5 and 17, they were assigned two points.

Test items were divided into two categories for the analysis; items asking for details (9 items) and items about the text or paragraph in general (8 items). The dependent variables in this study are the results of the digital test (P_d) and the results of the test made on paper P_p). The independent variables are the item category; detail (D) or general (G), the length of the text; short text (ST) and long text (LT).

Both versions of the test have been corrected by hand and the results have been analysed with an independent samples t-test. The analysis was carried out with IBM SPSS Statistics.

Question	Questions category	Difference	Medium	N	Mean	SD
Text 1		-0.07	Screen	55	0.95	0.80
			Paper	50	0.88	0.69
Text 2		0.60	Screen	55	3.36	1.80
			Paper	50	3.96	1.67
Text 3		-0.27	Screen	55	4.51	1.98
			Paper	50	4.24	2.08

Results

Table 1 Mean scores for each text

An *independent-samples t-test* was conducted to compare the results of the three texts. Text 1 was a relatively short text compared to text 2 and 3. There was a 0.07 point difference in the results of text 1, favouring the group on screen. There was not a significant difference between the scores of the digital test (M=0.95, SD=0.80) and the results of the paper test (M=0.88, SD=0.69), conditions; t(103)= -0.45, p=0.66. There was a 0.60 point difference in the results of text 2, favouring the group on paper. There was not a significant difference between the scores of the digital test (M=3.36, SD=1.80) and the results of the paper test (M=3.96, SD=1.67) conditions; t(103)= -1,01, p=0.316. There was a 0.27 point difference in the results of text 3, favouring the group on screen. There was not a significant difference between the scores of the digital test (M=4.51, SD=1.98) and the results of the paper test (M=4.24, SD=2.08) conditions; t(103)= 0.68, p=0.498. Although the difference between the digital test and paper test is larger with the longer texts (text 2 and 3), this difference is not significant. These results indicate that the mode of assessment does not influence the performance of reading longer texts compared to shorter texts differently.

The results show that on there is not a significant difference between the average scores of the digital and paper tests. An *independent-samples t-test* was conducted to get more insight into the differences in scores between the digital and paper test for each question.

Table 2 Mean scores for each question

1	G	Screen	55	0.11	0.32	0.25
		Paper	50	0.36	0.49	
2	D	Screen	55	0.51	0.51	0.01
		Paper	50	0.52	0.51	
3	G	Screen	55	0.31	0.47	0.01
		Paper	50	0.32	0.47	
4	G	Screen	55	0.33	0.47	0.09
		Paper	50	0.42	0.50	
5	D	Screen	55	1.22	0.85	0.36
		Paper	50	1.58	0.64	
6	G	Screen	55	0.73	0.45	0.01
		Paper	50	0.74	0.44	
7	D	Screen	55	0.67	0.47	0.17
		Paper	50	0.50	0.51	
8	D	Screen	55	0.40	0.49	0.00
		Paper	50	0.40	0.50	
9	G	Screen	55	0.40	0.49	0.12
		Paper	50	0.52	0.51	
10	G	Screen	55	0.80	0.40	0.10
		Paper	50	0.90	0.30	
11	D	Screen	55	0.55	0.50	0.17
		Paper	50	0.38	0.49	
12	D	Screen	55	0.60	0.49	0.18
		Paper	50	0.42	0.50	
13	D	Screen	55	0.38	0.49	0.06
		Paper	50	0.44	0.50	
14	D	Screen	55	0.62	0.49	0.10
		Paper	50	0.52	0.51	
15	G	Screen	55	0.42	0.50	0.02
		Paper	50	0.40	0.50	
16	G	Screen	55	0.18	0.39	0.04
		Paper	50	0.22	0.42	
17	D	Screen	55	0.56	0.74	0.10
		Paper	50	0.46	0.73	

Table 2 shows the average scores for each question. The difference between the digital test results and paper test results was only significant for question 1 and question 5. In both cases the scores of the paper group were higher than the scores of the digital group. There was a 0.25 point difference in the results of question 1 between the two groups. This was a significant difference between the scores of the digital test (M=0.11, SD=0.32) and the results of the paper test (M=0.36, SD=0.49), conditions; t(103)= -3,17, p=0.02. There was a 0.36 point difference in the results of question 5 between the two

groups. This was a significant difference between the scores of the digital test (M=1,22, SD=0.85) and the results of the paper test (M=1,58, SD=0.64), conditions; t(103)= -2.44, p=0.017.

Even though the difference between the two groups is not significant for most questions, Cito would still consider the difference between most questions an anomaly. A difference of more than 0.05 is considered an anomaly by Cito. According to this norm 11 out of the 17 questions have deviant results. For question 7, 11, 12, 14 and 17 the digital results were higher, while fore question 1, 4, 5, 9, 10 and 13 the paper results were higher. The difference between the two groups for questions 2, 3, 6, 8, 15 and 16 was less than 0.05 points.

Question category	Medium	N	Mean	Difference
General	Screen	55	0.41	0.08
	Paper	50	0.49	
Detail	Screen	55	0.51	0.03
	Paper	50	0.47	

Table 3 Mean scores on screen and on paper

An *independent-samples t-test* was conducted to compare the results of participants taking the test on paper and participants taking the test behind a screen. There was a 0.05 difference in average score favouring the group on paper. There was not a significant difference in the scores for screen (M=9.15, SD=3.41) and paper M=9.10, SD=3.55), conditions; t(103)=0.07, p=0.95.

Medium	N	Mean	SD
Screen	55	9.15	3.41
Paper	50	9.10	3.55

Table 4 Mean scores on screen and on paper

Discussion

The aim of the study was to give insight into the differences in the performance in reading comprehension of foreign language readers assessed on a screen and on paper. The participants of this study were Dutch secondary school students for whom English is a foreign language. We compared a group of students who made an English reading comprehension exam on screen to a group of students who made the same exam on paper. The first sub-question was as follows: "Is there a difference in students' reading comprehension on long and relatively shorter texts presented on a screen and on paper?" It was expected that the difference between the scores of the digital version of the test and the paper version of the test would be greater with test items about longer texts. The results show that there is no significant difference between the results of test items about longer and test items about relatively shorter texts. This means the length of a text has no impact on the performance of second language readers when reading from a screen. The second sub-question was as follows: "Is there a difference in students' performance on different item categories concerning texts presented on a screen and on paper?" It was expected that different question categories would create a larger difference in performance between paper-based and computer-based assessment. However, it can be concluded that the difference in performance between paper-based and computer-based assessment is not larger for test items that require an overview of the text.

The research question in this thesis is: "Is there a difference in the performance of reading comprehension of foreign language readers being assessed on a screen compared to the performance of foreign language readers being assessed on paper?". It was expected that the results of the digital test would be lower than the test on paper, and that the mode of assessment would have an influence on the performance of students. However, the results of this study show that there is no significant difference in the performance of reading comprehension of second language readers being assessed on a screen compared to the performance of second language readers begin assessed on paper. This finding was unexpected since many studies have shown that there is a difference in reading comprehension between reading from a screen and reading on paper, especially when there was time pressure for participants (Ackerman & Lauterman, 2012; Kerr and Symons, 2006). The current study

does not support the previous research since participants in this study also had limited time to finish the tests. This indicates that second language readers are able to use reading comprehension strategies when reading from a screen. However, it is possible that different strategies are used when reading from a screen compared to reading from paper. These findings suggest that reading from a screen does not have a negative impact on reading comprehension. It is important to keep in mind that the finding in this study are somewhat limited because participants were tested under specific circumstances.

The texts used in this study were at C1 level (according to the Common European Framework of Reference for Languages (CEFR)), which is quite an advanced level in reading in a foreign language. It was expected that the English language proficiency of the participants were at C1 level or close to C1 level. According to the short circuit hypothesis (Clarke, 1980) and the linguistic threshold hypothesis (Alderson, 1984) readers need to have a certain level of language proficiency in the FL to be able to use their L1 reading skills in the FL. It seems likely that the FL proficiency of most participants would be sufficient to pass this threshold. The exam consisted of long texts as well as one short text and two question categories that demanded top-down or bottom-up reading. It was expected that since participants reading the text on paper did not have access to the entire text in one view, but had to scroll down to read further, this would hinder to use top-down reading on a screen. Surprisingly no significant differences were found in the performance of participants between certain texts or certain questions.

It is important to bear in mind that this study was limited to a group of foreign language readers. Future studies should include a group of first language readers as well to be able to compare first language reading to second language reading in the context of digitalization. There are still many unanswered questions about the use of reading strategies when reading on a screen. A qualitative study to the use of reading strategies on screen might provide a full picture. Moreover, the exam that was used in this study was a previous national exam for English reading comprehension. It was not an exam that was designed for computer-based assessment. It may be possible to accommodate readers more with an exam that is specifically designed for reading and assessment from a screen. It could be argued that the presentation type on a screen also influences reading comprehension and could either

facilitate readers or hinder them. This was not investigated in the present study. The texts on screen were presented as similar as possible to the texts on paper. Computer-based assessment creates new possibilities for examination, like including texts containing video fragments or hyperlinks. However, further research exploring the possibilities for computer-based assessment is required to establish their impact on reading comprehension

The age of digital reading is inevitably coming, especially in education. This study shows that there is no difference in reading comprehension reading from screen and reading from paper. It is possible that educators are more reluctant to the transition of paper-based assessment to computer-based assessment than their students, since it might be that they are not as comfortable with reading from a screen as their student population. Having a deeper understanding about reading on screen and the impact it has on reading comprehension will help educators and educational product developers to adapt to this change. Furthermore, this study shows that reading from a screen may not be an obstacle for the national school-leaving examination in secondary schools in the Netherlands to shift to a computer-based examination. Especially for the foreign language subjects, which have reading comprehension exams. It is important that educators have the right tools and information to assist students in this transition.

Conclusion

The findings of this thesis have provided a deeper understanding of foreign language reading on screen. This study has shown that there are no differences in foreign language reading comprehension performance between reading on screen and reading on paper among Dutch secondary school students. This might be related to students being used to digitalization in this era. Although the current study is limited, it offers some insight into the impact reading from a screen has on reading comprehension for foreign language readers. We suggest future research to focus on investigating the difference in use of reading comprehension strategies on screen and on paper. This might help educators to teach their students efficient reading on screen.

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